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W3F1-2000-0006
A4.05
PR

January 27, 2000

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

Subject: Waterford 3 SES
Docket No. 50-382
License No. NPF-38
Request for Additional Information
Technical Specification Change Request NPF-38-220
Emergency Diesel Generator Allowed Outage Time Increase

Gentlemen:

Please find attached the response to a Request for Additional Information related to Technical Specification Change Request NPF-38-220, which was forwarded to Entergy on December 21, 1999 by Mr. Chandu Patel of your staff. Technical Specification Change Request NPF-38-220 was transmitted to the NRC Staff by Letter W3F1-99-0022 dated July 29, 1999. The proposed change modifies Technical Specification 3.8.1.1 and associated Bases by extending the Emergency Diesel Generator allowed outage time (AOT) from 72 hours to ten days.

This response to the request for additional information does not affect the Technical Specification Change Request; therefore, the No Significant Hazards Consideration Determination remains valid.

A001

This letter does not contain any commitments. Should you have any questions or comments concerning this request, please contact Ron Williams at (504) 739-6255.

Very truly yours,

C.M. Dugger
Vice President, Operations
Waterford 3

CMD/RLW/ssf

Attachments: Affidavit
Request for Additional Information for NPF-38-220

cc: E.W. Merschoff, NRC Region IV
N. Kalyanam, NRC-NRR
J. Smith
N.S. Reynolds
NRC Resident Inspectors Office
Administrator Radiation Protection Division
(State of Louisiana)
American Nuclear Insurers

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the matter of	)	
	)	
Entergy Operations, Incorporated	)	Docket No. 50-382
Waterford 3 Steam Electric Station	)	

AFFIDAVIT

Charles Marshall Dugger, being duly sworn, hereby deposes and says that he is Vice President Operations - Waterford 3 of Entergy Operations, Incorporated; that he is duly authorized to sign and file with the Nuclear Regulatory Commission the attached supplement to Technical Specification Change Request NPF-38-220; that he is familiar with the content thereof; and that the matters set forth therein are true and correct to the best of his knowledge, information and belief.

Charles Marshall Dugger
Vice President Operations - Waterford 3

STATE OF LOUISIANA)
) ss
PARISH OF ST. CHARLES)

Subscribed and sworn to before me, a Notary Public in and for the Parish and State above named this 27th day of January, 2000.

Notary Public

My Commission expires at death.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION FOR PROPOSED CHANGE NPF-38-220

By letter dated July 29, 1999, Entergy licensee proposed changes to the plant's Technical Specifications (TS) for extending the allowed outage time (AOT) up to ten days for each emergency diesel generator (EDG) in order to perform preventive or corrective maintenance during plant operation at Waterford 3. Entergy stated that an EDG AOT extension of ten days from the existing three days may potentially result in a small increase in the "at power" risk. Although Entergy provided a risk evaluation supporting the proposed change, the NRC Staff required additional information to support the deterministic and probabilistic risk assessment evaluations. Accordingly, Entergy is providing the following additional information to respond to the NRC Staff's questions and justify an increase in the AOT.

Question 1

Use of an alternate ac power source, if applicable, to substitute for the EDG being taken out for extended maintenance or excess redundant (three or more) EDGs, if applicable.

Response

The use of an alternate ac power source to substitute for the EDG being taken out for extended maintenance is not applicable to the Waterford 3 design. Waterford 3 does not have an alternate ac power source beyond normal offsite power and two seismically qualified, class 1E, diesel engine driven generators. The risk assessment has been performed without any alternate or backup ac power source.

Question 2

Provide a discussion and information on the reliability and availability of offsite power sources relating to the proposed change.

Response

In a November 29, 1999 conference call between the NRC Staff and Entergy representatives, this question was clarified for Entergy to provide a discussion and information on past events at Waterford 3 since commercial operation that involved either a complete or partial loss of offsite power (LOOP) sources.

The Waterford 3 offsite electrical grid consists of two independent offsite power feeds connected to two separate switchyard buses. Offsite power is fed to the Waterford 3 plant from each of these switchyard buses through separate startup transformers to two separate non-safety buses. Each non-safety bus is connected by separate bus duct to a safety bus. (Reference FSAR Figure 8.2-3)

A review of available data on loss of offsite power sources was conducted to identify complete or partial loss of offsite power sources. The review identified no complete loss of offsite power at Waterford 3 since commercial operation, as defined by the Waterford 3 Individual Plant Examination (IPE) - loss of all offsite power sources with offsite power not available for immediate reclosure. However, events were identified that resulted in partial LOOP and required Technical Specification 3.8.1.1 ACTION statement entries. Any transients that resulted in a loss of power from offsite sources to the 4.16kV vital (ESF) buses were considered a LOOP event.

