Florida Power & Light Company, 6501 S. Ocean Drive, Jensen Beach, FL 34957

FPL

June 16, 2011

L-2011-220
10 CFR 50.90

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

Re: St. Lucie Plant Unit 1
Docket No. 50-335
Renewed Facility Operating License No. DPR-67

Response to NRC Electrical Engineering Branch Request for Additional Information Regarding Extended Power Uprate License Amendment Request

References:

(1) R. L. Anderson (FPL) to U.S. Nuclear Regulatory Commission (L-2010-259), "License Amendment Request for Extended Power Uprate," November 22, 2010, Accession No. ML103560419.
(2) Email from T. Orf (NRC) to C. Wasik (FPL), "St. Lucie Unit 1 EPU – request for additional information (Electrical Engineering)," May 20, 2011, Accession No. ML111400271.

By letter L-2010-259 dated November 22, 2010 [Reference 1], Florida Power & Light Company (FPL) requested to amend Renewed Facility Operating License No. DPR-67 and revise the St. Lucie Unit 1 Technical Specifications (TS). The proposed amendment will increase the unit's licensed core thermal power level from 2700 megawatts thermal (MWt) to 3020 MWt and revise the Renewed Facility Operating License and TS to support operation at this increased core thermal power level. This represents an approximate increase of 11.85% and is therefore considered an Extended Power Uprate (EPU).

By email from the NRC Project Manager dated May 20, 2011 [Reference 2], additional information related to electrical engineering was requested by the NRC staff in the Electrical Engineering Branch (EEEB) to support their review of the EPU LAR. The request for additional information (RAI) identified twenty-four questions. The response to these RAIs is provided in the attachment to this letter.

A001
NRR

In accordance with 10 CFR 50.91(b)(1), a copy of this letter is being forwarded to the designated State of Florida official.

This submittal does not alter the significant hazards consideration or environmental assessment previously submitted by FPL letter L-2010-259 [Reference 1].

This submittal contains no new commitments and no revisions to existing commitments.

Should you have any questions regarding this submittal, please contact Mr. Christopher Wasik, St. Lucie Extended Power Uprate LAR Project Manager, at 772-467-7138.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge.

Executed on 16-June-2011

Very truly yours,

Richard L. Anderson
Site Vice President
St. Lucie Plant

Attachment

cc: Mr. William Passetti, Florida Department of Health

ATTACHMENT

Response to NRC Electrical Engineering Branch Request for Additional Information Regarding Extended Power Uprate License Amendment Request

Response to Request for Additional Information

The following information is provided by Florida Power & Light Company (FPL) in response to the U. S. Nuclear Regulatory Commission's (NRC) Request for Additional Information (RAI). This information was requested to support Extended Power Uprate (EPU) License Amendment Request (LAR) for St. Lucie Nuclear Plant Unit 1 that was submitted to the NRC by FPL via letter (L-2010-259) dated November 22, 2010, Accession Number ML103560419.

In an email dated May 20, 2011 from NRC (Tracy Orf) to FPL (Chris Wasik), Accession Number ML111400271, Subject: St. Lucie Unit 1 EPU – request for additional information (Electrical Engineering), the NRC requested additional information regarding FPL's request to implement the EPU. The RAI consisted of twenty-four (24) questions from the NRC's Electrical Engineering Branch (EEEB). These twenty-four RAI questions and the FPL responses are documented below.

EEEB-1

Explain how the licensee is addressing environmental qualification (EQ) margins for the electrical equipment in accordance with the following regulations and regulatory guidance documents: (a) 10 CFR 50.49e(8), (b) Regulatory Guide (RG) 1.89, Revision 1, Section C.4, and (c) IEEE 323-1974, Section 6.3.1.5.

Response

(a) The EPU evaluation is based on a comparison of the current environmental conditions for all safety related Class 1E electrical equipment, equipment important to safety against the resulting EPU environmental parameters. Utilizing the criteria delineated in 10 CFR 50.49 (e) (8) Margins: the margin available between the required value and the actual qualification value was assessed. If the margin recommendation of the criteria documents was not met, the equipment was listed as an outlier. The outliers were further evaluated to determine the best action to maintain or restore qualification.

(b) The guidance provided in NRC Regulatory Guide (RG) 1.89, Rev. 1, Qualification of Class 1E Equipment for Nuclear Power Plants, Section C.4 is similar to the criteria and recommendations provided in the 10 CFR 50.49 (e) (8) Margins and IEEE Standard 323-1974, Section 6.3.1.5. These documents recommended the same actions to ensure the unquantified uncertainty, such as the effects of production variations and inaccuracies in test instruments, as well as to ensure that the postulated accident conditions have been enveloped and adequately account for commercial production variations. However, St. Lucie Unit 1 was originally required to meet IEEE 323-1971 for the environmental qualification (EQ) of electrical equipment. In January 1980, the NRC issued IE Bulletin (IEB) 79-01B, Environmental Qualification of Class 1E Equipment, to which FPL responded. In February 1983, Congress codified the requirements for the EQ of electrical equipment in Title 10, Part 50, Section 49 of the Code of Federal Regulations (10 CFR 50.49). On this basis, the margin recommendations of IEEE 323-1974 are not applicable to St. Lucie Unit 1.

(c) The values for margin identified in Section 6.3.1.5 of IEEE 323-1974 are used as criteria in the current EQ program. As part of the EPU evaluation, each environmental parameter value with the potential of being impacted by the EPU, specifically, temperature, pressure, and radiation have been reviewed to ensure the recommended margin requirements of IEEE 323-1974 have been met. Whenever the margin recommendations were not met for the peak accident values under the initial EPU screen for a specific piece of equipment, that piece of equipment was considered an outlier. If the IEEE 323-1974 margin recommendations could not be met, then alternative solutions, e.g., operating time duration, relocation, replacement or modification were considered. The above alternative solutions were only required to meet the IEEE 323-1974 margins at EPU conditions for radiation doses in the reactor auxiliary building HVAC area as described in the responses to questions EEEB-5 and 6. All other equipment remains qualified to current as well as EPU conditions.

EEEB-2

Figures 2.3.1-1 and 2.3.1-2, in Attachment 5 of the LAR, show the Unit 1 Containment LOCA and MSLB Accident Temperature and Pressure Profiles vs. Plant EQ Profiles of electrical equipment. The profiles in these figures do not appear to have the minimum EQ margins required per IEEE 323-1974. Provide justifications for apparent lack of margins. Provide discussion of the margins in the pre-EPU and post-EPU stages.

Response

Unit 1 Containment LOCA / MSLB Accident Temperature Profiles Vs. Plant EQ Profile

(Figure 2.3.1-1 of Attachment 5 of the LAR)

(Solid Thin Lines = LOCA Cases 1 through 9, Broken Line = MSLB Case 6, Solid Thick Line = EQ Analysis of Record)

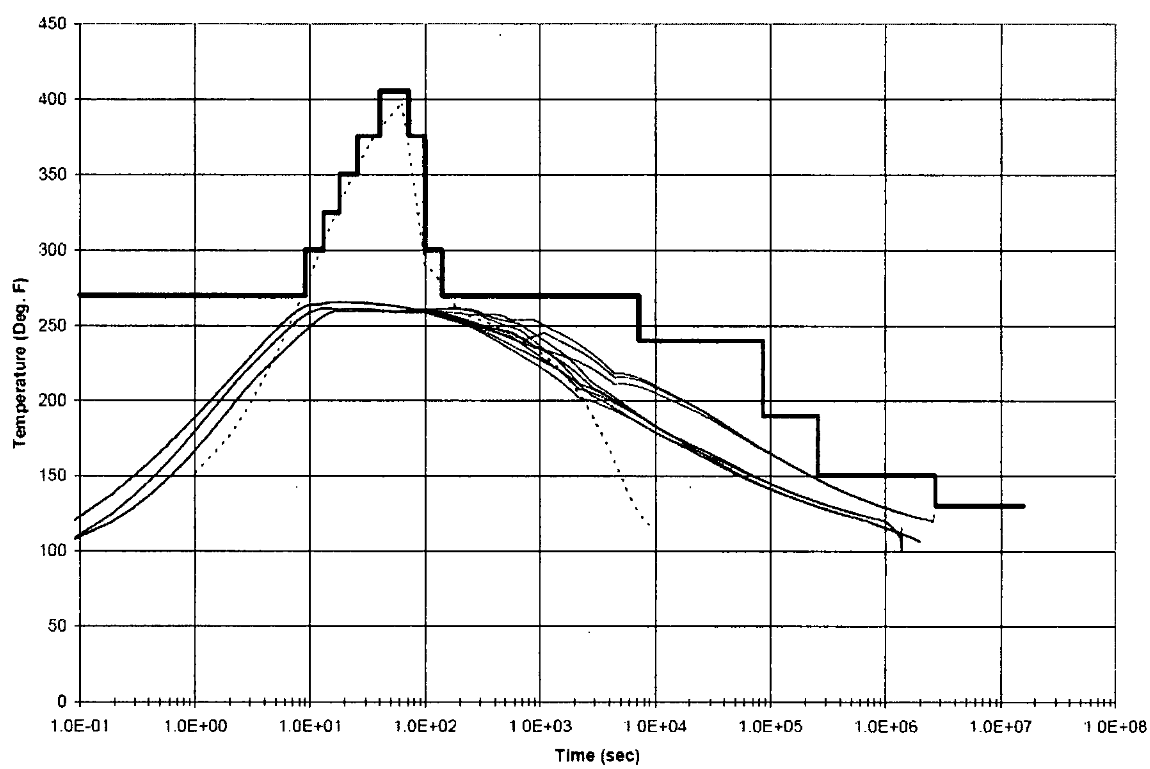

Figure 2.3.1-1 (shown above) shows the containment loss of coolant accident (LOCA) and main steam line break (MSLB) Accident Temperature Profiles vs. Plant EQ Profiles of electrical equipment. The curves provide visual indication of implemented margin from the onset of the accident for the EPU case. There are two accident types depicted, a short term (MSLB) and long term (LOCA).

