



JUL 19 2019

L-2019-147
10 CFR 50.90
10 CFR 50.91

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

RE: St. Lucie Unit 1
Docket Nos. 50-335
Renewed Facility Operating Licenses DPR-67

Subject: Exigent Technical Specification Amendment Request
One-Time Allowed Outage Time Extension for Inoperable EDG

In accordance with the provisions of Title 10 of the Code of Federal Regulations (10 CFR) 50.90, "Application for amendment of license, construction permit, or early site permit," and 10 CFR 50.91(a)(6), "Notice for public comment; State consultation," Florida Power & Light Company (FPL) is submitting an exigent request for an amendment to Facility Operating License No. DPR-67 for St. Lucie Unit 1 for Nuclear Regulatory Commission (NRC) approval.

FPL is requesting a change in the allowed outage time (AOT) for an inoperable emergency diesel generator (EDG). The current AOT allowed by Technical Specification (TS) 3/4.8.1 Action b is 14 days. FPL is requesting a one-time AOT extension for 30 days. The LAR justification and the exigent nature of the request are contained in the enclosure. Accordingly, FPL is requesting this proposed TS change under exigent circumstances, and requests that the NRC expedite the review of the requested change to support approval by July 28, 2019.

Attachment 1 of the enclosure provides a markup of the affected TS, the second attachment provides the word processed TS change, and the third attachment contains the PRA Evaluation of Risk Impact. The St. Lucie Onsite Review Group have reviewed this amendment request and concluded that operation of St. Lucie Unit 1 in accordance with the proposed change will not endanger the health and safety of the public.

FPL has determined that there are no significant hazards considerations associated with the proposed change and that the TS change qualifies for a categorical exclusion from environmental review pursuant to the provisions of 10 CFR 51.22(c)(9). Additionally, in accordance with 10 CFR 50.91(b)(1), FPL is sending a copy of this letter and enclosure to the Florida Department of Health.

This submittal contains a commitment to maintain the compensatory measures (contained in section 3.3 of the enclosure) in effect during the extended AOT time period. Please address any questions regarding this request to Wyatt Godes at 772-467-7435.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on **JUL 19 2019**

Respectfully,



For

Dan DeBoer
St. Lucie Nuclear Plant
Site Director

cc (Enclosure):

NRC Regional Administrator – Region II
NRC Senior Resident Inspector – St. Lucie Nuclear Plant
NRC Project Manager – St. Lucie Nuclear Plant
Director, Division of Radiological Health – Florida State Department of Health

St. Lucie Unit 1

EVALUATION OF PROPOSED CHANGE

Exigent Technical Specification Amendment Request
One-Time Allowed Outage Time Extension for Inoperable EDG

Table of Contents

1.0	SUMMARY DESCRIPTION	2
2.0	DETAILED DESCRIPTION	2
2.1	System Description and Operation.....	2
2.2	Current Technical Specification Requirements	3
2.3	Reason for the Proposed Change / Basis for Exigent Circumstances	3
2.4	Cause Determination / Common Cause Evaluation	4
2.5	Description of the Proposed Technical Specification Change	5
3.0	TECHNICAL EVALUATION.....	5
3.1	Deterministic Evaluation	5
3.2	Risk Assessment.....	6
3.3	Compensatory Actions	7
4.0	REGULATORY EVALUATION	7
4.1	Applicable Regulatory Requirements/Criteria	8
4.2	No Significant Hazards Consideration Determination Analysis.....	9
4.3	Conclusion	10
5.	ENVIRONMENTAL CONSIDERATION	10
	REFERENCES	11

ATTACHMENTS

1. Proposed TS Changes (Mark-Ups) for St. Lucie Unit 1
2. Proposed TS Changes (Final Typed) for St. Lucie Unit 1
3. PRA Evaluation of Risk Impact

1.0 SUMMARY DESCRIPTION

Pursuant to Title 10 of the Code of Federal Regulations (10 CFR) 50.90, "Application for amendment of license, construction permit, or early site permit," and 10 CFR 50.91(a)(6), "Notice for public comment; State consultation," Florida Power & Light Company (FPL) is requesting an exigent license amendment to amend the St. Lucie Unit 1 Technical Specifications (TS). The proposed exigent license amendment request (LAR) submits a one-time change to St. Lucie Unit 1 TS 3/4.8.1, "Electrical Power Systems, AC Sources, Operating," for Nuclear Regulatory Commission (NRC) approval. The proposed exigent LAR requests a one-time extension of the Action b Allowed Outage Time (AOT) for an inoperable emergency diesel generator (EDG) from 14 days to 30 days.

On July 15, 2019, at 0736 hours the 1B EDG was declared out of service (OOS) to support its surveillance run. At 0919 hours, while performing the surveillance run, the 1B EDG unexpectedly tripped on high water temperature. Subsequent investigation revealed that 1B2 Engine radiator fan was not rotating because the coupling between the crank shaft and stub shaft that drives the radiator fan failed from a fatigue mechanism. Furthermore, FPL determined that the EDG repairs require an extensive disassembly and refurbishment of the 1B2 EDG engine and will challenge the current AOT of 14 days.

Accordingly, FPL requests approval of the TS change by July 28, 2019, and that the implementation of the revised TS be effective immediately to avoid an unnecessary operational transient to initiate a plant shutdown. The opposite train EDG, opposite unit EDGs, station black out (SBO) crosstie breakers, and off-site power sources remain operable.

The inoperability of the 1B EDG has been entered into the St. Lucie Corrective Action Program (CAP). As part of the CAP, FPL will evaluate the cause of the failure to determine if there is any generic applicability for similar FPL/NextEra Energy EDGs.

2.0 DETAILED DESCRIPTION

2.1 System Description and Operation

The normal source of auxiliary AC power for plant start-up or shutdown is from the incoming off-site transmission lines through the plant switchyard and start-up transformers. The start-up transformers step down the 230 kV incoming line voltage to 6.9 kV and 4.16 kV for auxiliary system use. During normal plant operation, AC power is provided from the main generator through the unit auxiliary transformers. The unit auxiliary transformers step down the main generator output voltage from 22 kV to 6.9 kV and 4.16 kV.