1. On December 12, 1985, while the reactor was in mode 5, a bad weather related phase to ground fault developed on a transmission line between the Waterford 3 and Little Gypsy switchyards. The protective relaying cleared the fault in 10 seconds, however, the fault caused damage to one of the bushings on a Waterford 3 switchyard circuit breaker. Subsequent closing of this breaker and adjacent breakers caused four apparent ground faults in the system. The associated protective relaying successfully cleared these faults. This transient resulted in temporary loss of ties to two external sources for the switchyard and the ties to Waterford 3. Offsite power was lost and the emergency diesel generators (EDG) started in the emergency mode of operation. There were six external ties to the Waterford 3 Switchyard available at all times. The Waterford 3 East and West switchyard buses remained energized throughout this event. If required, plant loads could have been reclosed to an offsite source immediately. However, the plant was in cold shutdown and the EDGs ran successfully, and therefore there was no immediate need for reclosure to the offsite power source. (Reference LER 85-054-00)

2. On March 29, 1990, a severe transient occurred on the 230 kV transmission grid in the vicinity of Waterford 3. The transient was initiated when an employee at a chemical complex opened a knife switch to de-energize equipment for maintenance. This operation led to arcing and a ground fault on the system that was cleared in 0.5 seconds. The fault burnt a shield wire that fell across the transmission lines. Upon auto re-energization of the line 30 seconds later, a three phase fault developed on the network. This fault lasted approximately 0.5 seconds. The 230kV grid voltage dropped to approximately 34kV for 0.5 seconds. The momentary drop in voltage at the Waterford 6.9kV buses caused the reactor coolant pumps to slow to less than 96.5% of normal speed causing

the reactor to trip on low Departure from Nucleate Boiling Ratio (DNBR). The voltage transient also actuated the undervoltage relays on the 4.16kV "B" vital (ESF) bus and the corresponding Emergency Diesel Generator started. However, the undervoltage relays on the 4.16kV "A" vital (ESF) bus did not actuate which did not cause the "A" train to trip. The loading on the "A" vital (ESF) bus was less than the "B" vital (ESF) bus ("AB" aligned to "B" side). This event is categorized as a partial loss of offsite power. (Reference LER 90-003-01)

3. On August 25, 1990, with Waterford 3 at 100% power, a voltage transient occurred on the southeastern Louisiana 230kV grid. A lightning strike initiated a ground fault in the switchyard. This fault was rapidly cleared. A second fault, coupled with a breaker failure/explosion resulted in multiple faults in the Waterford switchyard. These faults isolated the switchyard from the southeastern Louisiana 230kV grid. Waterford 3 continued to supply the reduced switchyard loads, but eventually a resulting generator load rejection caused a reactor trip on high pressurizer pressure. The generator tripped at about 34 seconds The Waterford 3 switchyard was isolated from the grid for approximately 36 seconds, at which time the switchyard was re-energized from the grid. During this time the Waterford 3 vital (ESF) buses did not experience a voltage drop significant enough to start the EDGs. Approximately 37 minutes after the initial disturbance, power from one of the two 230kV supply lines was lost when the supply breaker was incorrectly opened by a service crew member trying to isolate the failed breaker. The other offsite power feed was still available. This event is categorized as a partial loss of offsite power. (Reference LER 90-012-00)

4. On September 30, 1992, while shutdown in Mode 6 for the fifth refueling outage, Waterford 3 experienced a loss of the 4.16kV "A" vital (ESF) bus when the bus feeder breaker from the non-safety bus supplying offsite power tripped on an apparent degraded voltage condition. The trip was caused by the actuation of three new undervoltage relays that were being installed as part of a design change. Because of an error in the design change implementation, no provision was made for the relays to sense bus voltage. Accordingly, as all three of the relays were eventually energized during the installation, none of them sensed actual bus voltage. This conditioned satisfied the necessary coincidence logic for the undervoltage/degraded voltage trip of the non-safety to vital bus feeder breaker. The relays functioned as designed in this condition and tripped the feeder breaker.

   The "A" side Emergency Diesel Generator, which would normally start to energize the 4.16kV "A" vital (ESF) bus on a degraded voltage condition, was

tagged out to perform outage related maintenance and inspections. As a result, the 4.16kV "A" vital (ESF) bus was de-energized for 59 minutes before offsite power could be restored by locally closing the non-safety to vital bus feeder breaker. This event is categorized as a plant-centered partial loss of offsite power. (Reference LER 92-018-00)

5. On June 10, 1995, a failed lightning arrestor on a Waterford switchyard transformer caused a momentary phase to ground fault on the 230kV grid. Waterford 3 was operating at 100% power. The grid transient actuated an 'over-sensitive' sudden pressure relay on Waterford 3 main transformer leading to a plant trip. The "A" train non-safety 4.16kV bus failed to transfer to the start-up transformer from the unit auxiliary transformer (UAT). The delayed opening of the feeder breaker from the UAT resulted in a fire in the non-safety 4.16kV switchgear and a loss of power to the "A" train vital (ESF) buses. The "A" Emergency Diesel Generator started and powered the "A" train components as designed. The "B" train was not affected by this event and did not lose offsite power. This event is categorized as a plant-centered partial loss of offsite power. (Reference LER 95-002-01)

