Florida Power
CORPORATION
Crystal River Unit 3
Docket No. 50-302

September 25, 1997
3F0997-30

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: Supplement to Technical Specification Change Request Notice 210

References:
1. FPC letter dated June 14, 1997 (3F0697-10) "Technical Specification Change Request Notice 210"
2. FPC letter dated August 26, 1997 (3F0897-25) "License Amendment Request 216, EDG Air Handling System"
3. FPC letter dated October 28, 1996 (3F1096-22) "Crystal River Unit 3 Forced Outage"
4. FPC letter dated September 17, 1997 (3F0997-31) "Request for Additional Information related to Emergency Operating Procedures Technical Specifications Change Request Number (TSCRN) 210 (TAC No. M98991)"

A001 1/1

Dear Sir:

Florida Power Corporation (FPC) hereby submits supplemental information as described in Reference 1 which includes, in part, a discussion of the modifications and procedures necessary to implement Technical Specification Change Request Notice (TSCRN) 210. This supplemental information does not alter any conclusions of TSCRN 210. This information completes four of the commitments made in Reference 1.

Background

In TSCRN 210, FPC requested approval of proposed changes to the Technical Specifications, as well as other aspects of the licensing and design basis, to address modifications and procedure changes required to mitigate the consequences of certain small break loss of coolant accidents (SBLOCA). The approval of TSCRN 210 is necessary to resolve identified unreviewed safety questions (USQs) and to permit implementation of modifications and procedures required for plant restart. In order to maximize the time available for NRC review and to support the Crystal River Unit 3 (CR-3) restart schedule, FPC submitted TSCRN 210 as early as practical. This resulted in additional commitments as part of TSCRN 210 to provide supplemental information regarding several ongoing activities such as calculations, modifications and procedure changes. FPC and the NRC have held several meetings and conversations subsequent to the issuance of TSCRN 210 during which the NRC has requested additional information to support its review. FPC has provided additional information in Reference 4 and is providing its response to the NRC's other requests herein.

Supplemental Information

The supplemental information to support the NRC's review of TSCRN 210 is provided in the attachments hereto. This supplemental information does not alter FPC's previous conclusions or the basis for the conclusions provided in TSCRN 210. A summary of these attachments follows:

Attachment A - List of Commitments

The attachment provides the list of commitments made in this submittal.

Attachment B - Calculations

Consistent with Commitment 1 of Reference 1, FPC has completed the calculations for the emergency feedwater (EFW) block valve cycling and Control Complex Cooling, and has confirmed that the conclusions of these calculations support TSCRN 210. Additionally, FPC has confirmed that the required maximum accident loads on the EDGs are bounded by the lower limit of the emergency diesel generator (EDG) refueling interval surveillance test (i.e., 3300 kW) proposed by TSCRN 210.

Attachment C - Modifications

Consistent with Commitment 5 of Reference 1, FPC confirmed that the modifications associated with TSCRN 210, except for impact on the EDG Air Handling System, will not involve an unreviewed safety question, and that no modification changes have been made which would alter the Technical Specifications or Bases proposed by TSCRN 210. The attached Table 2 is a replacement for the Table 2 contained in TSCRN 210. Since the impact of the EDG uprate modification on the EDG Air Handling System involves an unreviewed safety question, a proposed amendment to the CR-3 Operating License was submitted by License Amendment Request 216 (Reference 2).

Attachment D - Emergency Operating Procedures

Consistent with Commitment 3 of Reference 1, FPC has confirmed that no changes have been made to the operator actions addressing a SBLOCA that would alter the Technical Specifications or Bases proposed by TSCRN 210. The attached Tables 3A and 3B are replacements for those contained in TSCRN 210. FPC has expanded Table 3B of TSCRN 210 to include a complete list of operator actions required for mitigation of a SBLOCA. Both Tables 3A and 3B identify those operator actions that have been previously reviewed by the NRC. However, FPC requests that the NRC review these operator actions as an integral part of TSCRN 210 in order to achieve a comprehensive review of the SBLOCA mitigation strategy.

Attachment E - Table Summary and Description of Initial Simulator Validations

This Table includes the results of seven initial simulator validations of various Emergency Operating Procedure (EOP) scenarios. The results of these simulations indicate that operator response was within the time frame for required actions. This information was requested during meetings at the NRC's offices on September 18, 1997 to discuss FPC letter number 3F0997-31 dated September 17, 1997 (Reference 4).

Attachment F - Draft Appendix to the Operating License

In a meeting held on June 24, 1997, between the representatives of FPC and the NRC staff, the NRC discussed the possibility of incorporating one or more conditions associated with the issuance of TSCRN 210 into a new appendix to the CR-3 Operating License. The NRC requested FPC to propose a draft of such an appendix to facilitate issuance of the license amendment proposed by TSCRN 210, which is provided in this attachment.

Attachment G - EDG Test Plan

As discussed in Reference 1, the EDGs are being modified to increase their service ratings. As part of the modifications, FPC will successfully complete testing in accordance with its written EDG test plan and obtain vendor certification to demonstrate that the EDGs are qualified to perform at their new service ratings specified by TSCRN 210 prior to entering Mode 4 from the forced outage initiated on September 2, 1996. This attachment provides the test plan for the new ratings based on the installed modifications.

Attachment H - Update of Commitments Made in TSCRN 210

This attachment updates the list contained in Reference 1 and reflects the completion of those commitments associated with supplemental information and the additional commitment associated with EDG testing. This attachment replaces the list of commitments contained in TSCRN 210

Attachment I - List of Acronyms and Abbreviations Used

This attachment provides a listing of the acronyms and abbreviations used in the submittal.

FPC hereby incorporates the enclosed information into TSCRN 210. The above supplemental information demonstrates that TSCRN 210 is adequate as submitted, including the evaluation of the no significant hazards consideration and, when approved, will permit FPC to operate CR-3 within the approved design and licensing basis.

As the NRC is aware, FPC anticipates CR-3 will be ready to restart in December 1997. FPC requested in Reference 1 that the NRC approve TSCRN 210 effective November 1, 1997, with an implementation period of up to 30 days. That schedule has not changed. To facilitate the NRC's approval of TSCRN 210, FPC suggests that a meeting be held approximately the first week of October 1997 to address the attached supplemental information.

If you have any questions concerning this supplemental information to TSCRN 210, please contact Mr. David Kunsemiller, Manager, Nuclear Licensing at (352) 563-4566.

Sincerely,

JJHolden

J.J. Holden, Director
Site Nuclear Operations

JJH/mal

cc: Regional Administrator, Region II
Senior Resident Inspector
NRR Project Manager

Attachments:

A. List of Commitments
B. Calculations
C. Modifications
D Emergency Operating Procedures
E. Table Summary and Description of Initial Simulator Validations
F. Draft Appendix to Operating License
G. EDG Test Plan
H. Update of Commitments Made in TSCRN 210
I. List of Acronyms and Abbreviations Used

STATE OF FLORIDA
COUNTY OF CITRUS

John J. Holden states that he is the Director, Site Nuclear Operations for Florida Power Corporation; that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission the information attached hereto; and that all such statements made and matters set forth therein are true and correct to the best of his knowledge, information, and belief.

John J. Holden

John J. Holden, Director
Site Nuclear Operations

Sworn to and subscribed before me this 24 day of September 1997, by John J. Holden.

Garrett Hebb

Signature of Notary Public
State of Florida

GARRETT HEBB
MY COMMISSION EXPIRES
MAY 1, 1998
#CC 368952
Bonded thru
Troy Fain Insurance
NOTARY PUBLIC, STATE OF FLORIDA

(Print, type, or stamp Commissioned Name of Notary Public)

Personally Known GPH -OR- Produced Identification _____

FLORIDA POWER CORPORATION

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50-302/LICENSE NUMBER DPR-72

ATTACHMENT A

LIST OF COMMITMENTS

ATTACHMENT A

LIST OF COMMITMENTS

The following table identifies those actions committed to by Florida Power Corporation in this document. Any other actions discussed in the submittal represent intended or planned actions by Florida Power Corporation. They are described to the NRC for the NRC's information and are not regulatory commitments. Please notify the Manager, Nuclear Licensing of any questions regarding this document or any associated regulatory commitments.

ID Number	Commitment	Due Date
3F0997-30-1	Florida Power Corporation (FPC) will successfully complete testing in accordance with its written EDG test plan and obtain vendor certification to demonstrate that the Emergency Diesel Generators are qualified to perform at their new service ratings specified by TSCRN 210.	Prior to entering Mode 4 from the forced outage initiated on September 2, 1996.

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ATTACHMENT B

CALCULATIONS

ATTACHMENT B
CALCULATIONS

Many of the calculations to support TSCRN 210 were complete by the submittal date of TSCRN 210. However, to maximize the time available for NRC review and to support the CR-3 restart schedule, certain other calculations were still pending completion at that time. The anticipated conclusions of these pending calculations were used to support TSCRN 210. To ensure that the conclusions of the calculations are valid, their inputs and assumptions were verified and subjected to interdepartmental reviews, except for the calculations involving Control Complex Cooling, EFW block valve cycling, and EDG loading.

In TSCRN 210, FPC committed to:

- confirm that the calculations for EFW block valve cycling and Control Complex Cooling are complete and their conclusions support TSCRN 210, and
- confirm to the NRC that the expected maximum steady state accident loads on the EDGs are bounded by the lower limit of the EDG refueling interval surveillance test proposed by TSCRN 210.

Each of these calculations is discussed below.

Control Complex Cooling

As described in the Safety Assessment for TSCRN 210, operation of the motor driven EFW pump is limited by EDG capacity limitations for certain SBLOCA scenarios. As such, the motor driven EFW pump (EFP-1) must be secured prior to loading the Control Complex Cooling chiller. In order to mitigate a SBLOCA involving a failure of the 'B' train DC electrical system, FPC would cross-connect the turbine driven EFW pump (EFP-2) to the 'A' train EFW flowpath prior to securing EFP-1. It has been determined that operators can complete this cross-connection in less than one hour. Therefore, FPC initiated calculations to confirm that the Control Complex Cooling would not be required within the first hour of this postulated accident.

FPC has issued the calculations for the Control Complex Cooling issue. These calculations determined the transient temperature profile for the rooms in the Control Complex and compared these profiles to the maximum temperature for each room of the Control Complex. This calculation concluded that the maximum temperature limits for each of the Control Complex rooms would not be exceeded for at least 60 minutes as long as the Control Complex and EFIC Room ventilation fans are operating within 30 minutes. The assessment of the EDG loads reflects the operation of the ventilation fans concurrently with the motor driven feedwater pump. The operator action to ensure the ventilation is running is included in the list of operator actions discussed in Attachment D of this letter.

In summary, FPC has completed the calculations associated with the Control Complex Cooling and has confirmed that their results support TSCRN 210.

EFW Block Valve Cycling

As described in the Safety Assessment for TSCRN 210, the 'B' powered flow control valves, EFV-55 and EFV-56, would open and be unable to control EFW flow for certain SBLOCA scenarios with a loss of Battery 'B'. The OTSG would fill and the 'A' powered block valves, EFV-11 and EFV-32, would close once the steam generator overfill setpoint is reached. As the OTSG levels decrease to the overfill reset setpoint, the EFW block valves will open allowing EFW flow to the OTSGs. This cycling would be terminated by manual operator action when cross connecting EFW. FPC initiated calculations to determine the frequency of cycling and motor operator capability of the EFW block valves.

FPC has issued calculations addressing this EFW Block Valve Cycling issue. These calculations address the number of cycles the valves would experience, the OTSG overfill and reset setpoints, and the time limits for cycling the valves. The time the EFW block valves can cycle has been conservatively limited to the design temperature of the motor operator, which is a function of the number of cycles, the stroke time, and the ambient temperature postulated in the vicinity of the valves, and reflects revised setpoints for the overfill and reset settings. FPC calculations are based on a motor stroke time which is conservatively greater than the stroke time acceptance criteria for the surveillance testing of the motor operated valve (MOV). The ambient temperature is based on the CR-3 Environmental Qualification Program, which documents the temperature postulated in the intermediate building after one hour assuming a loss of ventilation. The results of the calculations determined that the EFW block valves are capable of cycling for more than one hour. Consistent with the safety assessment for TSCRN 210, this is sufficient time to complete the manual operator actions to cross-connect EFW and terminate block valve cycling.