In the event of a complete loss of the normal offsite AC power sources, i.e. Loss of Offsite Power (LOOP), station on-site emergency AC power system will be supplied by the on-site EDGs and station batteries.

The 4.16 kV system consists of normal and emergency buses. Normal buses provide power to loads which are non-safety related. All safety related loads are powered from the emergency buses. There are two normal buses (1A2 and 1B2) which receive power directly from the unit auxiliary or start-up transformers.

The emergency portion of the 4.16 kV system is arranged into two redundant load groups (A and B). Each of these load groups consists of the complement of safety related equipment needed to achieve safe plant shutdown and/or to mitigate the consequences of a design basis accident. Additional safety related

equipment (e.g., the third component cooling and intake cooling water pumps) is arranged as a "third service" or "swing" load group AB. This load group consists of equipment which can be used as back-up or replacement to the equipment in either of the main redundant load groups A or B. Load group A is powered from the emergency bus 1A3 and load group B from the emergency bus 1B3. Emergency bus 1AB serves load group AB. Additionally, the two safety related "swing" 4.16 kV busses 1AB and 2AB can be inter-connected between Units 1 and 2 via the SBO crosstie connection.

Whenever the normal power sources are available, power is supplied directly to the 4.16 kV system through the two normal buses, each of which is tied to one of the redundant emergency buses. Emergency bus 1AB is normally tied to either (but never both) emergency bus 1A3 or 1B3. The tie breakers of bus 1AB are interlocked electrically to prevent this bus from being simultaneously connected to both buses 1A3 and 1B3.

Upon a loss of the normal power sources, the crosstie breakers between the normal and emergency buses will automatically open and the EDGs will automatically start and begin supplying power directly to the emergency buses.

The standby AC power source consists of two redundant EDGs, their attendant air starting and fuel supply system, and automatic control circuitry. The EDGs supply power to those electrical loads which are needed to achieve safe shutdown of the plant or to mitigate the consequences of a loss of coolant accident (LOCA) in the event of a coincident LOOP.

Each diesel generator consists of two diesel engines mounted in tandem with a 3500 kw generator coupled directly between the engines. Each engine in each diesel generator set has a self-contained cooling system which consists of a forced circulation cooling water system which cools the engine directly and an air cooled radiator system which removes the heat from the cooling water. The cooling water pump and radiator fan are driven directly from the engine crankshaft. After starting, the diesel generator set cooling system requires no external source of power and does not depend on any plant cooling system.

2.2 Current Technical Specification Requirements

The TS requirements for an inoperable EDG are as stated in TS 3/4.8.1 Action b. The relevant part applicable to this one-time AOT extension is that with one diesel generator inoperable, restore the diesel generator to OPERABLE status within 14 days or be in at least HOT STANDBY within the next 6 hours and in HOT SHUTDOWN within the following 6 hours.

On July, 15, 2019, at 0736 hours the 1B EDG was declared out of service (OOS) to support its surveillance run. At 0919 hours, while performing the surveillance run, the 1B EDG unexpectedly tripped on high water temperature. The 1B EDG continues to remain OOS for repairs, and the current TS 3/4.8.1 Action b AOT expires on July 29, 2019 at 0736 hours.

2.3 Reason for the Proposed Change / Basis for Exigent Circumstances

The 14-day AOT of TS 3/4.8.1 Action b expires on July 29, 2019, at 0736 EDT, which requires the plant to be in at least HOT STANDBY within the next 6 hours and in HOT SHUTDOWN within the following 6 hours. On July 17, 2019, FPL determined that the 1B2 EDG engine repair scope will challenge the current AOT, and provide little margin for contingencies.

FPL could not have reasonably anticipated the failure of the 1B2 EDG engine. There was no adverse maintenance history concerning this component. Past surveillances were all satisfactory. A surveillance summary is provided below:

	DATE
1B EDG POWERPACK REPLACEMENT CMM	6/18/2018
1B EDG SURVEILLANCE - MONTHLY	6/25/2018
1B EDG SURVEILLANCE - FAST START	7/16/2018
1B EDG SURVEILLANCE - MONTHLY	8/20/2018
1B EDG SURVEILLANCE - MONTHLY	9/17/2018
1B EDG SURVEILLANCE - MONTHLY	10/19/2018
1B EDG SURVEILLANCE - MONTHLY	11/26/2018
1B EDG SURVEILLANCE - MONTHLY	12/17/2018
1B EDG SURVEILLANCE - FAST START	1/15/2019
1B EDG SURVEILLANCE - MONTHLY	2/18/2019
1B EDG SURVEILLANCE - MONTHLY	3/18/2019
1B EDG SURVEILLANCE - MONTHLY	4/15/2019
1B EDG SURVEILLANCE - FAST START including 24 hr run	5/24/2019
1B EDG SURVEILLANCE - MONTHLY	6/17/2019

Based on the information in Section 3.2 of this enclosure, a forced outage to repair the 1B2 EDG engine would result in an unnecessary transient to the unit.

2.4 Cause Determination / Common Cause Evaluation

Due to the emergent nature of the event, FPL has not completed a full cause evaluation at this time. However, FPL's preliminary inquiry determined that the 1B2 EDG engine failure was caused by the failure of the radiator fan accessory drive coupling from a fatigue mechanism. The initial visual assessment indicates that the driving loads were a combination of both torsional and cyclic bending stresses. Engineering has identified numerous conditions that could result in high torsional or cyclic bending loads on the crankshaft, such as nonfunctioning crankshaft vibration dampener, misalignment of the fan power take off (PTO) hollow shaft to the crankshaft coupling, bearing issues, or alignment of the PTO bearing pedestal.

Past operational history revealed that in 1988, and again in 1991, the 1B2 engine fan idler pulley shaft failed. The fan idler pulley is the tension device for the fan belts, and those failures may have caused some loading on the drive shaft, ultimately contributing to the high torsional or cyclic bending loads on the crankshaft. This scenario will be vetted in the ongoing investigation into the shaft failure. The search found no similar failures on any other of the St. Lucie EDGs that may have contributed to stress concentrations in the coupling. The health of the 1A EDG was verified by successful surveillance history and the 1A EDG radiator couplings were intact when the EDG was barred over.