The MSLB curve is depicted by a dotted line and is initially shown to be bounded by the bold dark curve. However, as can be seen, the IEEE 323-1974 recommended margin does not appear to be met. The margin and qualification is accomplished by a thermal lag analysis. The thermal lag analysis demonstrates (analytically) that the internal temperature of the equipment never exceeds the EQ temperature of record for the LOCA analysis (bold curve without the excursion portion).

For EPU, the LOCA curves are bounded by the EQ profile (bold curve without the excursion) with margin and satisfies the current licensing basis. The intent of the IEEE 323-1974 recommended margin was to ensure the peak accident values were compared to the components qualification test value for the parameters of concern.

The pre-EPU MSLB and LOCA were handled in a similar fashion as to that discussed for the EPU conditions

Unit 1 Containment LOCA/MSLB Accident Pressure Profiles
Vs.
Plant EQ Profile

(Figure 2.3.1-2 of Attachment 5 of the LAR)

(Solid Thin Lines = LOCA Cases 1 through 9. Broken Line = MSLB Case 6. Solid Thick Line = EQ Analysis of Record)

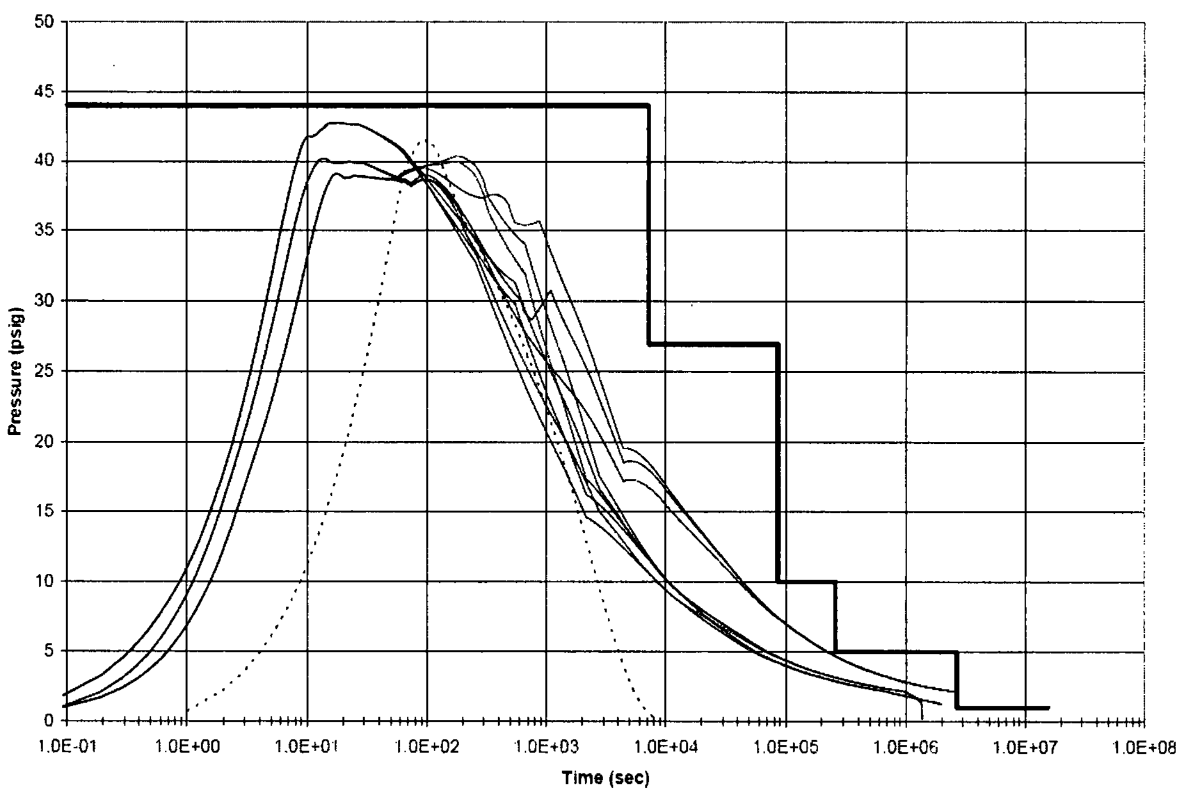

Figure 2.3.1-2 (shown above) shows the containment LOCA and MSLB Accident Pressure Profiles vs. Plant EQ Profiles of electrical equipment. The curves provide visual indication of implemented margin from the onset of the accident for the EPU case. There are two accident types depicted, a short term (MSLB) and long term (LOCA).

As can be seen from the above pressure curves, the margin is accounted for during the peak pressure of the event; and, a difference of 3 or 4 psig at the peak is not considered a viable threat to the operation of the equipment. See details in response to the following question.

EEEB-3

Page 2.3.1-6 in Attachment 5 of the LAR states, "Pressure effects are generally stress-related rather than age degradation related." Provide clarification as to how pressure effects were considered for environmental qualification.

Response

Aging effects on non-metallic materials are typically caused by prolonged exposure to temperature and radiation or, in the case of loss of material, through excessive wear. These are considered age related where the non-metallic material exhibits signs of drying, cracking, embrittlement, and loss of material (wear aging). Each are clearly defined in the IEEE Standard 323-1974, as well as 10 CFR 50.49. Pressure is a stress related effect, such as compression which unlike radiation, temperature, and wear aging is more of a forcing function which can drive moisture into (or out of) an object/equipment. Pressure effects unto themselves are not generally considered a detrimental environmental qualification (EQ) aging mechanism, but instead need to be considered as part of EQ with respect to a driving force for humidity and moisture during the event. It should be noted that all components are subjected to pressure testing as part of qualification and no pressure impact has been identified.

EEEB-4

Page 2.3.1-6 in Attachment 5 of the LAR, states, "Using the information available in the Doc Pacs, any [EQ] equipment that could not be qualified by direct comparison to the beta radiation dose plus the total integrated gamma dose was assessed for potential beta dose reduction. Factors included consideration if a component was sealed, equipment shielding considerations." Provide a summary of EQ calculations in which radiation reduction factors were considered necessary as a result of EPU. In particular, confirm whether the following statement in RG 1.89, Section C.2.c(6) was considered in the calculation: "If, after considering the appropriate shielding factors, the total beta radiation dose contribution to the equipment or component is calculated to be less than 10% of the total gamma radiation dose to which the equipment or component has been qualified, the equipment or component is considered qualified for beta and gamma radiation environment."

Response

The results of the radiation comparisons show that the equipment in the Environmental Qualification (EQ) Program will continue to be qualified at the EPU conditions and thus, will continue to meet the current licensing basis with respect to the requirements of 10 CFR 50.49. Calculations, analyses, and evaluations were performed in support of the radiation environments that are postulated to result from implementing EPU. Although some increase in radiation doses is evident, the increase is not detrimental to the equipment exposed.

The current 1-year post-accident in-containment beta radiation dose is based on the Division of Operating Reactors (DOR) Guidelines, Enclosure 4 of IE Bulletin (IEB) 79-01B, Environmental Qualification of Class 1E Equipment, paragraph 4.2, item 2 page 6, i.e., an unshielded beta dose of 2.0E+08 rads, and on the detailed calculations documented in Appendix D of NUREG-0588, Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment, Table D-2; i.e., a beta dose of 1.4E+08 rads at 720 hrs.

As indicated in LAR Attachment 5, Section 2.3.1, Environmental Qualification of Electrical Equipment, many calculations were performed to assess and evaluate the effects of beta which include insulation thickness, cable nesting in cable trays, separation by physical distance and separation by shielding material, and other construction material, which also include physical distance from the source.