EDG Loading

FPC is performing modifications to the EDGs at CR-3 which will increase the 2000 hour and 200 hour service ratings. FPC proposed in TSCRN 210 a revision to the EDG refueling interval surveillance test to address the increased service ratings. TSCRN 210 proposes an increase in the minimum load for this test from 3100 kW to 3300 kW.

TSCRN 210 describes that accident loads include the automatically connected steady state accident loads and the required manually applied accident loads. However, steady state loads do not include loads imposed by the starting of motors such as during block loading, and short duration loads such as motor operated valves, battery charger surges, and short duration pump surge flows.

As discussed in the cover letter of TSCRN 210, a revision of the CR-3 EDG loading calculation is ongoing. Based on the work completed to date, FPC has confirmed that the maximum required accident loads on the EDG will be less than 3300 kW with voltage administratively controlled relative to nominal voltage. Loads imposed by the starting of motors are not included in the service ratings and are less than the EDG manufacturer limits of

3910 kW for such loading. As stated in the cover letter for TSCRN 210, the calculation is scheduled to be completed prior to the implementation of the license amendment resulting from TSCRN 210.

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ATTACHMENT C

MODIFICATIONS

ATTACHMENT C
MODIFICATIONS

As stated in TSCRN 210, plant modifications supporting TSCRN 210 are in various stages of implementation. As such, the 10 CFR 50.59 evaluations for each of these modifications were not yet completed. However, to support the ongoing NRC review, FPC identified the modifications to be completed this outage related to SBLOCA mitigation in Attachment F, Table 2 of TSCRN 210.

In the submittal for TSCRN 210, FPC committed to confirm that:

- the associated modifications do not involve an unreviewed safety question, and
- no changes were made in the proposed modifications which would alter the Technical Specifications or Bases proposed by TSCRN 210.

Since TSCRN 210 was submitted, additional modifications were identified associated with the uprate of the Emergency Diesel Generators (EDG). These modifications involve Appendix R fire protection for the cooling fan cables as well as replacement of the radiators and associated air flow issues. The need for the fire protection of the cooling fan cables is necessary since both room cooling fans are required for the operation of the EDG, as discussed in FPC's August 26, 1997 letter (3F0897-25). The potential for the EDG rooms to exceed the design basis temperatures was discussed in LERs 50-302/97-013-00 and 50-302/97-19-00. These modifications have been added to Table 2 of TSCRN 210 and indicated by a revision bar.

FPC has reviewed the modifications identified in Table 2 against TSCRN 210 and has confirmed that these modifications have not been changed in such a manner that would alter the Technical Specifications and Bases proposed by TSCRN 210.

FMEA/MAR 97-08-12-01

FPC informed the NRC in an October 28, 1996 letter (3F1066-22) of its plan to address eight design issues related to restart. One of these eight issues involves the Failure Modes and Effects Analysis (FMEA) of a loss of DC power. This FMEA has been completed and has identified a system interaction that could occur during a SBLOCA concurrent with a LOOP and a loss of the 'A' train DC power, which was reported to the NRC in Licensee Event Report 97-021-00. This system interaction would affect the ability of the operator to bypass the engineered safeguards (ES) signal and obtain manual control of the ES systems, which is required by the SBLOCA analysis in TSCRN 210. The resolution of the system interaction is a plant modification, Modification Approval Record (MAR) 97-08-12-01, which will restore the operator's ability in appropriate accident scenarios to bypass the ES signal and obtain manual control of the ES systems. Accordingly, the proposed plant modification has been added to Table 2 of TSCRN 210. This modification will correct the system interaction and will not alter any conclusions of TSCRN 210.

Except for MARs 97-08-12-01, 95-05-15-01/02/05, and 97-08-04-01, the 10 CFR 50.59 reviews for the modifications identified in Table 2 have been completed. MAR 96-10-05-01 involving the EDG Air Handling System and the uprate of the EDGs was determined to involve an unreviewed safety question. Consistent with 10 CFR 50.59, the proposed amendment to the CR-3 Operating License was submitted to the NRC via FPC's August 26, 1997 letter (3F0897-25). The completed 10 CFR 50.59 reviews for the remaining modifications were determined not to involve an unreviewed safety question.

The MAR for which the 10 CFR 50.59 reviews is not complete at this time, has been reviewed by the CR-3 Safety Analysis Group (SAG), who has concluded that this plant modification will not involve an unreviewed safety question. The CR-3 SAG is responsible for the review and approval of the plant modification 10 CFR 50.59 reviews.

FPC has modified Table 2 to add the recent Loss of 'A' Battery ES Modification MAR and to reflect the above information for each of the related modifications. The revised Table also reflects the location of the new generator installed for the auxiliary feedwater pump (FWP-7) in response to a NRC question during an earlier meeting.

Table 2
Modifications

MOD	MAR	Subject	Description	Alters TSCRN 210/ USQ
1	96-11-01-01	ASV-204 EFIC Auto Opening Reinstallation	Restores the automatic opening of ASV-204, the steam admission valve to EFP-2, on an "A" EFIC actuation. This will restore the load sharing capability of the Emergency Feedwater System for the LOCA concurrent with LOOP and loss of EDG-1B in order to reduce the load on EDG-1A	Does not alter TSCRN 210/ No USQ involved
2	96-10-02-01	Emergency Feedwater Cavitating Venturis	Installs passive flow restricting devices on the discharge side of both EFP-1 and EFP-2. This will prevent excessive pump flow resulting in possible failure mechanisms of runout or inadequate NPSH available.	Does not alter TSCRN 210/ No USQ involved
3	96-10-10-01 96-10-10-02 96-10-10-03	EFV-12 Valve Mods, MOV Installation, Conduit Supports	Replace valve EFV-12 on the cross-tie piping between EFW train A and train B, a manual operated gate valve, with a motor operated gate valve. This will facilitate operator action to open this valve remotely and route discharge of EFP-2 through the cross-tie piping to the OTSGs.	Does not alter TSCRN 210/ No USQ involved
4	97-01-04-01	EFP-2 Flow Indications	Installs flow indication from the cavitating venturis installed downstream of EFP-2. This control room indication of EFP-2 flow rate will be powered from the opposite train ('A' side) to provide flow indication should a 'B' side failure disable its flow indication. This will provide feedback to the operator of flow from EFP-2 when EFP-1 needs to be secured for EDG load management.	Does not alter TSCRN 210/ No USQ involved
5	97-04-01-01	EFP-1 500 psig Trip Defeat Switch	Installs a control switch to allow operator action to defeat the automatic trip of EFP-1 (500 psig RCS pressure). Defeating this trip will allow EFP-1 operation during a SBLOCA. This switch will allow continued EFP-1 operation when DHP-1A starts on a 500 psig actuation, after EDG-1A load management by operator action.	Does not alter TSCRN 210/ No USQ involved

Table 2
Modifications

MOD	MAR	Subject	Description	Alters TSCRN 210/ USQ
6	97-04-02-01	RW/SW Pumps Pull-To-Lock Switches	Replaces existing control switches with a Pull-To-Lock switch on Nuclear Service and Decay Heat Seawater pumps RWP-2A and -2B and Nuclear Services Closed Cycle Cooling pumps SWP-1A and -1B. This will prevent automatic restart of these pumps on subsequent Engineered Safeguards actuation signal facilitating EDG-1A load management.	Does not alter TSCRN 210/ No USQ involved
7	96-12-17-01	EDG Small Load Reduction Modifications, DOP 2A/2B	This modification will remove the auto-start function from both nonsafety control circuits of the Flush Water Pumps. This will prevent them from auto-loading onto the EDGs.	Does not alter TSCRN 210/ No USQ involved
8	96-10-05-01	Diesel Power Uprate Project	Implements modifications to increase the service ratings of the EDGs. (1) The combustion air flow rate will be increased by replacing nozzle rings in turbochargers with larger ones, and (2) combustion air intercoolers will be replaced with a dual pass intercooler.	Does not alter TSCRN 210/ USQ, see letter dated Aug. 26, 1997 (LAR 216)
9	96-03-12-01 and Associated FCNs	Emergency Diesel Generator Indication Upgrade	Installs more accurate power meters (kW indication) for EDGs-1A and -1B. Accuracy was further improved by changes to CT/PTs. EDGs can be loaded higher because of improved instrument accuracy.	Does not alter TSCRN 210/ No USQ involved

Table 2
Modifications

MOD	MAR	Subject	Description	Alters TSCRN 210/ USQ
10	96-06-02-01	EFIC Integral Windup Reset	Installs windup reset on integral controller on the EFIC system. This will provide for faster response of EFW for control of flow to the OTSGs. This reduces EFW flow and consequential EDG-1A loading upon initiation.	Does not alter TSCRN 210/ No USQ involved
11	97-03-01-01	Standby Generator for FWP-7	Installs a new diesel generator (not safety-related) to provide an alternate backup power supply for FWP-7. The generator will be installed on the berm, but below the postulated maximum hurricane flooding level.	Does not alter TSCRN 210/ No USQ involved
12	97-02-17-01	MUV-27 HPI Autoclosure	Changes the Engineered Safeguards automatic actuation logic for the normal Makeup supply valve MUV-27 to add automatic closure upon receipt of a diverse containment isolation signal (which also initiates HPI). The purpose of the modification is to aid in HPI flow balancing actions in the event of a broken HPI line. MUV-27 must be closed to help ensure accurate HPI flow indication.	Does not alter TSCRN 210/ No USQ involved
13	97-08-12-01	Loss of 'A' Battery ES Modification	Provide circuit changes to allow the operator to bypass the ES signal and obtain manual control of the ES systems.	Does not alter TSCRN 210/ Will not involve USQ
14	97-05-19-01	EDG Appendix R Cables	Reroute and protect cables for the room cooling fans and add switches for fans to the remote shutdown panel. Provide conduits and supports for the rerouted/protected control cables for the room cooling fans.	Does not alter TSCRN 210/ No USQ involved

Table 2
Modifications

MOD	MAR	Subject	Description	Alters TSCRN 210/ USQ
15	97-05-17-02	EDG Appendix R Cables	Provide conduits and supports for the rerouted/protected control cables for the room cooling fans.	Does not alter TSCRN 210/ No USQ involved
16	97-05-15-01/02/05	EDG Radiator Replacement	Replace the EDG radiators, including the fans (increase air flow rate for radiators. Modification of radiator fan drive to allow higher fan horsepower for cold weather operation to be determined based on results of EDG radiator test runs.	Does not alter TSCRN 210/ Will not involve USQ
17	97-04-03-02	EDG Building HVAC	Adds registers to the engine room supply air ductwork to reduce pressure loss in the ductwork, rebalance system to redistribute the air in the engine room, replace the ventilation system filters with ones that have a lower pressure drop.	Does not alter TSCRN 210/ No USQ involved
18	97-08-04-01	Radiator Discharge Air Recirculation	Modifications to the EDG building to minimize recirculation of radiator discharge air.	Does not alter TSCRN 210/ Will not involve USQ

FLORIDA POWER CORPORATION

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ATTACHMENT D

EMERGENCY OPERATING PROCEDURES

ATTACHMENT D
EMERGENCY OPERATING PROCEDURES

As stated in TSCRN 210, the affected emergency operating procedures (EOP) necessary to implement TSCRN 210 are in various stages of revision. However, to support the NRC's review, FPC identified in Tables 3A and 3B of TSCRN 210, (1) operator actions required to be completed within the first 20 minutes of the SBLOCA scenarios addressed by the solution sets (Table 3A), and (2) new operator actions required to be completed after 20 minutes of these SBLOCA scenarios (Table 3B). Some of these actions are "defense in depth."

In TSCRN 210, FPC committed to confirm that:

- the necessary procedure changes do not involve an unreviewed safety question, and
- no changes were made to the proposed procedures which would alter the Technical Specifications or Bases proposed by TSCRN 210.