Repair will require an extensive disassembly and refurbishment of the 1B2 EDG engine. An aggressive repair schedule has been developed for this repair. The current estimate returns the EDG to service within the 14 day AOT, but does not allow for any additional discovery. Although PRA shows that the current AOT could be extended well past 30 days, FPL is proposing an extended AOT consistent with the Risk Informed Completion

Time backstop of 30 days (Reference 2).

2.5 Description of the Proposed Technical Specification Change

The proposed change revises TS 3/4.8.1 Action b with "***" indicating an applicable Note to the "... within 14 days**" portion of the Action. The Note states "*** A one-time AOT extension for the inoperable 1B EDG allows 30 days to restore the EDG to OPERABLE status. This extension expires on August 14, 2019 at 0736 hours."

Attachment 1 to this enclosure provides the existing St. Lucie Unit 1 TS page marked up to show the proposed changes. Attachment 2 to this enclosure provides the proposed St. Lucie Unit 1 TS page retyped to show the changes incorporated.

There are no TS Bases changes associated with this proposed change.

3.0 TECHNICAL EVALUATION

3.1 Deterministic Evaluation

During the proposed AOT extension, Units 1 and 2 will be in Mode 1. None of the EDGs (1A, 2A, and 2B) or offsite power sources are affected by the 1B EDG maintenance and remain operable. As such, sufficient AC power supplies remain available to perform the safety function.

EDG capacity is such that any three of the four diesels can supply all required loads for the safe shutdown of both units without offsite power. Each of the four EDGs can supply one of the four separate Class 1E emergency busses. Each is started automatically on a loss of offsite power (LOOP) or Loss of Coolant Accident (LOCA). The EDG arrangement provides adequate capacity to supply the ESF loads for the Design Basis Accident, assuming the failure of a single active component in the system.

Since the EDGs can accommodate a single failure, the one-time extension of the AOT for an inoperable EDG has no impact on the system design basis. Safety analyses acceptance criteria as provided in the Updated Final Safety Analysis Report (UFSAR) are not impacted by this change. AC power sources credited in the accident analyses will remain the same.

To ensure that the single failure design criterion is met, LCOs are specified in the plant TS requiring all redundant components of the onsite power system to be operable. In the event that an EDG is inoperable in Modes 1, 2, and 3, existing TS 3/4.8.1 Action b. requires verification of the operability of the offsite circuits on a more frequent basis. When the required redundancy is not maintained, action is required within the specified AOTs to initiate the required actions for a loss of function. The AOT provides a limited time to restore equipment to operable status and represents a balance between the risk associated with continued plant operation with less than the required system or component redundancy and the risk associated with initiating a plant transient while transitioning the unit based on the loss of redundancy. Thus, the acceptability of the maximum length of the extended AOT interval relative to the potential occurrences of design basis events is considered. Since extending the AOT for a single inoperable EDG does not change the design basis for the standby emergency power system (i.e., EDGs), the one-time extension of the TS 3/4.8.1 Action b AOT is acceptable.

St. Lucie's coping time during SBO is not affected by the proposed change. The coping time is calculated based on guidance provided in Nuclear Utility Management and Resource Council (NUMARC) 87-00, Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors, Revision 1, August 1991 (i.e., Reference 1). During a SBO, the most significant requirement is to quickly restore AC power.

To accomplish the above, SBO flow charts and associated text procedures provide instructions for coping with a SBO or an Extended Loss of All AC Power (ELAP). These coping methodologies are not changed by the proposed one-time extension of the TS 3/4.8.1 Action b AOT.

3.2 Risk Assessment

A quantitative and qualitative analyses of risk was performed to support the conclusion that the change in risk associated with the proposed one-time AOT increase of the 1B EDG is acceptable, and is calculated consistent with NRC guidance documents.

The following tables document the Probabilistic Risk Assessment (PRA) conducted in support of the proposed one-time Technical Specifications (TS) change to extend the AOT from 14 days to a total of 30 days associated with 1B EDG being inoperable. Because the proposed change is not considered a permanent change to the AOT, the following acceptance guidelines from Regulatory Guide 1.177 (Ref. 2) are applicable for evaluating the risk associated with one-time only AOT changes:

- ICCDP of less than 1.0E-06 and ICLERP of less than 1.0E-07, or
- ICCDP of less than 1.0E-05 and ICLERP of less than 1.0E-06 with effective compensatory measures implemented to reduce the sources of increased risk.

The results of quantification are presented in Tables 4.1-1 below.

Table 4.1-1: PSL Unit 1 ΔCDF and ΔLERF Hazard Breakdown					
		Internal Events	Internal Flood	Fire	Total
CDF	BASE CASE	3.55E-06	7.58E-07	4.31E-05	
	1B EDG OUT OF SERVICE	3.62E-06	7.58E-07	7.12E-05	
	ΔCDF	7.00E-08	1.62E-10	2.81E-05	2.82E-05
LERF	BASE CASE	4.22E-07	4.41E-07	8.44E-07	
	1B EDG OUT OF SERVICE	4.33E-07	4.41E-07	8.66E-07	
	ΔLERF	1.10E-08	3.00E-11	2.20E-08	3.30E-08
<i>Note: CDF and LERF results presented as "at-power" results for this onetime CT extension, instead of annualized like would be presented in a permanent plant change.</i>					

The ICCDP and ICLERP are presented in Table 4.1-2 is based on an overall 1B EDG CT of 30 days, including the 14 days associated with the current TS limit.

Table 4.1-2: ICCDP and ICLERP for Technical Specification Extension	
Based on Total Completion Time	Per Day

ICCDP	ICLERP	ICCDP	ICLERP
2.32E-06	2.71E-09	7.73E-08	9.05E-11
<i>The ICCDP and ICLERP values were calculated using the following equations:</i> $ICCDP = \Delta CDF * (30/365) \quad ICLERP = \Delta LERF * (30/365)$			

The risk results presented in the above tables are shown to not pose a significant challenge to the risk level as presented in RG 1.177 for one-time CT changes.