EEEB-5

Provide a comparison of radiation levels, pre and post EPU for plant areas that have electrical equipment that have changed from mild to harsh radiological environments.

Response

As a result of EPU, localized areas, previously mild areas, on the 43-foot elevation of the reactor auxiliary building HVAC area, in the vicinity of the shield building ventilation system HEPA and charcoal filters, could receive a total integrated dose (TID) greater than 1E+05 rads. There are no other plant areas containing Class 1E electrical equipment that have changed from mild to harsh as a result of the EPU.

The comparison of the pre-and post EPU dose to equipment is given in the following table:

Dose Information for Impacted Electrical Equipment

Component Tag No.	Component Description	Pre-EPU TID* (Rad)	EPU TID* (Rad)
HVS-4A - MTR	RAB main supply fan (HVS-4A)	1.0+E5	1.25E+05**
HVE-6A - MTR	Shield building exhaust fan (HVE-6A)	1.0+E5	1.04E+05**
D-23 MTR OPER	Motor operator for damper D-23	1.0+E5	2.34E+05**
D-24 MTR OPER	Motor operator for damper D-24	1.0+E5	3.94E+05**

* TID for EQ = 60 yr Normal Op + Accident 1 yr

** EPU component doses

EEEB-6

Page 2.3.1-9 and Table 2.3.1-1 in Attachment 5 of the LAR list four components which are now considered to be located in a harsh radiation environment. However, in Table 2.3.1-2, five components (additional component HVE-6B) are identified. Explain the apparent discrepancy.

Response

This was an editorial error in LAR Attachment 5, Table 2.3.1-2. The complete list of affected equipment in the reactor auxiliary building (RAB) HVAC area, in the vicinity of the shield building ventilation system HEPA and charcoal filters, should be four components. See the response to EEEB-5 above.

Subsequent to submittal of the LAR, more refined radiation analyses have been performed in order to accurately calculate the EPU total integrated doses (TIDs) for the four identified components. Analyses of the equipment in the RAB HVAC area included the following:

- Use of a three dimensional model of the HEPA and charcoal filters to address the off-center location of components.
- Development of a refined source term for both the HEPA and the charcoal filter using the post-LOCA EPU radioactivity transport model.

The results of the analyses concluded that EPU TID values were reduced below the environmental qualification (EQ) threshold dose of 1E5 Rads for the two fan motors (HVS-4A and HVE-6A). However, the TID values for the two damper motors (D-23 and D-24) remain above the 1E5 Rad threshold and will still require shielding.

A metal shield will be constructed for the damper motors to reduce their TID below 1E5 Rads.

Dose Information for Impacted Electrical Equipment

Component Tag No.	Component Description	Pre-EPU TID* (Rad)	EPU TID* (Rad)
HVS-4A - MTR	RAB main supply fan (HVS-4A)	1.0+E5	<1.0E+05
HVE-6A - MTR	Shield building exhaust fan (HVE-6A)	1.0+E5	<1.0E+05
D-23 MTR OPER	Motor operator for damper D-23	1.0+E5	1.5E+05
D-24 MTR OPER	Motor operator for damper D-24	1.0+E5	2.0E+05

* TID for EQ = 60 yr Normal Op + Accident 1 yr

EEEB-7

Provide a justification for not performing an evaluation of High Energy Line Break analysis for the impact on the EQ of the electric equipment inside containment.

Response

Containment temperature analyses were performed for EPU conditions. It was determined that the peak EPU loss of coolant accident (LOCA) and main steam line break (MSLB) temperatures were both bounded by the current peak environmental qualification (EQ) temperature profile. As can be seen in the curves provided (Figure 2.3.1-1 of Attachment 5 of the LAR) as part of the response to RAI EEEB-2, the EQ profile envelopes the required or challenge temperatures to the equipment, keeping in mind that the narrow bandwidth, short duration, MSLB temperature spike is accommodated by a thermal lag analysis.

Refer to Attachment 5 of the LAR, Section 2.2.1 that addresses postulated high energy line break (HELB) events and concludes that there are no new break locations.

EEEB-8

Page 2.3.1-10 in Attachment 5 of the LAR states, "The localized MSLB accident temperature of 3200 F [320°F] is exceeded by a few degrees for a matter of seconds while steam is flowing; however, this has been evaluated for qualified equipment in the trestle area and found not to have any impact." Discuss in detail how the localized MSLB accident temperature of 3200 F [320°F] is exceeded by how many degrees for how many seconds while steam is flowing. Discuss how this condition meets the required EQ temperature margin in accordance with 10 CFR 50.49 and Regulatory Position C.4 in Regulatory Guide 1.89.

Response

The current Unit 1 Environmental Qualification (EQ) high energy line break (HELB) temperature profile for the bounding break in the steam trestle area is 320°F for 95 seconds. This profile was postulated in FPL's response to the NRC IE Bulletin (IEB) 79-0IB, Environmental Qualification of Class 1E Equipment, and was conservatively based on the temperature of the steam as it leaves the break location (320°F) and the maximum amount of time required to blow down the steam generator (95 seconds). Because of the short duration of the HELB and the fact that the Unit 1 steam trestle is an open outdoor environment, the area was considered essentially mild.

Although EPU has almost no affect on the temperature and pressure of the steam in the main steam lines, it will impact the flow and consequentially the mass energy release of the steam from the bounding HELB. This in turn requires a review of the temperature profile and the subsequent affect on the EQ of equipment within the scope of 10 CFR 50.49 in the steam trestle.

The mass and energy release for a main steam line break (MSLB) was equivalent to the break currently used for the bounding profile of 320°F for 95 seconds. Only the first 106 seconds of the profile are used, since after that time the mass rate out of the break has decreased and continues to decrease. Along with the blowdown data, the temperature of the steam as it exits the pipe was evaluated.

The blocked test profile from the EQ documentation package (Doc Pac) for main steam trestle boxes has an equivalent thermal degradation of 3.05 minutes at 320°F. Comparing this to the Cumulative Time column from the vendor profile, this value falls in between 105 and

106 seconds. Although the full 106 seconds is not enveloped, it is considered acceptable for the following reasons:

- The main steam trestle is essentially an open outdoor environment with minimal solid panels to allow for pressurization of the area. Therefore, unless the piece of equipment is exposed directly to the steam plume, it is not expected to see temperatures in excess of 212°F;
- Once the steam generator inventory is depleted, the flow rate out of the break drops to near zero in a very short period of time to dry out; and
- The temperature of the steam plume once it exits the piping, in more realistic terms, would drop quickly through the adiabatic expansion to atmospheric pressure.

The use of the steam temperature as it leaves the break in the main steam line for the required EQ temperature profile for the area is conservative. Therefore, the small portion of the profile that is not enveloped by the current test profile is considered to be insignificant.

The limiting break locations potentially affect two components, MV-09-11 and the pushbutton station for MV-09-12 (B1507).

MV-09-11 is EQ qualified to inside containment criteria via report B0058 (Limitorque). This temperature profile conservatively bounds any postulated profile from an outside containment steam line break.

B1507 is not EQ qualified to an inside containment report like MV-09-11, however, the following factors indicate that it is unlikely to be adversely impacted by the postulated break:

- Distance from break to box is approximately 21 feet;
- Push button enclosure construction is an electrical box installed within a NEMA-4 (weather-tight) box;
- Line-of-sight to break location is severely limited due to several obstructions;
- B1507, although not qualified to an inside containment report, was evaluated to withstand exposure to 300°F for one year as part of FPL's response to NRC IEB 79-01B; and
- It has been concluded that the distance to the critical component exceeds the area of influence.

FPL determined that EPU will not adversely affect the conclusions of EQ Doc Pac and the boxes will continue to provide a mild environment for the equipment inside of them.

The current qualification is considered sufficient when the additional conservatisms listed above are taken into account.

EEEB-9

Confirm that the Target Dose, shown in Table 2.3.1-1, Attachment 5 of the LAR, is the Target Total Integrated Dose for the impacted electrical equipment.

Response

The target dose of 9.50E+04 Rad given in LAR Attachment 5, Table 2.3.1-1, is the total integrated dose (TID).

EEEB-10

Page 2.3.4-3 in Attachment 5 of the LAR states, "Each battery's capacity permits 4 hours of emergency operation without assistance from a battery charger. Each station battery supplies power for 125 VDC safety loads that include ....instrument power along with some non-Class [1E] loads..." Confirm that a failure of these non-safety loads under postulated environmental conditions will not prevent satisfactory accomplishment of safety functions of the safety-related batteries.