Consistent with this commitment, FPC has confirmed that no changes have been made to these operator actions that would alter the Technical Specifications or Bases proposed by TSCRN 210. To facilitate the NRC staff review, both Tables 3A and 3B have been annotated to identify the EOP steps that pertain to each action. The step numbers are as reflected in the draft revisions of EOPs submitted for review in Reference 4. FPC has expanded Table 3B of TSCRN 210 to include a complete list of operator actions required for mitigation of a SBLOCA.

Regarding whether the operator actions involve an unreviewed safety question, both Tables 3A and 3B identify those operator actions that have been previously reviewed by the NRC. However, FPC requests that the NRC review the complete list of operator actions as an integral part of TSCRN 210 in order to achieve a comprehensive review of the SBLOCA mitigation strategy.

Table 3A
Operator Actions Less Than 20 Minutes

OA	Operator Action	Time	Basis	Prior NRC Review	Reference
1	Trip all running RCPs	< 2 minutes	Required for loss of subcooling margin based on voiding condition of reactor coolant	Yes	NRC letter to FPC dated 5/29/86 (Generic Letter 86-05) refers to B&W Owners Group (BWOG) studies which concluded that compliance with 10 CFR 50.46 is achieved if operator action to trip RCPs is taken within 2 minutes. See EOP-3, Step 2.1 and EOP 13 Rule 1, "Loss of SCM" No changes were made that impact TSCRN 210
2	If Subcooling Margin (SCM) is lost and ES has not actuated, initiate manual HPI and Reactor Building Isolation and Cooling (RBIC) - isolates letdown (USQ6) - initiates HPI flow - isolates normal makeup (USQ6) (contingency actions are provided in OA 4 within 20 minutes if power is not available) - isolates RCP seal control bleed off valves - actuates EFIC - initiates Emergency RB cooling	10 minutes	Required for loss of subcooling margin (precedes automatic initiation)	Partial (Manual initiation of RBIC has not been reviewed)	NRC letter to FPC dated 7/6/79 (SER for Order dated 5/16/79 based on TMI-2 Accident) recognizes CR-3 revision to Emergency Procedure EP-106, which defines operator action in response to a spectrum of break sizes. States EP-106 was "judged to provide adequate guidance to the operators to cope with small break LOCA." EP 106 (currently EOP-03, "Loss of Subcooling Margin") contained guidance to initiate HPI and ensure adequate HPI flow. See EOP-3, Step 2.1 and EOP-13 Rule 1, "Loss of SCM" No changes were made that impact TSCRN 210
3	Ensure all four HPI injection valves are open - switch power supply for affected injection valves by manipulating switches in control room	10 minutes	Required only for loss of 1 train of Class 1E power	Yes	NRC letter to FPC dated 5/29/79 "Permanent Solution to SBLOCA issue" recognizes operator action to turn associated transfer switch to open affected HPI valves by 10 minutes. See EOP - 3, Step 3.3 No changes were made that impact TSCRN 210

Table 3A
Operator Actions Less Than 20 Minutes

OA	Operator Action	Time	Basis	Prior NRC Review	Reference
4	Isolate RCP seal injection (USQ6) (As a contingency action, if power is lost to MUV-27 (normal makeup) and MUV-18 (RCP seal injection), transfer to an energized bus and close valves)	20 minutes	Required to maximize HPI flow to reactor	No	FPC letter to NRC dated 2/28/79, answers a previous question of whether or not it was necessary to isolate any flow paths in the makeup system after a LOCA. FPC refers to RCP seal injection and normal makeup and refers to a Gilbert Associates report that concludes adequate HPI flow is achieved without these lines isolated. NRC letter to licensees with B&W designed systems (Generic Letter 86-05) dated 5/29/86 states the cooling water sources supporting the RCP with the potential of being isolated are seal injection, seal bleedoff, component cooling water to seal line coolers, and component cooling water to RCP motors and oil coolers. The need to isolate RCP Seal Injection was discovered in 1995 to be necessary due to discovery that operators relied on non-Reg Guide 1.97 instrumentation to measure this flow when determining HPI pump runout flow limits (see LER 95-026). Seal injection isolation was also determined necessary during Refuel 10 in 1996 upon discovery that worst case instrument error may result in inadequate HPI flow (see LER 96-006). FPC letter dated July 7, 1997 (NOV 96-07) discusses the additional need for closure of RCP seal controlled bleed-off (CBO) valves after 90 seconds if seal injection has not been restored. See OA-2 See EOP - 3, Step 3.7 No changes were made that impact TSCRN 210

Table 3A
Operator Actions Less Than 20 Minutes

OA	Operator Action	Time	Basis	Prior NRC Review	Reference
5	Ensure adequate HPI flow (USQ6) (isolate a broken injection line using new isolation criteria) Requires bypassing ES to gain control of HPI valve.	20 minutes	Required only for break in HPI line	Partial	FPC letter to NRC dated 10/27/89 states HPI must be successfully balanced to support SBLOCA mitigation as described in various B&W topical reports accepted by NRC. Subsequent FPC letter dated 10/31/89 states that mitigation strategy employed from the late 1970's through the reviews done in response to NUREG 0737 relied on balancing HPI flow for breaks in HPI injection lines. These letters relate to LER 89-037, issued in November 1989 reporting a design basis condition in which instrumentation used for balancing HPI flow was inadequate. NRC letter dated 12/20/89 confirmed verbal concurrence to resume power operation with the HPI instrumentation problems. One condition was operator action for HPI flow balancing. NRC letter dated 2/17/95 from Gary Holahan to Ed Jacks (BWOG Operator Support Committee) states staff has completed its review of BWOG response to NUREG 0737 Item I.C.1 regarding EOP Guidelines and is finalizing an SER on the topic. Balancing HPI flows was a part of the ATOG/TBD guidelines incorporated into FPC procedures. FPC issued LER 96-007 on 3/15/96 to report another design basis condition involving HPI flow instrumentation. The flow deficiencies described therein were addressed by revised SBLOCA analyses provided by Framatome Technologies in April 1996 which required isolation of the affected HPI line versus balancing. Most recent FTI analyses have provided new isolation criteria. See EOP - 3, Step 3.6. EOP - 3, Step 3.9 is an "If at any time" step that addresses bypassing or resetting ES to ensure ES equipment is properly aligned. No changes were made that impact TSCRN 210

Table 3A
Operator Actions Less Than 20 Minutes

OA	Operator Action	Time	Basis	Prior NRC Review	Reference
6	Ensure adequate EFW flow (USQ6) (EFIC was initiated in OA2; therefore, ensuring EFW flow is a confirmation step only) This step manually raises OTSG levels to the Inadequate Subcooling Margin, ISCM level	20 minutes	Raise OTSG levels to ISCM setpoint (90%)	Yes	B&W (Taylor) letter to NRC (Baer) dated 5/1/78 provides topical report 10104, "B&W's ECCS Evaluation Model," which notes operator action is necessary during early stages of the accident to mitigate consequences and meet 10 CFR 50.46. Auxiliary feedwater is assumed to be available. NRC letter to FPC dated 7/6/79 provides a SER for actions taken in response to Commission Order dated 5/16/79. The SER states that a generic review of B&W analyses entitled "Evaluation of Transient Behavior and Small RCS Breaks in the 177 Fuel Assembly Plant" resulted in a principle finding that reconfirms SBLOCA analyses demonstrate a combination of heat removal by the steam generator and the HPI system combined with operator action to ensure adequate core cooling. These results are applicable to CR-3 considering the ability to manually start the redundant EFW pumps and HPI pumps from the control room, assuming failure of automatic EFW actuation. NRC letter to FPC dated 8/30/85 provides a SER for NUREG 0737 Item II.K.3.30, "SBLOCA Methods." Section III.5.a of the SER states "the timing of operator action to raise the secondary system water level to 95% was found not to be critical." See EOP - 3, Step 3.8 No changes were made that impact TSCRN 210

Table 3B
Operator Actions After 20 Minutes

OA	Operator Action	Failure Scenario	Prior NRC Review	Cycle 11 Only	Basis	Reference
7	Start Control Complex Ventilation in emergency mode if fans are not already running	LOBA LOBB EFP-2	No	No	To assure control room operator dose is not exceeded and to provide control complex cooling. Required to be accomplished within 30 minutes	EOP - 3, Step 3.11 requires concurrent performance of EOP-14, Enclosure 17, "Control Complex Emergency Ventilation System." No changes were made that impact TSCRN 210
8	If at any time BWST is < 20 ft, transfer ECCS pump suction to RB sump	LOBA LOBB EFP-2	Yes	No	To ensure sufficient source of borated water for injection by HPI/LPI. Depending on break size, action may be required between 25 minutes and 1-1/2 hours	EOP - 3, Step 3.12 directs performance of EOP - 14, Enclosure 19, "ECCS Suction Transfer." No changes were made that impact TSCRN 210
9	If 'B' DC power is lost, crosstie EFP-2 to A train (EFV-12) **AND** Secure EFP-1	LOBB	No	Yes	EFP-1 can only provide flow for a specific time period, then EFP-2 must be aligned to ensure sufficient margin is maintained on the 'A' EDG for later adding of Control Complex Chiller	EOP - 3, Step 3.15 directs performance of EOP-14, Enclosure 11, "EDG A Load Management." No changes were made that impact TSCRN 210

Table 3B
Operator Actions After Than 20 Minutes

OA	Operator Action	Failure Scenario	Prior NRC Review	Cycle 11 Only	Basis	Reference
10	Put EFIC in manual permissive **AND** Close EFW block valves (deenergized after closure)	LOBB	No	Yes	Required to prevent cycling of the limited duty motors on the EFW block valves	EOP - 3, Step 3.8 establishes applicability of EOP - 13, Rule 3, "EFW Control." Also, EOP - 14, Enclosure 11, "EDG A Load Management," Step 11.4 requires the normal EFP-2 discharge path to be isolated No changes were made that impact TSCRN 210
11	Manage EDG load in order to extend EFP-1 operation by - • Shutdown SWP-1A & RWP-2A after verifying redundant pumps are operating and placing switches in Pull-to-Lock to prevent reactuation of pumps (EDG loading) • Place EFP-1 Trip Defeat Switch in defeat position to prevent automatic trip of EFP-1 on RCS pressure of 500 psig	EFP-2	No	Yes	**Defense in Depth action** for postulated single failure of the loss of EFP-2. These actions extend the time EFP-1 is available for OTSG cooling	EOP - 3, Step 3.15 and EOP - 8 Step 3.7 direct performance of EOP-14, Enclosure 11, "EDG A Load Management." No changes were made that impact TSCRN 210

Table 3B
Operator Actions After 20 Minutes

OA	Operator Action	Failure Scenario	Prior NRC Review	Cycle 11 Only	Basis	Reference
12	Start Control Complex Chiller if not already running	LOBA LOBB EFP-2	No	No	Required within 80 minutes to ensure control complex instrumentation remains within analyzed temperature ranges for instrument accuracy	EOP - 3, Step 3.16 and EOP - 8, Step 3.8 provide instructions to concurrently perform EOP - 14, Enclosure 18, "Control Complex Chiller Startup" No changes were made that impact TSCRN 210
13	Isolate the RB sump by closing RB sump pump discharge valves, placing RB sump pumps in Pull-to-Lock, and closing waste gas header isolation valves	LOBA LOBB EFP-2	Yes	No	Required by IE Bulletin 79-05A to isolate systems utilized to transfer radioactive liquid and gases from the containment. These penetrations go to the waste gas header and the Miscellaneous Waste Storage tank. Isolating the RB sump penetration will maintain inventory in the containment for possible ECCS pump suction for long term recirculation	EOP - 8, Steps 3.11 and 3.12 No changes were made that impact TSCRN 210