The Risk Assessment is provided in full in Attachment 3 to this enclosure.

3.3 Compensatory Actions

The following are compensatory actions that will be in place during the extended AOT which will help substantially mitigate the added Internal Events risk from having the 1B EDG OOS:

1. No Load Threatening Tests or Maintenance activities will be allowed.
2. Ensure opposite train tests and surveillances are rescheduled.

From ADM-17.16, Implementation of the Configuration Risk Management Program, requires the following RMAs while in the extended AOT:

- Conduct a plant fire protection walkdown of the areas that could impact EDG availability, offsite power availability, or the ability to use the SBO crosstie prior to entering the extended AOT.
- Perform a thermographic examination of high risk potential ignition sources in the Cable Spreading Room and the Control Room prior to entering the extended AOT.
- Restrict planned hot work in the Cable Spreading Room and Control Room during the extended AOT.
- Establish a continuous fire watch in the Cable Spreading Room when in the extended AOT.
- Switchyard work will be prohibited while the EDG is OOS.
- A Unit 2 EDG or the SBO crosstie shall only be removed from service for corrective maintenance required to ensure or restore operability of the equipment.
- Ensure that the relevant Guarded Equipment protected train measures have been taken.
- Validate availability of the minimum required fire detection and/or functional suppression systems in the identified important Fire Zones to be protected per ADM-17.16 Attachment 1. If not met, then initiate fire watches in the affected zones in accordance with the Fire Protection Plan.
- Brief operators and fire team members on the significance of a fire in the identified important fire zones to be protected.

In addition to the above compensatory measures, existing plant procedures address monitoring weather conditions, and ensuring that actions are taken in the event adverse conditions are expected on-site. These actions, relevant during Hurricane Season, include housekeeping, flooding, and high wind preparation considerations. Also, the procedure places the unit outside the EDG limiting condition of operation (LCO) applicability for operating units (i.e., MODES 1 or 2) by directing a shutdown to at least HOT STANDBY (for Category 1, 2, or 3 hurricanes) or COLD SHUTDOWN (for Category 4 or 5 hurricanes) at least two hours prior to the onset of hurricane force winds at the site.

4.0 REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements/Criteria

10 CFR 50.36(c)(2)(ii), stipulates that a TS Limiting Condition for Operation must be established for each item meeting one or more of the following criteria:

- Installed instrumentation that is used to detect, and indicate in the Control Room, a significant abnormal degradation of the reactor coolant pressure boundary.
- A process variable, design feature, or operating restriction that is an initial condition of a design basis accident or transient analysis that either assumes the failure of, or presents a challenge to the integrity of a fission product barrier.
- A structure, system, or component that is part of the primary success path and which functions or actuates to mitigate a design basis accident or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.
- A structure, system, or component which operating experience or PRA has shown to be significant to public health and safety.

The proposed changes do not modify any plant equipment that provides emergency power to the safety-related emergency busses. Evaluation of the proposed changes has determined that the reliability of AC electrical sources is not significantly affected by the proposed changes and that applicable regulations and requirements continue to be met.

The St. Lucie design was reviewed for construction under the General Design Criteria for Nuclear Power Plant Construction, issued for comment by the Atomic Energy Commission (AEC) in July 1967 and is committed to meet the intent of the General Design Criteria (GDC), published in the Federal Register on May 21, 1971, as Appendix A to 10 CFR Part 50.

GDC 17 requires that nuclear power plants have onsite and offsite electric power systems to permit the functioning of SSCs that are important to safety. The onsite system is required to have sufficient independence, redundancy, and testability to perform its safety function, assuming a single failure. The offsite power system is required to be supplied by two physically independent circuits that are designed and located so as to minimize, to the extent practical, the likelihood of their simultaneous failure under operating and postulated accident and environmental conditions. The proposed change does not affect St. Lucie's compliance with the intent of GDC 17.

GDC 18, Inspection and testing of electric power systems, states that electric power systems that are important to safety must be designed to permit appropriate periodic inspection and testing of important areas and features, such as insulation and connections to assess the continuity of the systems and the condition of their components. The proposed change does not affect St. Lucie's compliance with the intent of GDC 18.

Section 50.63(a) of 10 CFR, Loss of all alternating current power, requires that each lightwater-cooled nuclear power plant licensed to operate be able to withstand for a specified duration and recover from a station blackout. The proposed change does not affect St. Lucie's compliance with 10 CFR 50.63(a).

Therefore, based on the considerations discussed above:

1. There is a reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner;

2. Such activities will be conducted in compliance with the Commission's regulations; and
3. Issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

FPL has determined that the proposed change does not require any exemptions or relief from regulatory requirements, other than the TS, and does not affect conformance with the intent of any GDC differently than described in the Safety Analysis Report.

4.2 No Significant Hazards Consideration Determination Analysis

FPL is requesting that, on a one-time basis, the AOT for Technical Specification 3/4.8.1, Action b, be extended from the original 14 days to 30 days for the 1B EDG. The exigent license amendment request is requested in order to avoid an unnecessary shutdown of St. Lucie Unit 1 without a commensurate benefit in nuclear safety.

FPL has evaluated whether a significant hazards consideration is involved with the proposed amendment(s) by focusing on the three standards set forth in 10 CFR 50.92, Issuance of amendment, as discussed below:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No

The proposed license amendment provides a one-time 30 day AOT allowance in TS 3/4.8.1, Action b for one EDG. This change will have no effect on accident probabilities since the EDGs are not considered accident initiators. The proposed AOT extension does not require any physical plant modifications. Since no individual precursors of an accident are affected, the proposed amendment does not increase the probability of a previously analyzed event.

The consequences of an evaluated accident are determined by the operability of plant systems designed to mitigate those consequences. The EDGs are backup power to components that mitigate the consequences of accidents. The current TSs normally permit a single EDG to be inoperable for up to 14 days. The proposed license amendment extends the current AOT for the 1B EDG on a one-time basis, to no more than a total of 30 days. The proposed change does not affect any of the assumptions used in deterministic safety analysis. Granting the proposed change will not adversely affect the consequences of an accident previously evaluated.