Response

The Unit 1 safety related station batteries, through the 125 VDC Class 1E buses 1A and 1B, supply power to Class 1E loads, and some non-Class 1E loads. The 125 VDC Class 1E buses are electrically separated from the non-Class 1E loads by a single bus circuit breaker, following the guidance provided by IEEE-279-1971, Criteria for Protection Systems for Nuclear Power Generating Stations, and IEEE-308-1970, Criteria for Class 1E Power Systems for Nuclear Power Generating Stations, based on Unit 1 design basis as described in the UFSAR Table 1.7-1, which follows the criteria provided by Atomic Energy Commission (AEC) Safety Guide 6, Independence between Redundant Standby (Onsite) Power Sources and between their Distribution Systems, dated March 10, 1971. The circuit breakers provide electrical isolation and remove faulted loads from the 125 VDC Class 1E buses.

Two modifications are planned to be implemented that will affect the safety related portions of the Class 1E 125 VDC System at EPU conditions. The first modification changes the power sources for isolated phase bus duct cooling fans from 480 VAC motor control centers (MCCs) to 480 VAC load centers. The second modification changes the power sources of vent fans 1HVS-4A and 1HVS-4B from 480 VAC MCCs to 480 VAC load centers. The new load center circuit breakers will add minor load to existing load center control power circuits. There are no changes to the configuration of Class 1E 125 VDC buses 1A and 1B at EPU conditions, by addition or removal of bus circuit breakers.

The EPU changes will not impact the current design basis criteria, and any failure of the non-safety related loads under postulated environmental conditions will not prevent satisfactory accomplishment of safety functions of the safety related batteries at EPU conditions.

EEEB-11

Table 2.3.1-2 in Attachment 5 of the LAR indicates submergence level in the Reactor Containment Building is increased due to EPU but there is no impact on the electrical equipment. Provide a summary of your evaluation that determined that there is no impact on the electrical equipment.

Response

Component evaluation sheets for equipment inside containment, below the current conservatively established 26-foot maximum flood elevation were reviewed and no additional equipment was identified as being below the 26-foot level as a result of the implementation of EPU. Environmental qualification (EQ) documentation packages reviewed were found to have an adequate discussion of qualification for submergence. No new equipment or components were identified that would have required relocation or qualification for submergence.

Additionally, another 25 items of EQ equipment installed inside containment between the 26-foot and 27-foot elevations were identified and also reviewed. The items identified consisted of the following equipment: Namco conduit seals, Rosemount transmitters, Teledyne jumper wire, and Valcor solenoid valves. These equipment types were verified to be above the flood level.

Maximum containment flood level after a large break loss of coolant accident (LBLOCA) for EPU at post recirculation actuation signal (RAS) is 25.66 ft, while for pre-EPU the maximum flood level is 25.70 ft. This corresponds to a reduction of 0.04 ft or 0.48 inch in the water level. Note that the pre-EPU calculation was conservative, as it did not adjust the water volume available from different sources to the containment sump based on the sump water temperature at RAS.

EEEB-12

Section 2.3.3.2.4 in Attachment 5 of the LAR provides a summary of the following planned modifications for EPU conditions:

- **The current limiting reactors (CLRs) are being replaced with lower impedance CLRs. Provide the following: 1) Details on the change in fault current as a consequence of this change, and fault current contribution due to the higher rating of the main generator and additional motor loads and 2) A summary of the calculation performed to validate the degraded voltage relay setting after the auxiliary system load and impedance changes.**
- **The non-safety sections of the 480V Motor Control Centers 1A5/1B5 and 1A6/1B6 will be tripped on a safety injection actuation signal (SIAS). If this modification is required to satisfy separation criteria, provide details on how the existing configuration is in compliance with separation criteria between safety and non-safety related circuits.**

Response

There are five 480 VAC load centers (LCs) in the St. Lucie Unit 1 auxiliary power distribution system. Two of these LCs are non-safety related (1A-1 and 1B-1), and three of these LCs are safety related (1A-2, 1B-2 and 1AB). The current limiting reactors (CLRs) are being replaced in 480 VAC LCs 1A-2 and 1B-2. The 480 VAC LC 1AB does not have a CLR installed in it. LCs 1A-2 and 1B-2 supply the power feeds to 480 VAC motor control centers (MCCs) 1A5, 1A6, 1A7, 1A8, 1B5, 1B6, 1B7, and 1B8. These MCCs are downstream of the new CLRs and will be affected by this modification. MCC 1AB is fed from 480 VAC LC 1AB which can be fed from either an "A" train or the "B" train source, but not both at one time. The replacement of the CLRs will have no effect on MCC 1AB.

The following tables were compiled from data taken from existing plant documentation and from EPU project studies. The studies included all known plant changes at the time they were conducted, which includes the CLR change out as well as the higher rating of the main generator, and any new motor loads that are being added.

Short Circuit Margins for Existing 480 VAC LC Breakers

480 VAC Bus	EXISTING			EPU	
	Breaker Rating (amps)	Calculated Fault Current (amps)	Margin (%)	Calculated Fault Current (amps)	Margin (%)
LC 1A-2 (1)	30,000	29,333	2.2	29,459	1.8
	50,000	29,333	41.3	29,459	41.08
	65,000	29,333	54.9	29,459	54.68
LC 1A-2 (2)	30,000	14,517	51.6	20,658	31.14
LC 1B-2 (1)	30,000	29,044	3.2	29,126	2.91
	50,000	29,044	41.9	29,126	41.75
	65,000	29,044	55.3	29,126	55.19
LC 1B-2 (2)	30,000	14,197	52.7	20,328	32.24

Short Circuit Margins for Existing 480 VAC MCC Breakers

480 VAC Bus	EXISTING			EPU	
	Breaker Rating (amps)	Calculated Fault Current (amps)	Margin (%)	Calculated Fault Current (amps)	Margin (%)
MCC 1A5	14,000	14,896	-6.4	19,742	-41.01
	22,000	13,502	38.6	17,894	18.66
	25,000	16,405	34.4	21,741	13.04
	30,000	13,502	55.0	17,894	40.35
MCC 1A6	14,000	15,213	-8.7	20,463	-46.16
	22,000	13,789	37.3	18,547	15.70
	25,000	16,754	33.0	22,534	9.86
	30,000	13,789	54.0	18,547	38.18
MCC 1A7	14,000	7,066	49.5	8,446	39.67
	25,000	7,782	68.9	9,039	63.84
MCC 1A8	14,000	8,119	42.0	9,839	29.72
	25,000	8,364	66.5	9,878	60.49
	30,000	8,119	72.9	9,839	67.20
MCC 1AB (A)	14,000	10,940	21.9	10,951	21.78
	25,000	12,048	51.8	12,060	51.76
MCC 1B5	14,000	15,188	-8.5	20,546	-46.76
	22,000	13,766	37.4	18,623	15.35
	25,000	16,726	33.1	22,626	9.50
	30,000	13,766	54.1	18,623	37.92
MCC 1B6	14,000	14,253	-1.8	19,023	-35.88
	22,000	12,919	41.3	17,243	21.62
	25,000	15,697	37.2	20,950	16.20
	30,000	12,919	56.9	17,243	42.52
MCC 1B7	14,000	6,741	51.9	8,064	42.40
	25,000	7,424	70.3	8,601	65.60
MCC 1B8	14,000	8,513	39.2	10,549	24.65
	25,000	8,909	64.4	10,686	57.26
	30,000	8,513	71.6	10,549	64.84
MCC 1AB (B)	14,000	10,840	22.6	10,845	22.54
	25,000	11,938	52.2	11,943	52.23

The 480V MCC circuit breakers are rated 14kA, 22kA, 25kA or 30kA (symmetrical) interrupting. As shown, the circuit breaker interrupting ratings envelope the fault duty on the circuit breakers with the exception of the circuit breakers rated 14kA interrupting capacity on MCC buses 1A5, 1A6, 1B1, 1B5 and 1B6. The over duty condition on these breakers is present under both existing and EPU conditions. There is a program in place, as follows, to accomplish the required corrective action. The over dutied TED circuit breakers on buses 1A5, 1A6, 1B1, 1B5 and 1B6 are scheduled to be replaced with THED circuit breakers that have a higher rating that envelopes the duty on the circuit breakers. Condition Reports have been initiated that 1) describes the over duty condition of circuit breakers on MCCs 1A5, 1A6, 1B1, 1B5 and 1B6 and recommended corrective action program; and 2) describes the corrective action program for over dutied circuit breakers on MCCs 1A5, 1A6, 1B1, 1B5 and 1B6 and track progress of the corrective action. The uprated margins for the replacement breakers are shown in bold italics below.