Table 3B
Operator Actions After 20 Minutes

OA	Operator Action	Failure Scenario	Prior NRC Review	Cycle 11 Only	Basis	Reference
14	If only EFP-2 is supplying feedwater to the OTSG, the RCS cooldown will be stopped prior to reaching an EFP-2 operational limit. Manage operation of EFP-2 by closing ASV-5 and ASV-204 on low OTSG pressure (Cycle EFW) and restart EFP-2 when pressure increases. (Mitigation strategy includes operation of diesel backed FWP-7 as a Defense in Depth action)	LOBA LOBB	No	No	To maintain EFP-2 as an available source of feedwater and operate the pump within analyzed regions. Use of FWP-7 provides additional resources available to operators during a LOOP	EOP - 8, Step 3.16 directs use of EOP-14, Enclosure 7, "EFP-2 Management." (see Steps 7.12, 7.13, and 7.14) This may involve entry into EOP - 4 and return to EOP - 8. No changes were made that impact TSCRN 210
15	If EFP-2 is not operating when in a LOOP condition with inadequate subcooling, limit cooldown prior to EFP-1/LPI.	EFP-2	No	Yes	If EFP-2 is not available, steps must be taken to ensure EFP-1 operates as long as needed	EOP - 3, Step 3.15 directs performance of EOP - 14, Enclosure 11, "EDG A Load Management," (see Step 11.14) No changes were made that impact TSCRN 210
16	Establish RCS Cooldown using TBVs or ADVs	LOBA LOBB EFP-2	Yes	No	Initiates RCS cooldown to achieve end point of event (start of decay heat)	EOP - 8, Step 3.17. No changes were made that impact TSCRN 210

Table 3B
Operator Actions After Than 20 Minutes

OA	Operator Action	Failure Scenario	Prior NRC Review	Cycle 11 Only	Basis	Reference
17	Periodically re-evaluate HPI line break criteria on RCS repressurization	LOBA LOBB EFP-2	No	No	Required for specific HPI line pinch areas to ensure a broken line will be isolated if isolation criteria is not met early in the event while in EOP-3	EOP - 3, Step 3.21 transitions to EOP - 4 on inadequate heat transfer. EOP - 4, Step 3.56 is an "If at any time" step and requires closure of the affected HPI line on ISCM No changes were made that impact TSCRN 210

FLORIDA POWER CORPORATION

CRYSTAL RIVER UNIT 3

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ATTACHMENT E

TABLE SUMMARY AND DESCRIPTION OF INITIAL SIMULATOR VALIDATIONS

Time Dependent Steps Based on Loss of SCM

Operator Required Action	Required Time to Complete (Min)	Actual Time Action Completed (Min:sec) During Simulator Validations								
		7/30/97	8/5/97	8/6/97	8/12/97	8/13/97	9/15/97	9/15/9	9/19/97	9/19/97
		2 RO 1 SRO	1 RO 1 SRO	2 RO 2 SRO	3 RO 2 SRO	2 RO 1 SRO	See scenario	2 RO 2 SRO	1 RO 1 SRO	1 RO 1 SRO
		Scenario 1	Scenario 2	Scenario 71	Scenario 69	Scenario 75	Scenario 88	Scenario 89	Scenario 97	Scenario 98
Trip RCPs	< 2	Note 3	Note 3	Note 3	Note 3	Note 3	Note 1	0:06	00:25	0:04
Ensure HPI Valves open	10	3:10		2:20	2:00		4:01	1:47	3:05 Note 4	2:52 Note 4
Close MUV-27	20			< 10:45	3:00	3:00	9:18	4:15	4:25 Note 4	4:32 Note 4
Isolate high flow line	20	14:30	15:15			5:00	13:13	N/A	N/A	N/A
Close MUV-18	20			10:45	6:00	6:00	15:08	6:06	5:30	6:36 Note 4
Ensure CC Vent in Emerg Mode	30	23:13		18:45		17:00	32:37 Note 2	15:54	13:35	14:55
Ensure CC Chiller running	80		59:15		42:00		51:13	23:17	Note 4	16:59 Note 4

Empty Box indicates time not captured

Note 1: Confirmed tripped 1 second after loss of SCM.

Note 2: Action was delayed due to damper indication problems resulting from battery failure. Indication is being fixed in plant.

Note 3: Pumps were stopped due to LOOP. Time not captured.

Note 4: Automatic actuation, confirmation of action only.

Scenario 1

100% Power, MCC-3AB is aligned to the B Bus. RCS leak develops in the B2 HPI nozzle. Leak starts at 50 gpm and increases to 200 gpm. Rx trip on low pressure or manual operator action. When Rx trips, a LOOP occurs including the 22KV backfeed to the air compressors. B EGDG fails to start due to loss of B Battery. EOP-02 is entered and immediate actions performed. EOP-03 is entered on loss of SCM. The failed HPI line is isolated. EFW is cross-tied to allow shutdown of EFP-1. The "A" chiller is started. Scenario ends when EOP-08 is entered.

100% Power, MCC-3AB is aligned to the B Bus. RCS leak develops in the B2 HPI nozzle. Leak starts at 50 gpm and increases to 200 gpm. Rx trip on low pressure or manual operator action. When Rx trips, a LOOP occurs including the 22KV backfeed to the air compressors. B EGDG fails to start due to loss of B Battery. EOP-02 is entered and immediate actions performed. EOP-03 is entered on loss of SCM. The failed HPI line is isolated. EFW is cross-tied to allow shutdown of EFP-1. The "A" chiller is started. Scenario ends when EOP-08 is entered.

Scenario # 71 Pzr Surge Line Rupture

Simulator Setup/Programmed Failures:

100% RTP
EOL
No equipment OOS

- o Pressurizer surge line ruptures (full sheer).
- o Rx is tripped by RPS on low pressure.
- o EFP-2 trips on overspeed.
- o When RCPs are tripped by operator, a LOOP occurs.
- o Access to the AB is lost due to radiation levels. The PPO was not allowed back in to perform post event actions.

Scenario Challenges:

SCM will be lost and EOP-3 will be entered.
All EFW will be lost due to the LOOP and the failure of EFP-2, but EFW is not required for LBLOCAs.

Time dependent actions for starting CREVs, and the Chiller will be balanced with ECCS transfer to the sump.

Expected procedure usage:

EOP-2 immediate actions will be performed.
EOP-3 will be entered due to a loss of SCM.
EOP-13 Rules will be used as appropriate.
EOP-8 will be used to perform ECCS suction transfer to sump, and boron precipitation.

Scenario # 69 LOCA Cooldown with loss of A Battery and Offsite Power

Simulator Setup/Programmed Failures:

100% RTP
EOC Life
No equipment OOS
ES MCC 3AB will be powered from the A ES480 Volt bus.

- o Small leak occurs in cold leg (200 GPM).
- o Rx is tripped by operator or RPS.
- o Concurrent with Rx trip a loss of all off-site power occurs.
- o A-Battery failure occurs (single failure)
- o The leak in the cold leg increase to 0.006 of a full cold leg break.
- o Access to the AB is lost due to radiation levels. The PPO was not allowed back in to perform post event actions.
- o When EOP-8 is entered, the cold leg break will increase in size to 0.1 of a full break.

Scenario Challenges:

Loss of the A train will require transfer of ES status lights, transfer of ES MCC 3AB and closure of MUV-18 and 27 to allow determination of HPI flows.
Loss of A-Battery will also result in the use of the ES test switches to bypass ES to defeat the ES480v lockout. This will permit the starting of CREVs and the chiller.

When EOP-8 is entered the cold leg break will increase significantly. Rapid depressurization of the RCS will occur. Building spray actuation may occur.
When LPI flow reaches 1400 GPM, a transition to the large break branch of EOP-8 will occur.

The ES test switches will prevent a reactuation requiring manual LPI actuation. The reactuation of ES will require restarting CREVs and Chiller.

Transfer if ECCS suction transfer to the sump will occur on the B train only.

The scenario will end when EOP-8 is exited and the TSC will be contacted.
Boron precipitation control will not be performed due to only one train of LPI and inability to open drop line.

Expected procedure usage:

EOP-2 immediate actions will be performed.
EOP-3 will be entered due to a loss of SCM.
EOP-8 will be entered after completion of EOP-3.
EOP-13 Rules will be used as appropriate.
EOP-14 Enclosures 2,17,18,19 will be used.

Scenario #75 Loss of SCM with no EFW and Degraded HPI

Simulator Setup/Programmed Failures:

- o 100% RTP.
- o EOL
- o FWP-7 R/T'd for motor rebuild
- o ES MCC 3AB is powered from A ES 480 V Bus
- o Units 1 and 2 steam unavailable

A break occurs in the HPI line downstream of MUV-26 (App 200 gpm). When the Rx is tripped, a loss of offsite power occurs and A EDG fails to start.
MUP-1C is degraded to a maximum of 40% output. EFP-2 fails to start.

Operators perform the immediate actions of EOP-02 then transition to EOP-03. ES MCC 3AB is transferred to B side and MUV-18 and 27 are closed. Operator isolates broken HPI line to increase flow to the core but degraded MUP-1C is not adequate to remove core heat. With EFP-2 unavailable, operators will transition to EOP-04 and attempt to regain OTSGs. After PORV is opened, ASV-50 is reset and OTSG cooling is established. Transition to EOP-08 is made. The scenario ends when MSIVs are isolated and operators are managing steam for EFP-2.

Scenario Challenges:

- o Flowpath through EOP-03 with degraded HPI
- o Transition to EOP-04 when lack of heat transfer is recognized
- o Transition from HPI/PORV cooling to OTSG cooling
- o Control of cooldown and steam management for EFP-02 in EOP-08

Scenario #88 SBLOCA resulting in loss of SCM and LOCA Cooldown

Simulator Setup/Programmed Failures:

- o Mode 1 100% FP
- o SBLOCA on "B2" HPI line
- o Loss of offsite power
- o Loss of "B" Battery
- o Loss of Berm air compressors

Initially, only one RO and one SRO will be present in the Control Room. Second RO will not be allowed to enter until 2 min after loss of SCM. Full E-Plan response is required for NSS participation. STA will not be available until 10 minutes into the event. Time critical actions will be timed.

A SBLOCA develops on the "B2" HPI line. When the reactor trips, a loss of offsite power, B Battery and Berm air compressors occur. EOP-02 immediate actions are performed with transition to EOP-03 due to loss of SCM. Power is transferred to MUV-25 and 26. The high flow line is isolated and EFP-2 is cross connected to supply the A EFW train. Adequate SCM will not be regained and transition to EOP-08 will occur. Scenario ends when hold point in EOP-08 is reached for RCS pressure < 400 psi.

Scenario Challenges:

- o Flow path from EOP-02 to 03 to 08
- o EFP-2 management
- o EDG-1A load management

Scenario #89 Large OTSG Tube Rupture and LOCA Cooldown

Simulator Setup/Programmed Failures:

- Mode 1 100% FP
- 80 gpd tube leak increasing to 800 gpm in A OTSG
- MUP-1A OOS
- MUP-1C trip

Tube leak develops in A OTSG and rapidly increases to 800 gpm. The reactor is tripped and EOP-02 immediate actions are taken. SCM will be lost resulting in transition to EOP-03. MUP-1C trips on manual initiation of HPI. EOP-03 actions will be taken with exit to EOP-08 since SCM will not be regained. A OTSG will fill to > 90% requiring TRACC isolation. Scenario ends when OTSG is isolated and RCS cooldown is in progress and under operator control.

Scenario Challenges:

- Flow path from EOP-02 to 3 to 8
- TRACC isolation of A OTSG

Scenario #97 Cold Leg Break (Full Shear)

Simulator Setup/Programmed Failures:

- 100% FP, EOL
- Nothing OOS
- Cold leg break (full shear)
- DHV-42 fails to open during sump swapover

Break is inserted. Rx trip by RPS. AB access is lost due to radiation levels which won't allow PPO in to perform post trip actions. EOP-02 immediate actions will be performed with transition to EOP-03 due to loss of SCM. EOP-08 will be transitioned to from EOP-03 to perform sump swapover.