Therefore, the proposed amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No

Creation of the possibility of a new or different kind of accident requires creating one or more new accident precursors. New accident precursors may be created by modifications of plant configuration, including changes in allowable modes of operation.

The proposed amendment provides a one-time allowance of a 30 day AOT for TS 3/4.8.1, Action b. This change does not involve a modification or the physical configuration of the plant (i.e., no new equipment will be installed), create any new failure modes for existing equipment, or create any new limiting single failures. The plant equipment considered available when evaluating the existing AOT remains unchanged. The extended AOT will permit completion of repair activities without incurring transient risks associated with performing a unit shutdown with the EDG unavailable.

Therefore, the proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

Response: No

The proposed license amendment provides a risk-informed, one-time allowance of a 30 day AOT for TS 3/4.8.1, Action b. A deterministic evaluation of the proposed AOT demonstrates there is sufficient margin to safety during the extended EDG AOT period. During the extended AOT times, sufficient compensatory measures will be established to maintain the defense-in-depth design philosophy to ensure the electrical power system meets its design safety function.

Therefore, the proposed amendment does not result in a significant reduction in the margin of safety.

Based on the above, FPL concludes that the proposed amendment presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

4.3 Conclusion

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

5. ENVIRONMENTAL CONSIDERATION

A review has determined that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or a significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment needs to be prepared in connection with the proposed amendment.

REFERENCES

1. Nuclear Utility Management and Resource Council (NUMARC) 87-00, Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors, Revision 1, August 1991.
2. NRC SER - Issuance of Amendment Nos. 247 and 199 Regarding Adoption of Risk-Informed Completion Times in Technical Specifications (CAC NOS. MF5372 AND MF5373; EPID L-2014-LLA-0001), dated July 2, 2019. ADAMS Accession No. ML19113A099.
3. NRC SER – Issuance of Amendment Regarding Diesel Generator Allowed Outage Time Extension (TAC NO. MA205), dated January 19, 2001.
4. St. Lucie Unit 1 UFSAR amendment 29.

Attachment 1

Proposed TS Changes (Mark-Ups) for St. Lucie Unit 1

3/4.8 ELECTRICAL POWER SYSTEMS

3/4.8.1 A.C. SOURCES

OPERATING

LIMITING CONDITION FOR OPERATION

3.8.1.1 As a minimum, the following A.C. electrical power sources shall be OPERABLE:

- a. Two physically independent circuits between the offsite transmission network and the onsite Class 1E distribution system, and
- b. Two separate and independent diesel generator sets each with:
 1. Engine-mounted fuel tanks containing a minimum of 152 gallons of fuel,
 2. A separate fuel storage system containing a minimum of 19,000 gallons of fuel, and
 3. A separate fuel transfer pump.

APPLICABILITY: MODES 1, 2, 3 and 4.

ACTION:

- a. With one offsite circuit of 3.8.1.1.a inoperable, except as provided in Action f. below, demonstrate the OPERABILITY of the remaining A.C. sources by performing Surveillance Requirement 4.8.1.1.1.a within 1 hour and at least once per 8 hours thereafter. Restore the offsite circuit to OPERABLE status within 72 hours or be in at least HOT STANDBY within the next 6 hours and HOT SHUTDOWN within the following 6 hours. LCO 3.0.4.a is not applicable when entering HOT SHUTDOWN.
- b. With one diesel generator of 3.8.1.1.b inoperable, demonstrate the OPERABILITY of the A.C. sources by performing Surveillance Requirement 4.8.1.1.1.a within 1 hour and at least once per 8 hours thereafter; and if the EDG became inoperable due to any cause other than an inoperable support system, an independently testable component, or preplanned preventative maintenance or testing, demonstrate the OPERABILITY of the remaining OPERABLE EDG by performing Surveillance Requirement 4.8.1.1.2.a.4 within 8 hours, unless it can be confirmed that the cause of the inoperable EDG does not exist on the remaining EDG*, restore the diesel generator to OPERABLE status within 14 days or be in at least HOT STANDBY within the next 6 hours and in HOT SHUTDOWN within the following 6 hours. LCO 3.0.4.a is not applicable when entering HOT SHUTDOWN. Additionally, within 4 hours from the discovery of concurrent inoperability of required redundant feature(s) (including the steam driven auxiliary feed pump in MODE 1, 2, and 3), declare required feature(s) supported by the inoperable EDG inoperable if its redundant required feature(s) is inoperable.

* If the absence of any common-cause failure cannot be confirmed, this test shall be completed regardless of when the inoperable EDG is restored to OPERABILITY.

** A one-time AOT extension for the inoperable 1B EDG allows 30 days to restore the EDG to OPERABLE status. This extension expires on August 14, 2019 at 0736 hours.

Attachment 2

Proposed TS Changes (Final Typed) for St. Lucie Unit 1

3/4.8 ELECTRICAL POWER SYSTEMS

3/4.8.1 A.C. SOURCES

OPERATING

LIMITING CONDITION FOR OPERATION

3.8.1.1 As a minimum, the following A.C. electrical power sources shall be OPERABLE:

- a. Two physically independent circuits between the offsite transmission network and the onsite Class 1E distribution system, and
- b. Two separate and independent diesel generator sets each with:
 1. Engine-mounted fuel tanks containing a minimum of 152 gallons of fuel,
 2. A separate fuel storage system containing a minimum of 19,000 gallons of fuel, and
 3. A separate fuel transfer pump.

APPLICABILITY: MODES 1, 2, 3 and 4.