Short Circuit Margins for 480V AC MCC Breakers

480 VAC Bus	EXISTING			EPU	
	Breaker Rating (amps	Calculated Fault Current (amps)	Margin (%)	Calculated Fault Current (amps)	Margin (%)
MCC 1A5	14,000	14,896	-6.4	19,742	-41.01
	22,000	***14,896***	***32.29***	***19,742***	***10.26***
MCC 1A6	14,000	15,213	-8.7	20,463	-46.16
	22,000	***15,213***	***30.85***	***20,463***	***6.99***
MCC 1B5	14,000	15,188	-8.5	20,546	-46.76
	22,000	***15,188***	***30.96***	***20,546***	***6.61***
MCC 1B6	14,000	14,253	-1.8	19,023	-35.88
	22,000	***14,253***	***35.21***	***19,023***	***13.53***

It can be seen from the tables above that there will be changes in the short circuit current available at the LC (1 & 2), and MCC breakers as a result of the CLR changeout; however, there are no adverse impacts to the safety related LC and MCC breakers.

480V AC Switchgear Bus Momentary Current Margin

BUS	EXISTING			EPU	
	Bus Bracing (amps)	Maximum Duty (amps)	Margin (%)	Maximum Duty (amps)	Margin (%)
1A-2 (1)	39,900	39,531	0.92	39,694	0.52
1A-2 (2)	29,300	19,728	32.67	27,943	4.63
1B-2 (1)	39,900	39,152	1.87	39,257	1.61
1B-2 (2)	29,300	19,303	34.12	27,508	6.12

It can be seen from the table above that the short circuit currents for the 480 VAC buses has changed; however, there are no adverse impacts to the LC buses.

Analyses contained in plant calculations determine limiting voltage values at the buses containing the degraded voltage relays for use in degraded voltage relay settings. Maximum and minimum permissible switchyard voltages are calculated and evaluated for various plant conditions (cases). The analyses and cases are performed using the ETAP Power Station software (Version 5.5.6.N) to develop models used as the basis for plant calculations. Plant modifications are modeled in the various applicable plant calculations and test cases are reviewed for impact on the auxiliary power distribution system prior to implementation of any proposed modification.

The non-safety sections of the 480 VAC MCCs 1A5/1B5 and 1A6/1B6 are being tripped on a safety injection actuation signal (SIAS) in order to remove unnecessary loading on the safety related MCC buses during an SIAS event. These loads automatically are removed during a loss of offside power (LOOP) event to limit unnecessary emergency diesel generator loading. The modification to trip these non-safety related loads will result in a configuration similar to that of St. Lucie Unit 2. The non-safety loads as configured are in full compliance of the St. Lucie commitments to the NRC. Therefore; this modification is not being implemented to satisfy separation criteria.

EEEB-13

Appendix H in Attachment 5 of the LAR states that the proposed EPU meets the reactive capability requirements of the grid. Provide the specific reactive power requirements pre-EPU and post EPU and explain how the licensee satisfies the requirements of the Standard Large Generator Interconnection Procedures in FPL's Open Access Transmission Tariff (OATT). Confirm that post trip voltages at the safety busses are adequate for plant shutdown in the event that Unit 1 and Unit 2 were operating at the maximum required power factor during stressed grid conditions.

Response

The pre-EPU reactive power requirement for each St Lucie unit is its current reactive capability, which is grandfathered (prior to filing of FPL's OATT) as acceptable (LAR Attachment 5, Appendix H, 13th page). The current reactive capability (pre-EPU) is listed in the table below. The Standard Large Generator Interconnection Procedures and applicable reactive design requirements in FPL's OATT are applicable to the EPU incremental increase in MW output to the FPL transmission system. The incremental reactive power requirement for post-EPU is also listed in the table. Based on the engineering evaluation data provided for EPU studies, the units' post-EPU satisfy the reactive capability requirements by exceeding the incremental reactive power required for the additional real power delivered to the system.

Unit		Pre-EPU Reactive Requirement (equals current Capability) (MVARs Net)	Post-EPU Reactive Capability (MVARs Net)	OATT Required Post-EPU Incremental Reactive Power Increase for Additional Real Power (MVARs Net)	Actual Post-EPU Incremental Reactive Power Increase (MVARs Net)	MVARs in excess of OATT Reactive Capability Requirement
SL1	Summer	353	583	70	230	160
	Winter	353	541	73	188	115
SL2	Summer	353	542	80	189	109
	Winter	353	519	83	166	83

The following table shows that post trip voltages at the safety busses are adequate for plant shutdown during stressed grid conditions. The most anticipated stressed grid condition simulated a Midway 500/230 kV autotransformer out of service prior to the unit trip shutdown. (Midway is the first transmission substation downstream of St. Lucie Plant.) In the simulation, both units could not be forced to operate at maximum required power factor simultaneously without exceeding terminal voltage or switchyard bus voltage limits. The table indicates the maximum MVAR output of each unit prior to the contingency loss of St. Lucie Unit 2 (most severe contingency since Unit 2 is the largest generator) without exceeding voltage limits. The St. Lucie 230 kV bus voltage after the contingency remains adequate.

Scenario	Unit	MVAR Output	Terminal Voltage (pu)	St. Lucie 230kV Bus Voltage (kV)
Both St. Lucie Units online	St. Lucie #1	378	1.05	244
	St. Lucie #2	323	1.05	244
St. Lucie #2 unit tripped	St. Lucie #1	506	1.05	241 *

* St. Lucie Unit 1 MVAR output would be adjusted within 30 minutes to reduce the switchyard voltage to below 241 kV with St. Lucie Unit 2 on start-up.

EEEB-14

The results of grid stability analyses are provided in Appendix H. The voltages at the St Lucie 230 kV busses are assumed to be approximately 104% of nominal with the result that post contingency (i.e. post loss of line or generation) voltages are considered acceptable. Provide details on the allowable voltage range for the transmission system and the justification for selecting the 104% of nominal voltage as the starting point. Also include the reactive power support provided by St Lucie Units pre and post contingencies that were evaluated.

Response

The allowable voltage range for the St. Lucie 230 kV busses is 230 to 244 kV with both units on, and 230 to 241 kV with either unit on start-up in accordance with FPL procedures. Short duration excursions (less than 30 minutes) above the high limit are acceptable..

FPL, as a transmission operator, is required to establish a voltage schedule for those generating facilities connected to the FPL transmission system. FPL has established 104% of 230 kV as the voltage schedule for generating facilities directly connected to FPL's 230 kV transmission system. The voltage schedule is documented in FPL System Operations procedures and has been reviewed by the Florida Reliability Coordination Council (FRCC) and North American Electric Reliability Corporation (NERC).

The following table indicates the reactive power support provided by the St. Lucie units in both pre- and post-contingency for the events evaluated.

Case	Event	Pre-Contingency MVAR		Post-Contingency MVAR	
		St. Lucie Unit 1	St. Lucie Unit 2	St. Lucie Unit 1	St. Lucie Unit 2
1	PSL2 tripped	136.27	138.57	155.29	0
2	PSL1 off, PSL2 tripped	0	99.62	0	0
3	SL-Midway #3 line tripped	136.27	138.57	150.54	161.31
4	Midway 500/230 Tx tripped	136.27	138.57	188.62	221.72
5	Duval-Thalmann 500 tripped	136.27	138.57	137.88	141.19
6	Andytwn-Nobhill line tripped	136.27	138.57	131.05	130.32
7	(2) Nobhill lines tripped	136.27	138.57	128.04	125.55

EEEB-15

The seven case studies performed for grid stability analyses (Appendix H) concluded that the grid was stable for the specific cases. Case studies 3 and 4 indicate significant voltage and frequency variations for an extended duration (up to 8 seconds). Operating experience has indicated that reactor coolant pump (RCP) flow is changed when the RCP motor is subjected to voltage and frequency variations. Provide details on the effect of the voltage and frequency variations during the worst case grid transients and verify that the consequences of the grid transients will not lead to additional unit trips. In addition, explain how the models were validated with respect to operational events on the grid.

Response

The reactor coolant pump (RCP) assembly consists of the pump, connecting shaft, and motor/flywheel. The moment of inertia value for this assembly is 100,000 lb_m-ft^2. This configuration was provided in order for the RCP to ride through minor flow variations and frequency changes if and when they occur, and to provide coolant flow for up to three seconds (80% flow at three seconds) following a removal of power from all four RCPs. Additionally, the RCP motors were designed to be able to start, accelerate to rated speed, and support full loading conditions with 80% of rated voltage applied. The upper voltage limit for continuous motor operation is 7200 volts (+ 9%). The synchronous speed for the RCP motor at 60 Hertz (Hz) is 900 revolutions per minute (RPM). The motor speed at 60 Hz is 881 RPM and is the basis for the RCP operation. Each RCP motor is equipped with surge arrestors (capacitors).

Effect of Frequency Transient

Case studies 3 and 4 are provided in EPU LAR, Attachment 5 Appendix H. These are the most severe of the seven cases studied for voltage and frequency stability. A review of the frequency response for case studies 3 and 4 indicates the variation is apparent for eight (8) seconds. For the two case studies, the frequency response for the first two seconds is different with case study 4 being a bit more severe. From the two-second mark on, the case studies are very similar.