Scenario Challenges:

DHP-1A, BSP-1A and A Train MUP must be tripped during sump swapover due to failure of DHV-42

__Scenario #98 Letdown Line Rupture Downstream of MUV-49__

__Simulator Setup/Programmed Failures:__

- o 100% FP, MOL
- o Nothing OOS
- o Minimum crew staffing (1 SRO, 1 RO)
- o Letdown line rupture in AB immediately downstream of MUV-49

Break is inserted. Rx trip by RPS or operator. Access to AB is l;ost due to rad levels so PPO can't enter to perform post trip actions. EOP-02 immediate actions performed. EOP-03 entered due to loss of SCM. Performanceof Rule 1 will isolate the leak. EOP-02 will be reentered after completion of EOP-03

__Scenario Challenges:__

Isolation of leak will cause SCM to be regained and ES will have to be bypassed to throttle HPI

FLORIDA POWER CORPORATION

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ATTACHMENT F

DRAFT APPENDIX TO OPERATING LICENSE

ATTACHMENT F
DRAFT ADDITIONAL CONDITIONS

In a meeting held on June 24, 1997, between representatives of FPC and the NRC staff, the NRC discussed the possibility of incorporating one or more conditions associated the issuance of TSCRN 210 into a new appendix to the CR-3 Operating License. The draft appendix attached hereto addresses the testing of the EDGs resulting from the uprate modifications. This draft is provided at the request of the NRC in order to facilitate the issuance of the license amendment proposed by TSCRN 210.

DRAFT ADDITIONAL CONDITIONS

FACILITY OPERATING LICENSE No. DPR-72

Amendment Number	Additional Conditions	Applicability Date
To Be Determined	Florida Power Corporation (FPC) will successfully complete testing in accordance with its written EDG test plan and obtain vendor certification to demonstrate that the Emergency Diesel Generators are qualified to perform at their new service ratings specified by this Amendment, at which time this condition shall no longer be applicable.	Prior to entering MODE 4 from the forced outage initiated on September 2, 1996.

FLORIDA POWER CORPORATION

CRYSTAL RIVER UNIT 3

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ATTACHMENT G

EDG TEST PLAN

Attachment G
EDG Test Plan

Florida Power Corporation (FPC) is modifying the Crystal River Unit 3 (CR-3) emergency diesel generators (EDG) to increase their intermediate power ratings to add margin above design basis accident loads. The maximum 30-minute power rating of the EDGs is not changing. FPC has identified a rigorous test plan for the EDGs to confirm functionality, engine qualification, and to confirm that EDG room cooling is adequate.

The EDG test program includes multiple starts and loadings. During these runs, numerous parameters will be monitored to ensure each aspect of the modifications is fully tested. Each EDG will be run for approximately 96 hours. In addition to FPC's testing, the EDG vendor performed load testing on an EDG of the same type for the full duration of the new intermediate ratings, 3200 kW for 2000 hours and 3400 kW for 200 hours. The EDG vendor has also performed an analysis to confirm that FPC's EDGs, as modified, will be capable of operating at the new higher ratings.

The changes required for the FPC EDGs to meet the new ratings are minimal because most of the required modifications were installed in 1990. The post-modification testing in 1990 assured proper performance and confirmed qualification of the EDG at its current ratings. In order to establish the new ratings, only two stationary parts had to be replaced on the EDG engine. The power uprate does not require generator modifications. In addition to the modifications required for the power uprate, the engine cooling radiators are being replaced due to low cooling air flow rate to the radiator cores discovered during EDG testing and to facilitate future plans.

FPC has taken additional measures to ensure its test plan is adequate to provide reasonable assurance that the EDGs will perform as designed. Two independent third party consultants have reviewed the EDG test plan. Both concurred that the EDG test plan was adequate to demonstrate qualification and operability of the EDGs. In addition, FPC discussed the test plan with several IEEE 387 Board Members who concurred with FPC's EDG test plan as being adequate to demonstrate qualification and operability.

During a meeting on June 24 1997, the NRC requested FPC to provide the test plan for the EDG modifications. This submittal provides:

1. A summary of FPC's licensing basis including commitments to applicable standards and guidelines.

2. A discussion of the modifications made to the CR-3 EDGs.

3. Basis for EDG qualification.

4. A discussion of the post-modification testing program including a summary of the EDG starting and loading used in the determination of qualification. The test plan is based on the testing required to demonstrate that the modifications will perform as designed and to confirm adequate room cooling.

1. Licensing Basis

CR-3 was designed, constructed and licensed before either IEEE 387-1977, Reg. Guide 1.108 (the predecessor to Reg. Guide 1.9), or Reg. Guide 1.9 were issued. The EDGs for the plant were selected, installed and licensed in accordance with the design requirements of NRC Safety Guide 9, "Selection of Diesel Generator Set Capacity for Standby Power Supplies." Although CR-3 is not required to comply with IEEE 387 or Reg. Guide 1.9, performance of the analyses and testing described in this test plan demonstrates that FPC is meeting the technical content and intent of both those industry and licensing guidelines.

2. Summary of Modifications to CR-3 Emergency Diesel Generators

The following is a summary of the changes (modifications) to the FPC EDGs being installed in 1997 associated with the new service ratings. The modifications are listed according to the Modification Approval Record (MAR) packages issued for their installation.

2.1 MAR 96-10-05-01 - 150 kW Upgrade (FPC Restart Item D-6A)

A. Increased intermediate power ratings.
B. Replaced engine combustion air intercoolers with dual pass coolers and modified local piping.
C. Changed out turbocharger nozzle ring with one which slows down the rotor.
D. Increased the minimum amount of fuel oil to be stored in the day tank and the storage tanks.
E. Raised instrumentation setpoints for day tank level instruments.
F. Increased the minimum storage requirement for lube oil.
G. Removed damper from bulkhead and close opening with a plate.
H. Require operation of two room cooling fans.

2.2 MAR 97-05-19-01 - Appendix R Cable Modifications (FPC Restart Item D-29S)

A. Reroute/protect control cables for the room cooling fans and add switches for fans to the remote shutdown panel.

2.3 MAR 97-05-17-02 - Appendix R Conduit and Conduit Support Modifications (FPC Restart Item D-29S)

A. Provide conduits and supports for the rerouted / protected control cables for the room cooling fans from the above MAR.

2.4 MAR 97-05-15-01 - Emergency Diesel Generator Radiator Mechanical Replacement (FPC Restart Item D-29R)

A. Replace radiators including radiator fans (increase air flow rate of radiators).
B. Replace missile shield/flood barrier to reduce pressure drop/improve air flow rate of the air going to the radiator.
C Reroute fuel transfer piping.
D. Add antifreeze to radiator.
E. Lowered minimum design temperature which increased required fan horsepower during extreme cold weather operation (15°F ambient).
F. Moved engine room's exhaust dampers from one side of bulkhead wall to the other so the dampers do not interfere with new radiators and reroute associated control air.
G. Added separate surge tank for the intercooler cooling system.

2.5 MAR 97-05-15-02 - Electrical/I&C Work for Emergency Diesel Generator Radiator Replacement (FPC Restart Item D-29R)

A. Removal and reinstallation of electrical/I&C construction interferences.
B. Reroutes to match new positions of components.
C. Added lights inside the radiator compartment.
D. Added remote level instrumentation for surge tanks.

2.6 MAR 97-05-15-05 - Emergency Diesel Generator Radiator Fan Drive Modification (FPC Restart Item D-29R)

A. Modification of radiator fan drive to allow higher fan horsepower for cold weather operation to be determined based on results of the EDG radiator test runs.

2.7 MAR 97-04-03-02 - Emergency Diesel Generator Building HVAC Modifications for the Radiator Replacement (FPC Restart Item D-29R)

A. Adds registers to the engine room supply air ductwork to reduce pressure loss in the ductwork.
B. Rebalance system to redistribute the air in engine room.

C. Replace the ventilation system filters with ones that have a lower pressure drop to reduce the pressure drop of the system.

2.8 MAR 97-08-04-01 - Correction of Radiator Discharge Air Recirculation (FPC Restart Item D-6H)

A. Modifications will be made to the EDG building to minimize recirculation of radiator discharge air.

2.9 MAR 96-03-12-01 - kW Meter Upgrade

A. Reduce burden on CT/PTs to improve main control board kW meter accuracy.

2.A Discussion of EDG Modifications

2.A.1 The new power ratings will be as follows:

Duration	Old Rating	New Rating	Upper Limit Change
Continuous	0 to 2,850 kW	0 to 2,850 kW	Unchanged
2,000 hours	2,851 to 3,000 kW	2,851 to 3,200 kW	Increased
200 hours	3,001 to 3,250 kW	3,201 to 3,400 kW	Increased
30 minutes	3,251 to 3,500 kW	3,401 to 3,500 kW	Unchanged

As documented in the previous section, the EDG intermediate ratings were increased by installing two stationary bolt-on replacement parts which have no contact to moving parts on the engine. The new parts can be confirmed to be functioning properly by monitoring turbocharger RPM, blower and intercooler discharge temperatures, and cylinder firing pressure.

In order to provide adequate heat removal for the EDGs at the new ratings, the cooling system had to be modified. The radiator modification significantly improves the engine cooling by increasing the cooling air flow rate and significantly increasing the size of the radiator cores for improved heat transfer. A larger radiator fan is being installed; however, most of the moving parts associated with the radiator remain unchanged.

2.A.2 Missile Shield and Radiator Modifications

Other modifications are being made in addition to the engine modifications discussed above. The missile shield on the exterior of the EDG building is being modified to reduce its resistance to air flowing through it to the radiator, the engine combustion air, and the engine room cooling system. The missile shield does not connect directly to any EDG component, but it influences proper EDG performance.

The engine radiator is also being replaced with one of the same configuration but larger heat transfer capability. The new radiator provides more cooling air flow because its cores are significantly larger than the original units and have a lower pressure loss for air flowing through them. A new fan designed for the higher flow and lower pressure loss is also being installed. The new fan uses the same nominal horsepower as the original fan. The new fan is designed for the conditions of higher flow at a lower pressure rise so it uses the same horsepower as the original fan during standard operating conditions. The new radiator is the same configuration as the original radiator so the radiator fan drive is effectively the same as the original fan drive. The new radiator fan drive uses the same basic parts, so there is no significant impact of the new radiator fan drive when compared to the original radiator fan drive. The primary differences are the length of the drive shafts, changing the gear ratio in the right angle gear box to reduce the speed of the fan, and the diameter of the fan is increased. The new fan is different than the previous fan, but it will be tested for proper operation during the 3 day EDG functional test.

The radiator replacement has been fully analyzed by the vendor. Coltec report VTS-985-970714-01R, dated 7/31/97 documents the analysis. This analysis for the radiator and its interface with the engine is referenced in the following evaluation of the modifications. The radiator analysis plus the EDG power uprate analysis VTS-985-961108-01R, Revision 2, dated 5/28/97, documents the vendor's confirmation of the EDG's capability to perform up to 2955 kW. The vendor report will be updated after testing of the new radiator to confirm the radiator's capability to adequately cool the engine at the new ratings.

2.A.3 Implementing the Use of Antifreeze

During evaluations for replacement of the radiators, the potential of freezing the radiator during the first several minutes of operation was identified. The planned corrective action is to add antifreeze to the radiator water on a year-round basis. The use of antifreeze reduces the heat transfer capability of the fluid. However, the new radiator and radiator fan are adequate even when accounting for this effect. The air flow through the fan has been increased to provide more heat transfer to account for the reduction in heat transfer due to the antifreeze. The increase in air flow, in conjunction with the reduced differential pressure, causes the fan horsepower to closely match the fan horsepower required for the old fan. Coltec analysis VTS-985-961108-01R, Revision 2, dated 5/28/97, documents the vendor's confirmation of the

EDG's capability to use antifreeze in the engine and radiator. Similar engines have been using antifreeze for years with no known adverse conditions.

2.A.4 Implementing a Lower Minimum Design Temperature for Outside Air

FPC has conservatively reduced the design value for the minimum outside air temperature to 15°F. This affects the design value for the radiator fan horsepower. The fan effectively moves the same CFM even though the density of the air changes. As the air gets colder, it becomes more dense and the required fan horsepower increases. With the minimum design temperature lowered, the theoretical fan horsepower required increases. On the average, the minimum design temperature of 15°F occurs 1 hour per year per the Crystal River Nuclear Plant "Environmental and Seismic Qualification Program Manual" zone OS.

The fan horsepower required for the 15°F condition is 264 horsepower per Coltec report VTS-985-970714-01R, dated 7/31/97. This is 34 more horsepower than was previously analyzed prior to the uprate and the installation of the new radiator. This equates to an increase of 0.7% above the previously analyzed maximum engine horsepower of 5012. This is considered a negligible change which has been confirmed by the vendor. The vendor notes this condition occurs during the best operating conditions of the engine, when it is cool and drawing very dense combustion air for power operation. As soon as the engine warms up, in approximately 15 to 30 minutes, the low temperature condition is eliminated because the radiator is heating the air. In summary, a 0.7% increase in engine horsepower prior to the uprate is negligible because the engine is capable of meeting this short duration requirement as confirmed by the vendor.