ACTION:

- a. With one offsite circuit of 3.8.1.1.a inoperable, except as provided in Action f. below, demonstrate the OPERABILITY of the remaining A.C. sources by performing Surveillance Requirement 4.8.1.1.1.a within 1 hour and at least once per 8 hours thereafter. Restore the offsite circuit to OPERABLE status within 72 hours or be in at least HOT STANDBY within the next 6 hours and HOT SHUTDOWN within the following 6 hours. LCO 3.0.4.a is not applicable when entering HOT SHUTDOWN.
- b. With one diesel generator of 3.8.1.1.b inoperable, demonstrate the OPERABILITY of the A.C. sources by performing Surveillance Requirement 4.8.1.1.1.a within 1 hour and at least once per 8 hours thereafter; and if the EDG became inoperable due to any cause other than an inoperable support system, an independently testable component, or preplanned preventative maintenance or testing, demonstrate the OPERABILITY of the remaining OPERABLE EDG by performing Surveillance Requirement 4.8.1.1.2.a.4 within 8 hours, unless it can be confirmed that the cause of the inoperable EDG does not exist on the remaining EDG*; restore the diesel generator to OPERABLE status within 14 days** or be in at least HOT STANDBY within the next 6 hours and in HOT SHUTDOWN within the following 6 hours. LCO 3.0.4.a is not applicable when entering HOT SHUTDOWN. Additionally, within 4 hours from the discovery of concurrent inoperability of required redundant feature(s) (including the steam driven auxiliary feed pump in MODE 1, 2, and 3), declare required feature(s) supported by the inoperable EDG inoperable if its redundant required feature(s) is inoperable.

* If the absence of any common-cause failure cannot be confirmed, this test shall be completed regardless of when the inoperable EDG is restored to OPERABILITY.

** A one-time AOT extension for the inoperable 1B EDG allows 30 days to restore the EDG to OPERABLE status. This extension expires on August 14, 2019 at 0736 hours.

Attachment 3

PRA EVALUATION OF RISK IMPACT

PRA EVALUATION OF RISK IMPACT

This evaluation provides the details of the quantitative and qualitative analyses of risk used to support the conclusion that the change in risk associated with the proposed one-time Completion Time (CT) increase of the 1B Emergency Diesel Generator (EDG) is acceptable, and is calculated consistent with NRC guidance documents. The impact of internal events, internal flood, and fire is calculated quantitatively and external hazards are addressed qualitatively. The site is in hurricane season and has a specific procedure for guidance to apply appropriate risk management actions.

The PRA model does consider common cause aspects, however; the current 1B diesel crankshaft failure is anticipated to be a fatigue failure. The U2 diesels are newer and there is no indication of similar issue. The OE search has also shown no industry OE on this failure mechanism. Refer to section 2.4 for more information.

Attachment 3

Risk Evaluation

1.0 PRA SCOPE AND APPLICABLE HAZARDS

The change in risk associated with the one-time increase in the CT for the 1B EDG during operation in Mode 1 has been evaluated for St. Lucie Unit 1 (PSL1) in accordance with the guidance of RG 1.177. Hazard groups were evaluated to determine which sources of risk could affect the decision, and the risk from such hazards was assessed quantitatively.

Section 2.3.2 of RG 1.177 identifies the NRC's regulatory position on PRA scope, and states, in part:

"...in some cases, a PRA of sufficient scope may not be available. This will have to be compensated for by qualitative arguments, bounding analyses, or compensatory measures."

This section further states, in part:

"...The scope of the analysis should include all hazard groups...unless it can be shown that the contribution from specific hazard groups does not affect the decision."

RG 1.174, Section 2.3.1 further clarifies this concept:

"...A qualitative treatment of the missing modes and hazard groups may be sufficient when the licensee can demonstrate that those risk contributions would not affect the decision; that is, they do not alter the results of the comparison with the acceptance guidelines..."

Consistent with this regulatory guidance, it was determined that the change in risk associated with internal events, internal flooding, fire, and high winds due to tornadoes could affect the decision. Risk associated with seismic, external flooding, and high winds due to hurricanes have been dealt with qualitatively in each respective section.

The impact of the proposed one-time TS change for this application on the risk metrics Delta Core Damage Frequency (Δ CDF), Incremental Conditional Core Damage Probability (ICCDP), Delta Large Early Release Frequency (Δ LERF), and Incremental Conditional Large Early Release Probability (ICLERP) were evaluated with the PSL1 plant specific PRA models which include: Level 1 Internal Events model, a Level 1 Internal Flooding model, and a Level 1 Fire Model and associated LERF models.

2.0 PRA TECHNICAL ADEQUACY

All the PRA models used to quantitatively evaluate this one time CT extension have been peer reviewed and there are no PRA upgrades that have not been peer reviewed. The PRA models credited in this request are the same PRA models credited in license amendment request "Transition to 10 CFR 50.48(c) - NFPA 805 Performance-Based Standard for Fire Protection for Light Water Reactor Generating Plants (2001 Edition)", which was approved on March 31, 2016, and license amendment request "Application for Technical Specification Change Regarding Risk-Informed Justifications for the Relocation of Specific Surveillance Frequency Requirements to a Licensee Controlled Program," which was approved June 22,

Attachment 3

2015, with routine maintenance and updates applied.

The PRA models have been assessed against RG 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," Revision 2 consistent with NRC RIS 2007-06.

The internal events PRA model was subject to:

- a full-scope peer review in July 2002
- a Self-Assessment to RG 1.200 October 2007
- a focused-scope peer review (LERF) July 2009
- a focused-scope peer review (CCF) August 2009
- a Self-Assessment in November 2009
- a focused -scope peer review (DA, HR) in April 2011
- a focused -scope peer review (ISLOCA) in 2013
- a Self-Assessment to RG 1.200 Rev 2 March 2014

The Internal Events PRA model was peer reviewed in 2002 by the Combustion Engineering Owners Group (CEOG) prior to the issuance of Regulatory Guide 1.200. As a result, a self-assessment was conducted by FPL of the Internal Events PRA model in accordance with Appendix B of RG 1.200 Revision 2 to address the PRA technical adequacy requirements not considered in the 2002 peer review. The Internal Events PRA technical adequacy (including the 2002 peer review and self-assessment results) has previously been reviewed by the NRC in previous applications for transition to NFPA-805 and relocation of surveillance frequency requirements to licensee control. No PRA upgrades as defined by the ASME PRA Standard RA-Sa-2009 have occurred to the Internal Events PRA model since conduct of the CEOG peer review in 2002 that have not had a subsequent focused peer review to Appendix B of RG 1.200 Revision 2.

The internal floods PRA model was subject to a focused scope peer review in April 2011.

The Fire PRA model was subject to:

- a full-scope peer review of the PSL Fire PRA model June 2011.
- a focused-scope peer review (FSS) May 2013.
- a focused-scope peer review (FQ) June 2013.