The concern would be for cases where the frequency drops below 60 Hz as this would have the effect of trying to slow the motor speed. Where the frequency exceeds 60 Hz, the effect would be to try to increase the motor speed. The largest negative spike for case study 4 is, by inspection, 59.73 Hz, and this cycle from 60 Hz to 59.73 Hz and back to 60 Hz lasts for approximately 0.50 seconds. The motor speed would be 881(59.73/60) = 877 RPM. The next most significant negative spike is 59.87 Hz at the 1.75 second mark and also lasts for approximately 0.50 seconds. The motor speed would be 881(59.87/60) = 879 RPM. Further the inertia of the motor flywheel would not allow rapid responses to these small variations in applied frequency.

An additional consideration would be that the frequency changes seen for case studies 3 and 4 are symmetrical around the 60 Hz reference, i.e., there are as many positive spikes as there are negative spikes and the effects of these would tend to cancel each other.

The Unit 1 Technical Specifications, Table 2.2-1, indicates that the minimum RCP flow setpoint is ≥ 95%. The correlation between flow of a centrifugal pump and motor speed is linear. A pump flow of 95% would equate to a frequency of 95% of 60 Hz, or 57 Hz. The greatest negative transient of 59.73 Hz would not result in a plant trip.

Effect of Voltage Transient

Case studies 3 and 4 are provided in EPU LAR Attachment 5, Appendix H. The voltage ratio of the unit auxiliary transformer (UAT) is 20.9 kV to 6.9 kV or 3.03. The voltage ratio of the generator step-up transformer (GSU) is 227.05 kV to 20.9 kV or 10.86. The maximum voltage spike seen in the case studies is 1.1 per unit on a base of 230 kV or 253 kV for case study 3 for the first 0.5 second on the negative cycle. The voltage seen on the UAT low voltage winding would be 7,689 volts (253 kV/10.86/3.03). Using a voltage drop for cable resistance of 14 volts would reduce the voltage to the motor terminals to a value of 7675 volts. The upper voltage limit of the RCP motor for continuous operation is 7200 volts. Considering that the overvoltage of 475 volts would last for only a few cycles, and that there are surge arresters (capacitors) provided for such occurrences, the effect of the voltage transient would not result in a plant trip.

Grid Stability Study

FPL's Transmission Planning Group performed this grid stability using the PSS/E dynamic simulation software developed by Siemens/Power Technologies. The grid stability study tested the effects of transmission contingencies listed in General Design Criterion (GDC)-17 on the St. Lucie plant with the proposed power uprate projects in place and is based on the preliminary data provided by the generator manufacturer. The computer models for the generator and excitation systems provided by the manufacturer were evaluated with standard data validity tests such as simulation of open circuit step tests and were found to yield expected response characteristics.

FPL's Transmission Planning Group periodically studies actual system events, such as transmission faults when data is available in order to assess the accuracy of the computer models used for transmission studies. Validation tests on the St. Lucie computer models were performed for a transmission fault that occurred on April 30, 2008. This fault occurred on the Midway – Ranch 230 kV transmission line and was recorded by a synchrophasor measurement device installed at the Midway substation. The electrical fault caused a swing on the St. Lucie generators that is reflected in the Midway – St. Lucie 230 kV line flow recorded by the synchrophasor device. Comparison of the synchrophasor recording shows good correlation with the computer models. The validation testing of the April 2008 fault applies to the computer models for the pre uprate St. Lucie generator equipment.

EEEB-16

Page 2.3.3-5 in Attachment 5 of the LAR states, "However, isolated phase bus (IPB) main transformer (MT), unit auxiliary transformer (UAT) and potential transformer (PT) tap buses short circuit design ratings are less than the anticipated worst-case fault current levels for both pre-EPU and EPU conditions. This is a current plant design issue. The over duty condition on IPB tap buses will be further analyzed and corrective action, as appropriate, completed prior to EPU". Provide details on the final resolution and modifications on the above issue. Explain how the final modifications will resolve the above issue for EPU conditions.

Response

The design of the main current-carrying sections of the isolated phase bus (IPB), consisting of the main generator section, main transformer (MT) taps, and unit auxiliary transformer (UAT) taps, are similar in construction. Each phase consists of a tubular aluminum conductor concentrically located inside a cylindrical grounded aluminum enclosure. The conductors are supported by insulators inside the enclosure. Design of the lower-current carrying potential transformer (PT) tap consists of an aluminum C-channel conductor mounted via insulators inside a grounded aluminum enclosure for each phase.

This design makes the probability of a phase to phase or 3-phase fault extremely low. Due to the grounded enclosure for each phase, any fault would initially be a phase-ground fault which, with the high-impedance system grounding at St. Lucie, would be limited to less than 10A. This would not be expected to cause damage. Additionally, the IPB is protected by differential relaying which would act to open the switchyard breaker and trip the main generator. Thus, the only way a phase to phase or 3- phase fault could occur with the isolated phase bus design is with prior severe damage to the bus and enclosure. The IPB system has been evaluated by an independent consultant. The results of this evaluation are summarized as noted below.

Main and MT Taps

- The main bus and MT bus taps are adequate to operate during and after the short circuit fault.
- The short circuit forces on the conductor and the insulators are below the design limits.
- The temperature rise during the short circuit fault is small and is within the limits.

PT Tap

- The PTs are located in individual compartments and are isolated from each other. It is unlikely to have a phase to phase fault in the PT cubicle or in the PT bus.
- The PTs have fuses in their primary windings (IPB side).
- The net length of the conductor is only 32 inches. This will limit amount of force to which the insulator will be subjected. The insulator has adequate cantilever strength to withstand DC, 60 Hz, and 120 Hz forces produced on the conductor.
- The temperature rise during short circuit condition is within the limits.

UAT Taps

- Three phase windings in the MT and UAT could cause phase to phase or three phase fault currents in the UAT tap.

- The conductor in each phase is 50 inches long and has one insulator support. Under short circuit conditions, this conductor will be subjected to high DC and 60 Hz forces.
- Both forces will cause movement in the conductor. The resulting cantilever force will be higher than cantilever strength of the insulator.
- Conductor cross section area is 2.9 square inches. The small cross section or mass will cause temperature to reach 247°C. This is close to, but less than the acceptable limit.

Recommendations provided in the subject evaluation are summarized below.

1. Conductor in UAT bus

   Replace existing channel conductor with tube conductor with minimum of 5 square inch cross sectional area. An alternative method to correct the UAT conductor is to weld a stiffener plate to the existing conductor. This will limit the conductor movement and reduce the 60 Hz force on the insulator.

2. Insulator/ Insulator mounting in UAT bus

   The existing insulator has 3100 lbs cantilever strength. Replace it with higher strength insulator, or add another insulator next to the existing insulator to increase the strength.

The method selected to address the noted condition is to weld a stiffener plate to the existing U-shaped channel. This will create a conductor with a rectangular cross section. The plate is to be 5-inch wide X 0.5-inch thick and approximately 42-inch long. The additional area added to the conductor will be 2.5 square inches. When added to the existing 2.9 square inches, there will be a cross sectional area of 5.4 square inches. This will be greater than the area of 5 square inches as recommended.

Additionally, a second insulator will be added to increase the resistance to cantilever forces.

The independent evaluation results were expected as the program used to generate the short circuit analysis (ETAP) takes a very conservative approach. The modification for the UAT IPB taps is planned for the next Unit 1 refueling outage and will address the concerns identified.

EEEB-17

Page 2.3.3-6 in Attachment 5 of the LAR states, "The existing MT 1A will have its cooling unit upgraded. The existing MT 1B is to be swapped with existing spare transformer." Provide details on transformer impedances (MT 1A, MT 1B, and MT spare) and any evaluations performed for circulating currents in the event of unbalanced loading resulting in potential degradation of operating safety related equipment.

Response

The existing main transformer (MT) 1A was manufactured by ABB (serial number GBM 22812). The existing MT spare was also provided by ABB (serial number GBM 22811) and is a duplicate of the MT 1A. With the existing St. Lucie Unit 1 cooler package, operation of these transformers is limited to a rating of 475 MVA each. With additional cooling, these transformers are capable of operation at a rating of 635 MVA each. The factory acceptance test (FAT) for these transformers considered a base of 475 MVA. The FAT measured value of impedance for MT 1A was 9.88% for the 234,700 volts to 21,600 volts (10.866:1 winding ratio) winding connection. The FAT measured value of impedance for the MT spare was 9.9% for the

234,700 volts to 21,600 volts winding connection. The calculated value for the impedance of these transformers is 13.2% on a base of 635 MVA.