2.A.5 Elimination of Recirculation of Radiator Discharge Air

During 1997 surveillance testing of the FPC EDGs, a portion of the radiator discharge air was identified as recirculating back to the radiator room intake structure. This recirculation was measured during the testing as affecting the supply air temperature by as much as 15°F. The condition increases the supply air temperature to the radiator, combustion air, and the engine room cooling. Appropriate modifications will be installed to minimize the recirculation of radiator discharge air and conform with required design. The planned modifications are to the building. The affect on the supply air temperatures will be reduced to a negligible influence as determined by wind tunnel testing of the revised configuration. Functional testing will validate the wind tunnel testing and confirm proper EDG performance.

2.A.6 Engine Room Ventilation Modifications

The cooling to the EDG engine room is being increased for two reasons. First, the heat load to the engine room is increasing due to the engine and generator releasing more heat to the room due to the increased intermediate ratings. The increased heat loads are documented in

Coltec report VTS-985-970714-01R, dated 7/31/97. The second reason is testing performed in 1997 identified the heat load in the engine room at the present EDG ratings is higher than was previously documented.

The flow rate for the cooling air to the room will be increased approximately 50%. The increase will be accomplished by requiring both ventilation supply fans for each engine room to operate. There are two ventilation supply fans for each room. These fans are not driven by the engine of the EDG. Prior to this modification, only one of the two fans was required to operate. Both fans have always automatically started when the EDG started. The procedures allowed one of the fans to be secured after both fans were confirmed to be operating. Therefore, the only operating change is to eliminate the steps in the operating procedures allowing one fan to be secured. (Control cables for some of the fans are being rerouted and switches being added to comply with Appendix R protection requirements, but the operation of the fans is not effected). The cooling capability is tied to outside air temperature and the ventilation calculation has confirmed two fans are required only when the outside air temperature is above 85°F. (This value was conservatively determined and the number may change based on testing after all the modifications are installed).

The use of two fans is not considered a significant reduction in the EDG system reliability, but it is considered an Unreviewed Safety Question (USQ) since it can increase the potential for equipment malfunction. The USQ has been submitted for NRC approval by FPC's letter number 3F0897-25 dated August 25, 1997.

The supply fan filters are being replaced with ones having a lower pressure drop and grills are being added to the ductwork to reduce back pressure in the system. These changes are being implemented to maintain the present two fan air flow when the new radiators are installed. The radiators will slightly block a portion of the engine room exhaust damper. The ventilation system resistance is being reduced by the modifications discussed above to offset the additional resistance of the partial blockage of the exhaust damper. General system balancing will also be performed.

Engine room and component temperatures will be monitored during testing to confirm adequate cooling. The evaluations will account for the actual outside air temperature during testing.

3. <u>Basis for Emergency Diesel Generator Qualification</u>

The EDGs will be qualified after the modifications based on testing performed by the EDG vendor, analysis by the vendor and FPC, similarity of the components being replaced, and site testing of the EDGs after the modifications.

3.1 Qualification of the Engine Modifications and the Power Uprate

The engine modifications and power uprate have been qualified by the vendor and will be confirmed by site testing. The vendor performed the qualification for Baltimore Gas and Electric (BG&E) by testing a similar EDG at or above 3300 kW for 2000 hours and at or above 3500 kW for 200 hours. The Coltec qualification test reports are included as an enclosure to this test plan. The applicability and capability for the FPC EDGs to be uprated using the BG&E configuration was analyzed by the EDG vendor. Refer to section 3.4 below for a comparison of the FPC's EDG to the BG&E EDG. The FPC EDG power uprate analysis is documented in Coltec's report VTS-985-961108-01R, Revision 2, dated 5/28/97. This analysis documents the vendor's confirmation that the FPC EDG and its support systems will perform as required at the new ratings. The report accounts for the test EDG not having a radiator fan for engine cooling by reducing the rated power output of the FPC EDG by 100 kW. The 100 kW accounts for the horsepower used to power the crankshaft driven radiator fan. The report analyzes the FPC EDG support systems, including the radiator, and confirms the FPC EDG and its support systems capability at the new ratings.

Electrical systems and protection systems were evaluated and confirmed acceptable for the new intermediate ratings. This was expected since the maximum rating is not increasing. Even though the maximum rating is not increasing, FPC did extensive testing of the exciter in March 1997 and reconfirmed the capability of the component. The generator capability was reconfirmed in Coltec's report VTS-985-961108-01R, Revision 2, dated 5/28/97.

In addition to our internal review of the EDG modifications and test program, FPC requested assistance from numerous industry experts. Specifically we consulted with Coltec (the EDG vendor), the Woodard Corporation, MPR Associates Inc., and two IEEE 387 Board Members. These personnel reviewed the engine modifications and the power uprate. All agreed that the proposed modifications and test plan for the CR-3 EDGs are acceptable and clearly demonstrate qualification and operability of the EDGs.

In summary, the EDG modifications for the engine modifications and power uprate are qualified by the qualification testing performed by the vendor. The vendor, Coltec, confirmed the similarity of the FPC EDGs to the BG&E EDG tested.

3.2 1992 Modifications by Baltimore Gas and Electric (BG&E)

The following discussion provides additional information for understanding the similarity between the BG&E EDGs and FPC's EDGs.

In 1991, BG&E needed to increase the ratings for their EDGs at Calvert Cliffs. At that time, the BG&E EDGs were units of the same type as the pre-1990 modified FPC units. However, they needed higher intermediate ratings than the FPC units had been qualified and modified to in 1990. The EDG vendor suggested implementing the same changes FPC had installed in 1990 plus two other changes. The additional changes were to use dual pass combustion air intercoolers and to change the nozzle ring in the turbochargers to a pitch that allows the turbocharger rotor to operate at a lower RPM. These changes have been implemented at FPC in 1997 and are the subject of discussion above.

3.3 Discussion of BG&E Intermediate Rating Power Testing

BG&E required a rigorous and comprehensive qualification of the EDG modifications by the vendor. The vendor performed qualification tests on BG&E's spare EDG after modifying it to the new configuration. This test EDG was outfitted with the same configuration as the FPC EDGs except for the two additional changes. The vendor then performed power qualification testing on the spare EDG for a total of 2200 hours. The spare EDG was operated for 2000 hours at 3300 kW and 200 hours at 3500 kW. The test was for the full duration of the ratings. The testing is documented in Coltec report titled 200 Hour Rating Qualification Test Report and Coltec report titled Results of 2000 Hour Test at 385 BHP/Cyl. on 38TD8-1/8 O. P. Engine, Report #R-5.08-0236 (9/13/94).

3.4 Comparison of FPC Emergency Diesel Generator to the BG&E Emergency Diesel Generator Tested

The BG&E test EDG was the same configuration as FPC's EDGs except for two minor engine differences. Therefore, the new intermediate ratings for the BG&E EDGs are applicable to FPC's EDGs after the new intercoolers and nozzle rings are installed on the FPC engines. Documentation supplied in Table 1 confirms the BG&E EDG is the same configuration as FPC's EDG. This information has been confirmed by the EDG vendor. The FPC's EDG engines were modified in the first quarter of 1997 to install the new turbocharger nozzle rings and the new intercoolers. The functional testing of the modifications confirmed the performance of FPC's EDGs matches the test results of Coltec's testing of the BG&E test engine and also the test results of testing by BG&E at their site. Numerous parameters were measured during the testing. The key component parameters monitored are identified in the attached Table 2. The comparison of the test results confirm that FPC's EDGs have the same performance parameters as the qualified BG&E engines.

3.5 EDG Modification Impact Analysis

FPC performed an analysis of the impact of all the modifications on each of the EDG subsystems. Evaluations were performed on the potential impact that the changes could have on EDG starting and power operation. Also, the testing required to demonstrate that the EDGs are not adversely affected was identified. This analysis is included as Table 3, Impact of 1997 Uprate Modification to EDG reliability for Starting and Operation.

3.6 Qualification of The Radiator Modifications

The new radiators are larger but are of the same general configuration and utilize essentially the same drive components for the radiator fan. The EDG vendor, Coltec, provided the new radiators. The vendor analyzed the new radiators and confirmed the radiators will perform the required function. Since the radiators are of the same general configuration and perform the same function, the new radiators are considered a component replacement. The testing discussed in this submittal and the analysis performed by the vendor ensure qualification of the EDGs. Qualification was confirmed by the EDG vendor, two independent third party reviews, and discussions with five members of the 1995 IEEE 387 Board. All the modifications to be implemented during the radiator outage were discussed with all five IEEE 387 Board Members. The Board Members agreed that the radiator modifications would not impact EDG qualification.

3.7 Summary

The maximum rating for the FPC EDGs is not increasing. The BG&E Calvert Cliffs spare EDG, matching FPC's units, was power tested by the vendor for 2200 hours total at the new intermediate ratings. In addition, the two BG&E EDGs of the same type at Calvert Cliffs have been site tested and put in service with the modifications and new ratings. The changes to the BG&E EDGs have been in operation for more than three years. Therefore, the design has been thoroughly tested. The only changes that were required to make the FPC's EDG configuration match the qualified configuration of the BG&E EDG was the replacement of the turbochargers nozzle rings and replacement of the intercoolers.

4. EDG Post-Modification Test Plan

FPC is implementing the test plan discussed below. The testing confirms functionality, qualification and operability of the EDGs. The EDG testing objectives are:

1. Demonstrate the engine operates within specified limits at new power ratings. The key engine parameters are: turbocharger RPM, intercooler discharge temperature, firing pressures. Other EDG parameters to be monitored include jacket water and lube oil temperatures.

2. Demonstrate generator will perform as required at new power ratings. Main parameters to monitor included generator stator and field temperatures and also the exciter amps at the required generator output kW / kVA.

3. Demonstrate new radiator will perform its function at new ratings. The prime parameters to be monitored are: cooling air flow rate / radiator fan performance, heat transfer across radiator, heat transfer between engine components and radiator.

4. Demonstrate radiator discharge air recirculation has been eliminated by confirming the air temperature in radiator room is approximately the same as the outdoor temperature.

5. Demonstrate the engine room and component temperatures within criteria. The room exhaust air temperature and the temperature rise across the room will be monitored. In addition, the temperature of various components and cabinets will be monitored. The tests will be run a sufficiently long time to achieve temperature stability during data gathering.

The test results of the monitored parameters will be compared to the analysis and allowable operating parameters defined by the vendor to validate proper performance and assure similar results to the qualified BG&E engine.

The following is a general schedule for testing the emergency diesel generator radiator following the radiator modifications:

A. Unloaded Maintenance Run
Slow Start with incremental increase in speed (500 to 900 RPM)
   a. Inspect for leakage, multiple parameters checked
   b. If major leakage, maintenance required, then repeat Unloaded Maintenance Run
   c. Stop Engine with Overspeed Trip Test
Duration: Approximately 30 Minutes

B. Slow Start and Load (2625 to 2825 kW)
Record Radiator Data (Flow, dp)
Record 50+ parameters
Shutdown engine
Evaluate data for changing Radiator Fan Blade Pitch
Adjust Fan Blade Pitch
Duration: Approximately 2 to 3 hours

C. Slow Start and Load (2625 to 2825 kW)
Record Radiator Data (Flow, dp)
Record 50+ parameters
Shutdown engine
Evaluate data for changing Radiator Fan Blade Pitch
Adjust Fan Blade Pitch
Duration: Approximately 2 to 3 hours

D. Slow Start and Load (2625 to 2825 kW)
Record Radiator Data (Flow, dp)
Record Room Ventilation Fan Data (Dual/Single Fan, Clean/Dirty Filter)
Record 100+ parameters
Duration: Approximately 24+ hours

E. Fast Start and Load (2625 to 2825 kW)
Modified Missile Shield
Record Radiator Data
Record Room Ventilation Data
Record 50+ parameters
Duration: Approximately 1 to 4 hours

F. Slow Start and Load (2625 to 2825 kW)
SP-354A Final operational run with test equipment removed from engine room
Record 50+ parameters
Duration: Approximately 4 hours

G. Review test results and perform additional testing if necessary.

Summary of 1997 EDG Starts and Loads
After Radiator Modification

The following table summarizes the starts and rated load runs for the EDGs. This table includes normal surveillance runs as well as those done for post-maintenance testing. The EDGs have passed all surveillance tests since the completion of the turbocharger and intercooler modifications. Throughout the modification process, the EDGs have met the reliability goals of the EDG surveillance program.