A finding closure review was conducted on the identified PRA models in September 2017 and May 2019. Closed findings were reviewed and closed using the process documented in Appendix X to NEI 05-04, NEI 07-12 and NEI 12-13, "Close-out of Facts and Observations" (F&Os) as accepted by NRC in the staff memorandum dated May 3, 2017 (ML17079A427). The results of this review have been documented and are available for NRC audit. The results of this assessment were all Internal Events and all Internal

Attachment 3

Flood Finding Level F&Os closed. There are three Finding Level F&Os on the Internal Fire model. These three findings were reviewed and assessed to not have impact on this application.

This information demonstrates that the PRA is of sufficient quality and level of detail to support the categorization process, and has been subjected to a peer review process assessed against a standard or set of acceptance criteria that is endorsed by the NRC as required 10 CFR 50.69(c)(1)(i).

3.0 ONE-TIME COMPLETION TIME EXTENSION MODEL CHANGES

The following changes were made to the baseline model to form the application-specific model configuration:

1. The 1B EDG unavailability probability was set to 1.0 to reflect the diesel generator being out of service during the extended completion time.
2. The 1A, 2A, and 2B Diesel Generators, as well as 2 methods of station blackout cross ties to the other units assumed to be protected during the extended completion time.
3. All analyzed models were evaluated for the at-power (Mode 1) condition to determine CDF and LERF significance.
4. Common cause failures associated with common cause failure group EDGs 1A, 1B, 2A, and 2B were assumed with nominal values.

3.1 TREATMENT OF COMMON CAUSE FAILURES (CCFS)

The potential impact of the 1B EDG event on the reliability of the other EDGs was evaluated and was judged that there are no specific common cause failure concerns on the other EDGs. The preliminary investigation indicates that degradation of the 1B EDG crankshaft occurred due to fatigue failure. The U2 diesels are newer and have not experienced similar events or shown related or relevant adverse trends in their performance. The OE search has also shown no industry OE on this failure mechanism. Therefore, the apparent problems with the 1B EDG crankshaft are not considered to be present in other EDGs.

Attachment 3

4.0 QUANTITATIVE EVALUATION OF RISK

4.1 OVERALL RISK RESULTS

The following tables document the Probabilistic Risk Assessment (PRA) conducted in support of the proposed one-time Technical Specifications (TS) change to extend the CT from 14 days to a total of 30 days associated with 1B EDG being inoperable. Because the proposed change is not considered a permanent change to the CT, the following acceptance guidelines from Regulatory Guide 1.177 are applicable for evaluating the risk associated with one-time only CT changes:

- ICCDP of less than 1.0E-06 and ICLERP of less than 1.0E-07, or
- ICCDP of less than 1.0E-05 and ICLERP of less than 1.0E-06 with effective compensatory measures implemented to reduce the sources of increased risk.

The results of quantification are presented in Tables 4.1-1 below.

Table 4.1-1: PSL Unit 1 ΔCDF and ΔLERF Hazard Breakdown					
		Internal Events	Internal Flood	Fire	Total
CDF	BASE CASE	3.55E-06	7.58E-07	4.31E-05	2.82E-05
	1B EDG OUT OF SERVICE	3.62E-06	7.58E-07	7.12E-05	
	ΔCDF	7.00E-08	1.62E-10	2.81E-05	
LERF	BASE CASE	4.22E-07	4.41E-07	8.44E-07	3.30E-08
	1B EDG OUT OF SERVICE	4.33E-07	4.41E-07	8.66E-07	
	ΔLERF	1.10E-08	3.00E-11	2.20E-08	

Note: CDF and LERF results presented as "at-power" results for this onetime CT extension, instead of annualized like would be presented in a permanent plant change.

The ICCDP and ICLERP are presented in Table 4.1-2 is based on an overall 1B EDG CT of 30 days, including the 14 days associated with the current TS limit.

Table 4.1-2: ICCDP and ICLERP for Technical Specification Extension			
Based on Total Completion Time		Per Day	
ICCDP	ICLERP	ICCDP	ICLERP
2.32E-06	2.71E-09	7.73E-08	9.05E-11

*The ICCDP and ICLERP values were calculated using the following equations:
 $ICCDP = \Delta CDF * (30/365)$ $ICLERP = \Delta LERF * (30/365)$*

The risk results presented in the above tables are shown to not pose a significant challenge to the risk level as presented in RG 1.177 for one-time CT changes.

Attachment 3

Bounding Sensitivity Analysis

An upper-bound analysis was performed to assess the impact of the proposed AOT extension on the average CDF and LERF values. 1B EDG unavailability equivalent to the proposed AOT was assigned to the nominal unavailability such that the 1B EDG total bounding unavailability is equivalent to:

$$(AOT=30 \text{ day} / (365 \text{ day/year})) = 8.22E-02$$

When T&M probability equal to 8.22E-02 was set for the 1B EDG in cutsets associated with CDF and LERF calculations the following results were obtained.

Table 4.1-3: PSL Unit 1 ΔCDF and ΔLERF Hazard Breakdown - Bounding Case					
		Internal Events	Internal Flood	Fire	Total
CDF	BASE CASE	3.55E-06	7.58E-07	4.31E-05	
	1B EDG OUT OF SERVICE	3.56E-06	7.58E-07	4.51E-05	
	ΔCDF	3.55E-06	7.58E-07	4.31E-05	4.74E-05
LERF	BASE CASE	4.22E-07	4.41E-07	8.44E-07	
	1B EDG OUT OF SERVICE	4.23E-07	4.41E-07	8.46E-07	
	ΔLERF	1.00E-09	2.00E-12	2.00E-09	3.00E-09

Table 4.1-4: ICCDP and ICLERP for Technical Specification Extension			
Based on Total Completion Time		Per Day	
ICCDP	ICLERP	ICCDP	ICLERP
1.64E-07	2.47E-10	5.45E-09	8.22E-12

The risk results presented in the above tables for the bounding case are shown to not pose a significant challenge to the risk level as presented in RG 1.177 for one-time AOT changes. Although the bounding results have reduced risk impact compared to risk results of taking the EDG for the entire completion time, the latter risk impact is conservative.