The existing MT 1B was manufactured by McGraw–Edison (serial number C-07046-5). This transformer is rated at 475 MVA with the existing cooler package. It also is capable of operation at 635 MVA with additional cooling. The FAT measured impedance of this transformer for the 227,050 volts to 20,900 volts (10.864:1 winding ratio) winding connection is 10.6% on a base of 475 MVA . The existing combination of the MT 1A and the MT 1B transformers in parallel has been in operation for approximately 13 years with no problems identified with circulating currents.

The post EPU configuration will have the two ABB transformers (serial number GBM 22812 – MT1A and serial number GBM 22811-MT1B) operating in parallel. Each transformer will have a dedicated upgraded cooling package that will allow operation at levels up to 635 MVA. Because these two transformers have impedances that are very close to one another, there are no expectations that circulating currents between the two transformers will be problematic, and thus no additional evaluation is necessary.

EEEB-18

Section 2.3.3 of Attachment 5 of the LAR concludes that the emergency diesel generator (EDG) loading has increased but maximum load is within the rating of the EDGs. Provide a summary of calculation(s) detailing the EDG loading with EPU changes and the EDGs operating at the worst case allowable voltage and frequency.

Response

Emergency Diesel Generator (EDG)Loading

EDG 1A, which is associated with the most heavily loaded engineered safeguards features (ESF) buses among the Unit 1 EDGs, is used as a bounding case for Unit 1 EDG loading. EDG 1A and 1B have the following ratings:

Base Continuous Rating	3500 kW
2000 Hour Rating	3730 kW
30 Minute Short Term Rating	3960 kW

Steady State Loading

Unit 1 Technical Specifications (TS) require that auto-connected loads to EDG set do not exceed the 2000 hour rating of 3730 kW. Also, NRC Regulatory Guide (RG) 1.9, Application and Testing of Safety-Related Diesel Generators in Nuclear Power Plants, requires that EDG set continuous loading not exceed 90% of the 30 minute rating, a value of 3564.0 kW.

Unit1 EDG loading has been evaluated for EPU changes under loss of offsite power (LOOP) and LOOP/loss of coolant accident (LOCA), at frequencies of 60 Hz and 60.6 Hz (new TS over-frequency requirement) and EPU conditions. The LOOP conditions will be considered in the SBO scenario. The maximum steady state EDG loading has been analyzed as follows for the LOOP/LOCA conditions (more severe profile):

UNIT 1 MAXIMUM EDG LOAD AT EPU		
Description	Load @ 60 Hz LOOP/LOCA	Load @ 60.6 Hz LOOP/LOCA
Maximum Steady State Load	3385.4 kW (Load Block 9)	3464.7 kW (Load Block 9)
Maximum Continuous Rating	3564.0 kW	3564.0 kW
Margin	5.01%	2.79%

The Unit 1 EDG loading meets the requirements of Unit 1 TS and RG 1.9.

Transient Loading

The transient loading curves for the engine and generator are used to determine the capability to start a particular load or group of loads on the EDG with existing load already running on the EDG. When the starting load(s) remain within the transient capability of the engine, then it can be assumed that the EDG frequency (engine speed) remains within the specified limits. Similarly, when the starting load(s) remain within the transient capability of the generator, it can be assumed that the EDG voltage remains within the specified limits. The limits specified for St. Lucie are consistent with the RG 1.9 specified requirements (4160 ± 420 V, 60 ± 1.2 Hz, with voltage ≥ 75% rated and frequency ≥ 95% rated during transient). EPU analyses have confirmed that these limits are met.

The table above indicates that the maximum Unit 1 steady state EDG load of 3464.7 kW (Load Block 9 subtotal) is less than the maximum continuous rating of 3464.7 kW. Subsequent Load Blocks added to the EDG loading profile result in decreased load and do not exceed the generator transient capability. Therefore, the EDG will meet its operational criteria as defined in RG 1.9 (transient capability, voltage and frequency).

The Unit 1 EDG sets will continue to operate under EPU conditions within their design ratings, at the worst allowable voltage and frequency.

EEEB-19

The LAR indicates that EDG loading has increased. Provide a summary of the calculation validating the proposed 19,000 gallons of fuel oil requirement for each EDG (as shown on the marked-up pages of TS LCOs 3.8.1.1.b.2 and 3.8.1.2.b.2 of Attachment 3 of the LAR).

Response

The table below summarizes the calculation that supports the proposed new Technical Specification (TS) values of 19,000 gallons of fuel oil for each EDG set post EPU.

The fuel oil volumes listed below are based on using ultra low sulfur (ULSD, S15, <15 ppm sulfur) fuel oil as required by the Clean Air Act. The consumption and storage values provided below have been adjusted primarily to compensate for the lower high heating value (HHV) of ULSD when compared to low sulfur fuel (LSD), which is the basis for the current TS values. A lower HHV results in an increase in the fuel consumption rate by the EDG for a given load.

The load profile used in the fuel oil consumption calculation is based on loads that have been adjusted to account for 1% EDG overfrequency operation.

ITEM DESCRIPTION	VOLUME (gal.)	COMMENTS/BASIS
Total gallons consumed by one EDG in 7 days post LOCA/LOOP = total required usable volume	36,373	Consumption is based on EPU EDG loading profile over the 7 day time period. Consumption developed using test data to determine a consumption rate that is then adjusted for consumption of ultra low sulfur (ULSD) fuel oil. An outdoor temperature of 95°F is assumed for fuel density.
Assumed margin for future EDG loading revisions	168	Assumption to make total volume a round number (19,000)
Total required volume for system with future margin	36,541	Total consumed volume plus assumed margin
Two day tanks, usable volume credited towards system requirement	160	Each EDG has two engines. Each engine has its own day tank. The two day tanks are hydraulically linked so that the two tanks can be considered as one consolidated tank for the purpose of fuel oil consumption. TS value per day tank = 152 gal which includes 55.5 gallons unusable volume* and 16.7 gallons instrument measurement tolerance (2 inch variation in level); 152 – (55.5 + 16.7) = 79.8 gallons, rounded up to 80 gallons per day tank. Total usable volume of two tanks is 80x 2 = 160 gallons. * Includes volume below day tank outlet nozzle plus additional volume to prevent vortex formation.
Two Diesel Oil Storage Tank (DOST) usable volume	36,381	Total required volume minus volume in two day tanks. 36,541 – 160 = 36,381
One DOST required usable volume	18,191	One-half total required volume.
One DOST unusable volume	587	Includes volume below DOST outlet nozzle plus additional volume to prevent vortex formation.
One DOST instrument measurement tolerance	222	2 inch variation in level
One DOST TS total volume post EPU	19000	Sum of required usable volume plus unusable volume plus instrument measurement uncertainty

EEEB-20

Page 2.3.5-1 in Attachment 5 of the LAR states, "The SBO analysis credits the availability of an EDG from St. Lucie 2 as an alternate alternating current source." The safety related loading on EDGs for Unit 1 has increased. Provide a summary of the calculation detailing the margin in Unit 2 EDGs when used as an AAC source for Unit 1 SBO conditions.

Response

The Unit 1 station blackout (SBO) scenario postulates that:

- Both units are initially at 100% power;
- Loss of offsite power (LOOP) occurs at both units;
- Unit 1 is the SBO unit;
- Unit 2 is the station non-blacked out (NBO) unit; and
- There is no design basis accident coincident with SBO.

Unit 1 Emergency Diesel Generator (EDG) Loading (St. Lucie Unit 1 SBO)

EDG 1A, which is associated with the most heavily loaded engineered safeguards features (ESF) buses among the Unit 1 EDGs, has been evaluated as a bounding case for Unit 1 EDG loading. The evaluation determined that there are slight EPU changes (increase) for operation under LOOP/loss of coolant accident (LOCA) conditions, but no EPU changes for operation under LOOP conditions (considered in the SBO scenario).

Unit 2 EDG Loading (St. Lucie Unit 2 NBO)

Current SBO analysis credits the availability of a Unit 2 EDG as an Alternate Alternating Current (AAC) source for the Unit 1 SBO Unit. EDG 2A, which is associated with the most heavily loaded ESF buses among the Unit 2 EDGs, is used as a bounding case for Unit 2 EDG loading. EDG 2A and EDG 2B have the following ratings:

Base Continuous Rating	3669.4 kW
2000 Hour Rating	3934.3 kW
30 Minute Short Term Rating	4108.6 kW

The Unit 2 Technical Specifications (TS) require that auto-connected loads to EDG set do not exceed the 2000 hour rating of 3934.3 kW. Also, NRC Regulatory Guide (RG) 1.9, Application and Testing of Safety-Related Diesel Generators in Nuclear Power Plants, requires that EDG set continuous loading not exceed 90% of the 30 minute rating, a value of 3697.7 kW. The TS apply to LOOP/LOCA only (auto-connected loads) and not to SBO.