EDG Train	No. of Engine Starts (No Load)	No. of Rated Load Runs	Estimated No. of Operating Hours
"A" Train	3(1)	12(1)	64
"B" Train	4(1)	9(1)	50

(1) Includes only those starts and rated load runs since installation of new turbochargers and intercoolers.

The following is a general summary for the Power Uprate testing:

A. Slow Start and Load (2625 to 2825 kW)
Record 100+ parameters
Duration: Approximately 25 hours

B. Power Testing at 2000 Hour Rating (3100 to 3175 kW)
Record 100+ parameters
Duration: Approximately 14 hours

C. Power Testing at 200 Hour Rating (3300 to 3375 kW)
Operate during dual and single HVAC fans to confirm adequate cooling during both conditions
Record 100+ parameters
Duration: Approximately 22 hours

D. Full load rejection test (greater than 3300 kW)

E. Largest single load rejection test - shutdown

F. Hot Start and Load (2625 to 2825 kW)
Record 50+ parameters
Duration: Approximately 1 hour - shutdown

G. Fast Start and Load (2625 to 2825 kW)
Record 50+ parameters
Duration: Approximately 1 hour - shutdown

H. As a contingency, additional hot starts or engine ambient starts and loaded run testing may be performed based on system performance results.

Summary of EDG Starts and Loads
For Power Uprate

The following table summarizes the additional starts and rated load runs that are planned as part of the post modification testing planned after all EDG modifications are complete, prior to entering Mode 4.

EDG Train	No. of Engine Starts (No Load)	No. of Rated Load Runs	Estimated No. of Operating Hours
"A" Train	N/A	3	63
"B" Train	N/A	3	63

The order and exact durations of the testing may vary. All the tests will be performed and the basic intent of the durations will be maintained. The kW loading values account for instrument inaccuracy of 25 kW, so the test load is 25 kW less than the rating to prevent exceeding the rating. An operating band is provided to account for instabi[illegible] of the grid and operator control. The power level is maintained in the continuous rating of EDG when not performing a specific power test to maintain the heat load in the room. The heat load is maintained to monitor HVAC cooling capability during an extended run.

Prior to restart, FPC will perform the combined ES actuation with simulated LOOP test which requires the EDG to automatically load. This test may not be performed at the same time as the other EDG testing because the ES components must be made available to perform the test. Other plant restraints may prevent some of the ES components from being available concurrently with the EDG test.

After the testing is complete for each EDG, FPC will perform evaluations of test results with the vendor and confirm all systems function as required for the new ratings.

Summary of the 1997 Power Uprate Testing Program

Title	Description
Start and load run	Start and run at 2625 to 2825 kW for 1 hour
Fast start	Time to start & reach voltage and frequency
Combined ES Act	Simulated LOOP with de-energizing safety bus, EDG auto-start and auto-load sequencing, load > 5 minute
Single load reject.	Single largest rejected, voltage & frequency monitored
Full load rejection	Reject maximum load, voltage maintained & no overspeed
Endur. & margin	At least 22 hrs @ 2625 to 2825 kW & 2 hrs @ 3325 to 3375 kW, see note below
Hot restart	Full temp. restart - voltage, frequency & time

Note for Endurance and Margin test - The design of the CR-3 electrical system does not allow loading of the diesel to pre-specified loads in a LOOP configuration (i.e., not connected to the offsite grid). Therefore, while voltage and frequency will be monitored, they will be significantly influenced by the offsite grid. The voltage and frequency monitoring done during the load rejection tests serves to assure these parameters are being properly controlled.

The following table provides a summary of all starts and rated load runs completed or planned from the completion of the intercooler and turbocharger modifications until the end of the power uprate testing. The test program involves multiple starts and extended loaded runs as summarized in the table below. These tests will provide the data necessary to ensure qualification.

Summary of 1997 EDG Starts and Loads

EDG Train	No. of Engine Starts (No Load)	No. of Rated Load Runs	Estimated No. of Operating Hours	Total Starts/ Loads
"A" Train	3	15	127	18/15
"B" Train	4	12	113	16/12

Conclusion

A rigorous and comprehensive test plan is being implemented to confirm the EDGs are functioning as designed. The necessary EDG systems will be tested and monitored to confirm proper function. In conclusion, FPC is implementing a test plan which will confirm the qualification of the EDGs.

Table 1
BG&E/FPC
EDG PARTS COMPARISON

BG&E	PART DESCRIPTION	FPC
38TD8-1/8	Engine make/model	same
12	# Cylinders	same
16609598	Piston Assy - Upper	same
16609599	Piston Assy - Lower	same
16609595	Cylinder Liner/Belt Assy	same
16600739	Crankshaft - Upper	same
16600738	Crankshaft - Lower	16600998[1]
16604650	Block	same
16600737	Con Rod - Upper	same
16600736	Con Rod- Lower	same
16603864	Camshaft	same
16605621	Bearings	same
16501476	Blower	same
16611024	F.I. Pump	16611017[2]
16604922	L.O. Pump	16605139[1]
16610746	J.W. Pump	16600637[3]
16601667	I.C. Pump	same
16600208	Fuel Pump/Drive	same
16611593	Turbo Assy - 23"	same
16402002	Governor	16704844[4]
16605593	Vertical Drive	16600727[5]
TG2DJ	Generator Model	same
00604217	Generator Stator	same
00604189	Generator Rotor	same
11905506	Exciter	same

Discussion of differences:

(1) Lower crankshaft and L.O. Pump on FPC has provision for power take off.

(2) Fuel Injection Pump on FPC is a "back header" vs. BG&E "front header". Both pumps have 5/8" plunger/barrels and deliver same qualities of fuel to engine.

(3) Pump casting rotated to modify position of inlet/outlet. No other difference.

(4) BG&E uses EGB10 vs. FPC uses UG-8. No difference in load carrying capability.

(5) BG&E shafts incorporate end plate for easier maintenance. FPC shafts have "shouldered" ends. No difference in load bearing or wearing components.

TABLE 2
COMPARISON OF KEY ENGINE PARAMETERS TESTING FOR ENGINE POST MODIFICATION

	BG&E Engine at Coltec	BG&E Engine at Calvert Cliffs	'A' Engine at FPC		'B' Engine at FPC	
	3054kW	3250kW	2690kW	3190kW	2730kW	3145kW
Firing Pressure for Cylinder						
1	1250	1340	1200	1340	1220	1380
2	1238	1290	1200	1340	1200	1330
3	1210	1300	1100	1360	1200	1330
4	1230	1340	1100	1340	1210	1340
5	1240	1340	1100	1380	1250	1380
6	1240	1280	1200	1340	1230	1360
7	1190	1300	1180	1320	1220	1340
8	1240	1330	1200	1360	1240	1370
9	1200	1300	1180	1340	1230	1380
10	1210	1260	1200	1320	1220	1350
11	1210	1320	1200	1360	1250	1380
12	1270	1340	1200	1360	1240	1360
Turbo Charger RPM						
Control Side	17861	18050	16545	17925	16600	17959
Opposite Control Side	17568	17700	16320	17700	16421	17721
Inter-Cooler Discharge Temp	101	104	104	108	110	115
Fuel Rack	8.0	8.0	new 6.5 old 7.0	new 8.0 old 8.0	new 7.0 old 7.0	new 8.0 old 8.0

TABLE 2
COMPARISON OF KEY ENGINE PARAMETERS TESTING FOR ENGINE POST MODIFICATION

	BG&E Engine at Coltec	BG&E Engine at Calvert Cliffs	'A' Engine at FPC		'B' Engine at FPC	
	3054kW	3250kW	2716kW	3191kW	2730kW	3145kW
Exhaust Temp for cyl (°F)						
1	853	820	860	890	840	900
2	879	860	850	890	840	900
3	716	700	710	740	720	750
4	806	760	860	880	790	830
5	832	800	870	900	820	860
6	706	660	730	750	720	760
7	888	830	840	880	850	890
8	851	830	850	890	880	920
9	706	680	670	700	680	720
10	861	850	800	830	850	890
11	824	820	750	790	820	860
12	689	680	700	720	720	750
Turbo CS	904	860	900	930	900	940
Turbo OCS	861	840	930	960	880	920

TABLE 3
IMPACT OF 1997 UPRATE MODIFICATIONS TO EDG RELIABILITY FOR STARTING AND OPERATION

Sub-system	Changes	Impact to Starting	Impact to Power Operation	Required Testing
Starting	None - no modifications; function and operation unchanged	None	None - No change to air start system and not involved when engine is running	
Lubrication	a. System function, operation, and flow rates are unchanged b. Piping reroutes to match new radiators c. Conservatively increased minimum storage volume of lube oil, not required per vendor since oil consumption not increased	None a. No impact b. Pipe routing changes have negligible impact on flow and pressure drop c. No impact - lube oil is stored in drums outside of the EDG building	None a. No impact b. Piping reroutes will not affect lube oil flow or EDG operation; will be monitored for vibration. c. No impact - lube oil is stored in drums outside of the EDG building	Piping reroutes will be monitored for lube oil flow and vibration.
Fuel	a. Raised setpoints on day tank for pump start & stop and also low and high level alarm b. Increased minimum amount of fuel to be stored in day tanks and main storage tanks c. Flow rate into engine increases for 200 and 2000 hour ratings but no change for maximum rating so maximum flow rate does not change	System effectively unchanged a. Higher minimum day tank level does not affect starting b. Higher minimum storage tank level does not affect starting c. Fuel flow rate for start unchanged d. Rerouted transfer pipe has no impact on EDG start	a. Higher day tank level improves NPSH for pump operation b. Higher storage tank level improves NPSH for pump operation c. Engine driven fuel oil pump flow rate is actually unchanged since the pump is oversized and the extra fuel flow is being recirculated back to the day tank; the injector pumps are also oversized and inject only the required fuel	a & b. calibration testing will be performed on setpoint changes d. piping will be monitored for vibration and confirm

TABLE 3
IMPACT OF 1997 UPRATE MODIFICATIONS TO EDG RELIABILITY FOR STARTING AND OPERATION

Sub-system	Changes	Impact to Starting	Impact to Power Operation	Required Testing
	d. Rerouted fuel oil transfer piping		based on the fuel rack (pump plunger helix) position and the maximum power level has not changed; The fuel oil transfer pumps are capable of about 100% more flow than required based on pump performance tests, the transfer pumps are qualified for continuous operation and will operate for longer durations at intermediate ratings but about the same number of cycles based on the new positions of the on/off switches in the day tank There has been no increase for the maximum flow rate since the maximum kW rating has not changed (the 1.6% horsepower/ fuel oil flow rate variation accounting for the new ambient minimum design temperature and the use of antifreeze in the radiator is a negligible impact)	

TABLE 3
IMPACT OF 1997 UPRATE MODIFICATIONS TO EDG RELIABILITY FOR STARTING AND OPERATION

Sub-system	Changes	Impact to Starting	Impact to Power Operation	Required Testing
Combustion air	a. Combustion air intercooler has been changed out with more efficient dual pass units b. Nozzle rings in turbochargers replaced with rings which slow down the rotor c. Air flow rate is to increase slightly for a given power level due to more efficient combustion air intercooler - d. Pressure drop of supply air to inlet of filter should reduce due to missile shield modification and increase due to higher radiator air flow rate - total change should be less than 0.25" water so influence effectively negligible compared to change in barometric pressure e. No changes have been made to the system - function and operation unchanged	No impact for starting No changes to blower which provides air for starting a. Cooler air from intercooler does not occur until after engine has been running and cooler air would improve general engine performance b. Turbocharger nozzle ring change does not affect starting since turbocharger not used for starting c. Starting air flow rate does not change appreciably d. No impact for the missile barrier change because air flow has not been established during starting e. No functional changes	No negative affect on running No changes to blower a. Cooler air from intercooler improves general engine performance by providing cooler, denser air to the combustion chamber b. Turbocharger nozzle ring change improves the turbocharger life by slowing down the rotor while still providing adequate combustion air to the engine. The denser air from the intercooler reduces the pressurization requirement for the turbocharger thus allowing it to operate at a lower RPM for a given power level No moving parts have been changed so there is no required break in time No physical changes to the combustion air supply piping and the slight increase in flow	Confirm improved cooling by intercooler; confirm turbocharger RPM acceptable, confirm combustion air delta P acceptable (including missile barrier influence)