4.2 EVALUATION OF QUANTITATIVE RESULTS INSIGHTS

4.2.1 INTERNAL EVENTS

The resulting CDF and LERF cutsets for this application were reviewed. 1B Diesel generator redundancy for #1A, 2A and 2B does not significantly increase risk.

The top scenario in the delta CDF cutsets includes Small LOCA initiator with failure of startup

Attachment 3

transformer breaker to 4kV bus 1B2 feeding offsite power, unavailability of 1B EDG, and failure of Containment sump recirculation valve MV-07-2A on the opposite train. The top scenario in the delta LERF cutsets includes loss of NSR 4KV SWGR Bus 1B2 initiator with failure of 4KV SWGR Bus 1 B2 failure (annual-basis), failure of secondary heat removal where operator fails to establish SDC following transient, operator fails to maintain AFW due to depleted CST, operator fails to makeup to CST using TWST, operator fails to cross tie to Unit 2 CST, operator fails to makeup using TD-fire pump, and the containment fails early with H2 burn at 50% oxidation.

4.2.2 FIRE

The U1 PSL Fire PRA model used the methodology in NUREG/CR-6850-ERPI TR-1019259 EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities. The fire model produces results which are judged to be conservative based on the successive screening approach which applies increasingly detailed modeling based on the risk importance of the particular area.

The results of the FIRE delta CDF and delta LERF cutsets were reviewed for dominant accident sequences and overall contributors.

The following high fire risk areas will continue to be monitored in accordance with existing fire monitoring program:

- 1-4 - Diesel Oil Storage Tank Area
- 1-44A - 1A Cable Loft Enclosure
- 1-45 - Piping Penetration Room (1B Penetration Room)
- 1-47 - 1AB Switchgear Room
- 1-55E - Main Hallway 19.5'
- 1-55W - Main Hallway 19.5'
- 1-57 - Cable Spreading Room
- 1-6 - Diesel Generator 1A Room
- 1-60 - 4kV Switchgear Room 1A
- 1-61A - HVAC Equipment Area
- 1-70 - 4kV Switchgear Room 1B
- 1-80 - Steam Generator Blowdown Tank Area

The switchgear rooms are the dominant fire risk contributors.

INTERNAL FLOODING

The overall contribution to the total ICCDP and ICLERP for Internal Flooding is small. No additional risk management actions are needed.

Attachment 3

4.3 QUALITATIVE EVALUATIONS

4.3.1 EXTERNAL FLOODING

The potential increase in risk from external flooding while 1B EDG is unavailable is considered negligible due to the plant's design and surrounding topography. For PSL, the evaluated causes of external flooding are hurricane events. The weather is monitored frequently given the emergency diesel outage and if there is a threat of severe weather during the extended technical specification window, severe weather preparations would be made in accordance with site procedures. The procedures contain detailed unit guidelines for storm preparation.

For PSL, the specific major events of concern for external flooding event assessment are the probable maximum hurricane (PMH) and the probable maximum precipitation (PMP). The PSL Integrated Plant Evaluation for External Events (IPEEE) concludes that the St. Lucie Units 1 and 2 designs meet the RG 1.59 and SRP criteria, and thus poses no significant risk of severe accident as a result of external flooding. This is based on the NUREG-1407 statement that plants designed to the criteria in RG 1.59 and applicable SRP sections pose no significant threat of a severe accident.

4.3.2 SEISMIC

Due to the low seismic hazard, St. Lucie Unit 2 has been designated as a reduced-scope plant in NUREG-1407. As discussed in FPL letter L-95-58, Response to Generic Letter 88-20, dated February 17, 1995, in response to GL 87-02, Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors, FPL developed and implemented a site-specific seismic program. In December 1991, FPL committed to use this program as an alternative method to the seismic methodology proposed by the NRC, as discussed in the December 15, 1988 SER for St. Lucie Unit 2. FPL found no seismic vulnerabilities to potential severe accidents.

4.3.3 HIGH WINDS

High winds events at PSL are dominated by hurricane winds. Currently there are no hurricane threats in the Atlantic nor extreme weather predicted across the East Coast that could affect PSL. Therefore, the expected increase in risk from high winds during the exposure period is negligible due to the plant's design and the weather during the exposure period. Weather is monitored continually, and if there were a threat of severe weather, preparations will be made in accordance with plant emergency procedure for response to severe weather warnings. The procedure contains detailed unit guidelines for storm preparation.

The PSL IPEEE evaluated the risk impact of high winds, including hurricanes and tornadoes, and concluded that the PSL design either conforms to the SRP criteria or it has been demonstrated that where the design does not conform, the hazard frequency is acceptably low. The PSL

Attachment 3

design therefore, poses no significant threat of a severe accident as the result of high winds

4.3.4 TRANSPORTATION/NEARBY FACILITY ACCIDENTS

The potential increase in risk from transportation accidents or nearby facility accidents due to having the 1B EDG unavailable was qualitatively considered and determined to be negligible. There is been no change in the risk from these hazards since the IPEEE.

The PSL IPEEE concludes that since the St. Lucie Units 1 and 2 conform to the SRP criteria, there are no significant vulnerabilities to accidents related to nearby transportation routes, or nearby industrial or military facilities.

4.4 PRA UNCERTAINTY ANALYSIS

Reg. Guides 1.174 and 1.177 require that appropriate consideration of uncertainty be given in analysis and interpretation of findings. The impact of uncertainty is characterized and these uncertainties are recognized when assessing whether the principles stated in Reg. Guides 1.174 and 1.177 are being met. The bounding evaluation performed and whose results are listed under Section 4.1 demonstrates that, within reasonable assurance, the numerical risk results of this application lie below the criteria in RG 1.177 even when the uncertainties associated with the PRA model are taken into consideration. Three types of uncertainty are evaluated; parameter uncertainty, model uncertainty, and completeness uncertainty.

These are defined in Reg. Guides 1.174, Reg. Guide 1.177, NUREG 1855, and EPRI Report 1016737. No key sources of uncertainty were identified for this application that would be expected to significantly affect the results.