Unit 2 EDG loading has been evaluated for Unit 2 EPU changes under LOOP and LOOP/LOCA at EPU conditions. The evaluation determined that there are slight EPU changes (increase) for operation under LOOP/LOCA conditions (accident loads not considered in the SBO scenario), but no EPU changes under the LOOP conditions (considered in the SBO scenario). The SBO loading was unaffected by the increase in accident loading for LOOP/LOCA conditions.

Since there were no EDG load changes for the SBO scenario under EPU conditions, no new calculation was required. Therefore, the Unit 1 SBO analysis is unchanged, and will continue to credit the availability of an EDG set from St. Lucie Unit 2 as an AAC source at EPU conditions.

<u>EEEB-21</u>

Page 2.3.5-3 in Attachment 5 of the LAR, states, "One hour direct current (dc) coping is assumed to start at the actual time of the SBO. Attachment 8, 10 CFR 50.63 Station Blackout DC Coping, to this LAR provides an analysis of the station's ability to cope for up to one hour without alternate alternating current power available." Section 2.1 in Attachment 8 of the LAR states, "The transition from 25-minute to one-hour dc coping does not compromise the Class 1E 125 V dc system function during the SBO event. The station batteries have sufficient capacity to power the necessary loads for one hour under SBO conditions with 100% margin." Confirm that one hour dc coping time supported by the safety related station batteries will be verified by periodic battery service tests for the SBO load profile for the one hour dc coping duration.

<u>Response</u>

The one-hour station blackout (SBO) dc coping time supported by the safety related station batteries is confirmed via periodic battery testing to a bounding load profile. The Class 1E battery service test requirements are established by the St. Lucie Unit 1 125 VDC system calculation. The more heavily loaded safety train is the B train. The calculated profile is also shown in the Updated Final Safety Analysis Report (UFSAR) Figure 8.3-14.

Plant procedures provide performance discharge testing and service testing of the safety related batteries in compliance with Technical Specifications. The load profile used for testing is derived from the 125 VDC system calculation with additional margin.

Loading values for the 125 VDC B Train

Time	SBO 4-Hr Calc Current	AAC 1-Hr Calc Current	Service Test Current	Discharge Test Current
0 – 1 Min.	541A	541A	566A	518A
1 – 30 Min.	245A	245A	260A	518A
30 Min – 3 Hr 59 Min	239A	239A*	255A	518A
3 Hr 59 Min – 4 Hr	271A	____	298A	518A

* Alternate AC calculated profile ends at 60 Min.

Note: 20A was added to the first minute loads determined in the 125 VDC system calculation, per EPU LAR Attachment 5 Section 2.3.4.2.4.

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Page 26 in Attachment 8, Appendix A of LAR shows that time of the Motor Operated Valves (MOV) MV-08-03 (on bus 1AB) and MV-08-13/14 and MV-09-11/12 (on bus 1AB-1) as 0 – 60 seconds. However, Table 3.34 Station Blackout Sequence of Events in Attachment 8, Appendix B of LAR reflects beginning of Auxiliary Feedwater (FW) delivery to the steam generators at 336.6 seconds which would mean that all Auxiliary FW loads will start at approximately 336.6 seconds. Provide clarification for discrepancy on timing of actuation of Auxiliary Feedwater System motor operated valve loads between Page 26 in Attachment 8, Appendix A of LAR and Table 3.34 in Attachment 8, Appendix B of LAR.

Response

The subject motor operated valves (MOVs) are associated with operation of the 1C auxiliary feedwater (AFW) pump. Page 26 in Attachment 8, Appendix A of the LAR is a page from one of the calculations used to size the station batteries. The calculation assumes these MOVs actuate on an auxiliary feedwater actuation signal (AFAS) signal and stroke within one minute.

For battery sizing, the subject MOVs are considered to be actuated on an AFAS signal, and for conservatism are considered to be a 125 VDC load for the first minute (0-60 seconds) of the battery loading profile. The time interval shown on Page 26 in Attachment 8, Appendix A of the LAR reflects this value.

Station blackout (SBO) starts when offsite power sources are not available and the onsite power sources fail to start. The engineered safeguards features (ESF) AC bus loads would load shed in preparation for the automatic sequencing on of specific loads, but there would be no automatic sequencing on of ESF equipment, as there is no ESF bus voltage available for the prime movers. DC powered equipment required to respond to an AFAS following an SBO event would be sequenced automatically. Table 3.34, Station Blackout Sequence of Events, in Attachment 8, Appendix B of the LAR shows the time estimated for AFW flow to be initiated. The analysis presented in this section of the LAR is conservative with respect to analyzing SBO impacts on the reactor coolant system and core performance and thus assumes a bounding delay time for the initiation of AFW flow.

This time includes the following AFW times for the DC-powered pump train:

AFAS time delay setting:	235 sec
Timer error:	25 sec
MOVs:	45 sec
Total:	305 sec

The remaining time is to establish flow.

Accordingly, assuming simultaneous loss of offsite power (LOOP) and AFAS, the MOVs will not operate until 260 sec (235 + 25). They will operate later if AFAS is initiated after LOOP, i.e., it would depend upon the time needed for AFAS initiation on SG level. Therefore, the DC MOVs can be considered a random load as the occurrence of AFAS is somewhat random. When sizing batteries, random loads are included in the worst-case load period, which is the first minute.

Therefore, the differences in times shown are due to different purposes: one to calculate the initiation of AFW flow, the other to size the battery; both are correct as shown.

EEEB-23

Provide details on any load shedding that is required to extend the SBO coping time for the safety-related batteries to one hour due to proposed uprate.

Response

Load shedding is not required to support safety related battery operation during the station blackout (SBO) one hour coping period. The loading for the safety related batteries is developed in the 125 VDC system calculation. The calculation evaluates the battery capability as a 4-hour SBO coping facility and as a 1-hour SBO (alternate AC) AAC facility. The SBO coping battery profile is extended for a four hour period of time. The SBO AAC battery profile is extended for a period of one hour. The bounding case for both SBO events is the loading for Train B. Review of the loading values shows that each profile is the same for the period of one hour, at which time the SBO AAC profile is ended. UFSAR Figure 8.3-14 shows the SBO coping profile, which matches the bounding case conditions.

A review of the DC system model development used for the 125 VDC system calculation shows that manual operation of disconnecting loads to extend battery capacity is not included for either the 1-hour AAC study or the 4-hour SBO coping study. Loads are tabulated and load durations are shown in the calculation tables. Those loads shown as intermittent are loads that normally operate for a very short duration to perform their function (e.g. breaker trip coils). A few components change loading requirements during operation and are so modeled (e.g. inverters). All other loads are shown as steady-state; none are disconnected to reduce load. As stated in Section 2.3.4.2 of LAR Attachment 5, modifications associated with the LAR added 20A to the first-minute battery loading. None of the 125 VDC loads are manually shed.

EEEB-24

As a result of the proposed uprate, discuss any change(s) in frequency of loss of offsite power and/or reliability of the EDGs as discussed in Regulatory Guidance 1.155 since the NRC staff approved the original SBO Coping analyses.

Response

The requested uprate does not propose any changes in the frequency of a loss of offsite power (LOOP) event, nor does it propose any changes in the reliability of the emergency diesel generators (EDGs). The current licensing basis for the station blackout (SBO) event duration is four hours, which is documented in Section 15.2.13 of the Updated Final Safety Analysis Report (UFSAR) and in an NRC Supplemental Safety Evaluation dated June 11, 1992.

As noted in Attachment 8 of the EPU LAR, an NRC inspection in 2007 determined that, based on the plant's SBO coping strategy of providing an alternate ac source within 25 minutes, FPL was required to demonstrate that Unit 1 can cope on dc power for the first 60 minutes of the 4-hour event. The 2007 NRC inspection report cited the need to perform and submit the required dc coping analysis based on the plant's SBO licensing basis (or to verify the capability to provide alternate ac within 10 minutes). This did not represent a change to the licensed 4-hour event duration. The purpose of LAR Attachment 8 is to provide the 60-minute dc coping analysis in response to the 2007 inspection.

Section 2.3.5 of LAR Attachment 5 provides an evaluation of the EPU impacts on the station's ability to respond to an SBO event. Specifically, Section 2.3.5.2.3, Item 1 addresses SBO coping duration. As stated in the submittal, the proposed EPU does not impact the factors identified in NRC Regulatory Guide (RG) 1.155, Station Blackout, for the determination of the SBO event duration, including minimum EDG target reliability and the site's susceptibility to grid-related LOOP events. Other factors involve weather groupings and electrical systems' configuration, neither or which have been impacted by the proposed EPU.

The EPU does not propose any changes to the configuration or to the maintenance of the emergency power system other than modifications to improve bus margin as discussed in Section 2.3.3 of LAR Attachment 5. Grid stability studies were performed for EPU and modifications are planned to maintain grid conditions. This is discussed further in Section 2.3.2 and in Appendix H of LAR Attachment 5.