TABLE 3
IMPACT OF 1997 UPRATE MODIFICATIONS TO EDG RELIABILITY FOR STARTING AND OPERATION

Sub-system	Changes	Impact to Starting	Impact to Power Operation	Required Testing
			rate of combustion air does not have a significant impact on pressure drop which has been confirmed for power levels up to 3100 kW and will be rechecked during the 3400 kW run	
Exhaust	a. Air flow rate is to increase slightly for a given power level due to more efficient combustion air intercooler - b. No changes have been made to the system - function and operation unchanged.	None a. Slight increase in air flow will not be in effect during start	a. Slight increase in flow rate of exhaust gases due to the slight increase in combustion air flow rate does not have a significant impact which has been confirmed for power levels up to 3100 kW and will be rechecked during the 3400 kW run	Confirm delta P for exhaust is acceptable
Generator	None No changes have been made to the system - function and operation unchanged - intermediate power levels increased but maximum rating remains unchanged Coltec evaluated the generator and confirmed it has sufficient capacity.	None	None	Monitor temperature of field, stator, and bearing to assure proper function. Extrapolate test results to design conditions as necessary.

TABLE 3
IMPACT OF 1997 UPRATE MODIFICATIONS TO EDG RELIABILITY FOR STARTING AND OPERATION

Sub-system	Changes	Impact to Starting	Impact to Power Operation	Required Testing
Excitation	None No changes have been made to the system - function and operation unchanged - intermediate power levels increased but maximum rating remains unchanged In addition to the analysis by Coltec, the exciter was monitored during initial functional testing of the engine modification in Feb. and March 1997 and confirmed to operate with sufficient margin.	None	None	Monitor field current to assure remains below manufacturer's limit of 54 amps continuous. Extrapolate test results to design conditions as necessary.
Voltage regulation	None No changes have been made to the system - function and operation unchanged - intermediate power levels increased but maximum rating remains unchanged	None	None	
Governor	None No changes have been made to the system - function and operation unchanged	None	a. Maximum single load EDG must support as identified in the Tech Specs increased b. Maximum load EDG must support as identified in the Tech Specs increased but not above previous maximum load rating	a. Perform loss of single largest load test b. Perform loss of maximum load; confirm EDG does not trip on overspeed
Auxiliary electric	Lights and switch were added to the radiator compartment	None	None	

TABLE 3
IMPACT OF 1997 UPRATE MODIFICATIONS TO EDG RELIABILITY FOR STARTING AND OPERATION

Sub-system	Changes	Impact to Starting	Impact to Power Operation	Required Testing
Crankcase ventilation	None No changes have been made to the system - function and operation unchanged	None	None	
Control and protection systems	a. Improve main control board kW meter accuracy by removing burden on CTs b. Relocated auxiliary gauge panel to match radiator compartment and readouts for level of the surge tanks added	a. None - no changes to the primary control system, provides more accurate kW reading to the operator b. None - function and operation of instruments remain the same	a. None -no changes to the primary control system, provides more accurate kW reading to the operator b. None - function and operation of instruments remain the same	a. Perform calibration checks b. Perform calibration checks
Cooling air and ventilation system	a. Must run both fans per room instead of starting both and securing one - increasing required air flow. b. Adding grills to supply ductwork c. Adjusting grills to redistribute air flow (new balancing) d. Replacing filters with ones having lower pressure drop e. Two fan running concurrently draws more current than current due to one fan operating multiplied by 2.	No changes to ventilation system for starting Always had both fans start when EDG starts a, b, c, d, & e - changes do not impact EDG starting capability	Room cooling is improved a, b, & d. Changes are to maintain or increase cooling of EDG to assure design limits are maintained c. Adjusting grills is to improve local cooling, component temperatures will be monitored to confirm proper cooling e. Always had both fans start when EDG starts; running one or two fans has no impact on EDG start or load carrying capability	a. Verify required flow rates achieved b. & c. Perform system balance d. Confirm filter dP General - Component temperatures will be monitored to confirm proper cooling

TABLE 3
IMPACT OF 1997 UPRATE MODIFICATIONS TO EDG RELIABILITY FOR STARTING AND OPERATION

Sub-system	Changes	Impact to Starting	Impact to Power Operation	Required Testing
Primary Cooling	a. Pumps and cooling water pumps and flow rates are unchanged b. Radiator cores replaced with larger, more efficient ones c. Rerouted jacket water to match new cores d. Rerouted combustion air coolant piping to match new cores e. Radiator fan drive train replaced but most components are the same or very similar - the following is a summation of the differences: 1) Engine drive shaft - no change; floating shaft/couplings - same except 26.5" longer for relocated fan due to extended radiator compartment. 2) Clutch support bearing - no change	a. No impact b. No impact - all flow bypasses the radiator cores during the first few minutes of operation; c. No impact - clutch not engaged for start d. No impact - clutch not engaged for start e. No impact - drive train not engaged during start of engine until engine is up to 450 RPM due to clutch assembly. The new drive train is the same configuration and uses the same basic parts, so there is no significant impact of the drive train changes when compared to the present radiator drive train. 1) No impact - negligible increase in inertia, will perform frequency response testing to confirm 2) No impact 3) No impact 4) No impact confirm no impact due to inertia	a. No impact b. Positive impact - larger radiator cores provide improved cooling c. & d. rerouted jacket water and combustion air cooling piping has no impact on EDG which will be confirmed by the 3 day test. Will monitor for vibration and proper cooling e. No impact - see discussion under starting f. No impact - No influence on starting or operation of EDG as long as change in heat transfer capability is accounted for. The new larger cores and the fan air flow rates account for this. g. No impact - the two subsystems still operate and function the same; have the capability for independent control now	Monitor piping for vibration; monitor air flow rates for proper CFM; monitor EDG for proper cooling; monitor fan and fan drive train for vibration; Monitor fan performance - delta P and flow rate; monitor dP across missile barrier perform frequency recovery testing; verify proper operation of surge tank level alarms.

TABLE 3
IMPACT OF 1997 UPRATE MODIFICATIONS TO EDG RELIABILITY FOR STARTING AND OPERATION

Sub-system	Changes	Impact to Starting	Impact to Power Operation	Required Testing
	3) Centrifugal clutch - no change except potentially to change 3 of the 6 shoes from aluminum to cast iron so it can transmit more horsepower 4) Right angle gear drive - same make and effectively the same model except changed the gear ratio to 1:1 from 1:1.25 so fan tip velocity is minimized. 5) Double universal joint assembly - compressed length of the shaft increased from 62 to 75.5 inches 6) Fan drive bearing assembly - the new bearing assembly is much stronger with a larger diameter .‌.aft and the use of tapered roller bearings instead of ball bearings.	5) No impact - negligible increase in inertia and turns at slower speed so have offsetting influence, will perform frequency response testing to confirm no impact due to inertia. 6) No negative impact - improved reliability 7) No horsepower change for new fan for normal operating conditions from the nominal 180 HP. Due to the new minimum design temperature limits and also accounting using antifreeze in the radiator, the fan horsepower can increase to a maximum of 264 horsepower for approximately the first 10 minutes of operation. As the engine increases in temperature, the horsepower to drive the fan will reduce to 234 horsepower when the outside air temperature remains at 15°F.	h. Positive effect - The planned reduced pressure drop through the missile barrier will reduce the required horsepower for the radiator fan. This reduction has conservatively not been accounted for in the fan analysis discussion above. Testing will confirm the reduction in pressure drop and will be accounted for later.	

TABLE 3
IMPACT OF 1997 UPRATE MODIFICATIONS TO EDG RELIABILITY FOR STARTING AND OPERATION

Sub-system	Changes	Impact to Starting	Impact to Power Operation	Required Testing
	7) New larger diameter fan is designed to move more air at the same horsepower because the new radiator core has less pressure drop so the fan can move more air at a lower delta P. New fan is easier to adjust blade pitch Increased horsepower required to drive fan for low temperature operation due to revised design point 8) Fan discharge duct modified to match new size and position of fan relative to existing hole in roof 9) New upper compartment housing for radiator to match larger cores and fan	The horsepower requirement reduces as the outside air temperature increases. The maximum horsepower change from nominal is 264 - 180 HP = 84 HP. The engine is producing approximately 5012 HP at 3500 kW (including the normal fan horsepower of 180) so this variation is 1.7% of the standard engine horsepower. The variation from the previous fan maximum horsepower of 234 is only 34 horsepower more or 0.7% The maximum horsepower requirement occurs when the engine is drawing cold, dense air for combustion air and cooling so the engine capability is increased for this condition compared to a 95°F day. Therefore, there is no significant affect on required engine horsepower due to the fan change-out or operation in cold weather. Coltec confirmed, in their report VTS-985-970714-01R, that the cold weather fan horsepower is compared to normal fan horsepower is insignificant.		

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Sub-system	Changes	Impact to Starting	Impact to Power Operation	Required Testing
	f. Antifreeze added to jacket and intercooler water reducing heat exchange capacity g. Eliminated tie between jacket water and combustion air cooling water and added second surge tank for combustion air cooling water system h. Missile barrier modified to reduce pressure drop for cooling air flow to the radiator	The fan drive train changes has negligible impact on the ωR^2 of the EDG assembly, especially since the fan does not engage until the engine RPM is greater than 450. The new fan rotates at a 20% lower RPM than the old fan which reduces the inertia influence of the fan. Coltec confirmed, in their report VTS-985-970714-01R, that the ωR^2 of the new fan is 2347 lb-ft^2 and the ωR^2 of the old fan is 782 lb-ft^2. However, the inertia is not significant compared to the engine generator assembly which has a inertia of ωR^2 = 39,000 lb-ft^2. This is only a 4% change. Frequency recovery testing will be performed as part of the overall testing to confirm there is no influence due to this.		

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Sub-system	Changes	Impact to Starting	Impact to Power Operation	Required Testing
		8 & 9) No impact -Impact covered by fan discussion above f. No impact -No influence on starting or operation of EDG as long as change in heat transfer capability is accounted for. The new larger cores and the fan air flow rates account for this. g. No impact -the two subsystems still operate and function the same; two surge tanks were installed to minimize the tank size required and to simplify piping. h. Positive effect - The planned reduced pressure drop through the missile barrier will reduce the required horsepower for the radiator fan. This reduction has conservatively not been accounted for in the fan analysis discussion above. Testing will confirm the reduction in pressure drop and will be accounted for later.		

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IMPACT OF 1997 UPRATE MODIFICATIONS TO EDG RELIABILITY FOR STARTING AND OPERATION

Sub-system	Changes	Impact to Starting	Impact to Power Operation	Required Testing
Secondary cooling	N/A - do not use secondary cooling - use radiators	N/A	N/A	
Engine	a. Horsepower output increased for increased intermediate ratings b. Minor horsepower increase (1.6%) for fan drive during low temperature operation c. Combustion air system changes discussed above	a & b - None c. See combustion air discussion above	a & b. New intermediate ratings were qualified by Coltec on an EDG of the same type for the full duration of the rating. Maximum kW rating for EDG unchanged. No physical changes to engine other than those discussed in the combustion air system above which improve performance. The higher mass flow rate of combustion air reduces peak firing pressure which reduces engine stresses at a specific power level. The horse-power has a negligible power increase for the radiator fan associated with the new minimum ambient air temperature and using antifreeze	Monitor firing pressure for 3400 kW test; already done at lower power levels with acceptable results