6. On May 28, 1997 at 0901 hrs, while in Mode 5 during refueling outage 8, the failure of Startup Transformer "B" caused the loss of offsite power to the 4kV non-safety bus resulting in the loss of power to the 4.16kV "B" vital (ESF) bus. The "B" Emergency Diesel Generator started and powered the "B" train components as designed. The failure of Startup Transformer "B" was determined to be a turn-to-turn failure in the "C" phase of the 7.2 kV winding. Offsite power was restored to the "B" train at approximately 2329 hrs on May 29, 1997 by backfeeding through Main Transformer "B" and Unit Auxiliary Transformer "B". This event is categorized as a partial loss of offsite power. (Reference LER 97-024-00)

7. On July 20,1997, while in Mode 4, an inadvertent actuation of the lockout relay (86A2) resulted in opening the tie breaker from the 4kV non-safety to the 4kV vital (ESF) bus, resulting in a loss of power on the 4.16kV "A" vital (ESF) bus. The "A" Emergency Diesel Generator started and powered the "A" train components as designed. Incoming power from offsite sources to the plant was not affected. The root cause of the relay actuation was indeterminate. The relay was replaced. Offsite power was restored to the "A" train within 47 minutes. This event is categorized as a plant-centered partial loss of offsite power. (Reference LER 97-028-00)

The events specified above did not cause a complete LOOP at Waterford 3 because one of the two plant 4160 vital (ESF) buses was still available or the offsite power sources was available for immediate reclosure.

Question 3

As a station blackout commitment, you committed to maintain an EDG target reliability of 0.975. Address the reliability and unavailability of EDG when EDG AOT is extended to ten days. Also, discuss the impact of an AOT extension on EDG unavailability per Maintenance Rule.

Response

The assumptions of the Station Blackout Analysis (SBO) regarding Waterford 3's EDG target reliability of 0.975 will not be affected by the proposed AOT extension. This number is the product of start reliability and load-run reliability. Start reliability is derived by dividing the number of successful EDG starts by the total number of valid start demands. Similarly, load-run reliability is the number of successful EDG load-runs divided by the total number of valid demands to load. This calculated reliability is not influenced by AOT or plant risk factors. When the full scope of plant risk is considered, the Combustion Engineering Owner's Group "Joint Applications Report for Emergency Diesel Generators AOT Extension," CE NPSD-996, concludes that one of the factors that offsets the risks incurred by extending the AOT is increased EDG reliability "at power" and in the early (risk dominant) stages of shutdown.

The methodology for evaluating the SBO coping duration does not include the unavailability of EDGs as a contributor. The result of the SBO Analysis for Waterford 3 demonstrates a 4-hour coping duration. The coping duration will not be affected by the change in the EDG unavailability due to the proposed AOT extension.

The EDG unavailability is accrued when an EDG is taken out of service in a plant operating mode in which it is required to be operable. The current unavailability criteria, per the Maintenance Rule, consist of an on-line maintenance outage duration of 100 hours per EDG per year. This outage duration is currently based on the 72-hour allowed outage time for an EDG. Since both EDGs at Waterford 3 are required to be operable in Modes 1 through 4, the proposed AOT extension will directly increase the EDG unavailability, requiring a revision to the current on-line maintenance outage duration. Conversely, EDG availability during plant shutdown for a refueling outage will be improved, as concluded in the Combustion

Engineering Owner's Group "Joint Applications Report for Emergency Diesel Generators AOT Extension," CE NPSD-996.

Question 4

Provide details of the scheduled periodic inspections, maintenance, and overhauls with the approximate time required and frequency of performing each action. Also, provide the total maximum time required in the past to complete inspections, maintenance, and overhauls.

Response

The Preventive Maintenance Program at Waterford 3 includes two routine inspections of the emergency diesel generators (EDG) that would be scheduled for completion during an extended outage. One of the inspections is performed at 18-month intervals and the other is performed at 5-year intervals. The scope of the 5-year inspection encompasses the 18-month inspection. As a result, only one of the two inspections is accomplished on each EDG during a cycle.

Currently, Entergy performs major EDG inspections during refueling outages at Waterford 3. In that environment, the EDG outage duration is dependent more on the availability of resources (i.e., trained maintenance personnel not assigned to other refueling outage tasks) than on Technical Specification constraints. As a consequence, the inspection tasks are frequently spread over more than 10 calendar days. Based on Waterford 3's experience, it is estimated that by maximizing the performance of tasks in parallel, where possible, the 18-month inspection preventive maintenance work can be performed within 3 days. Similarly, it is estimated that the 5-year inspection maintenance work can be performed in 5 days.

The above estimates do not include the time required for equipment tagging and tag removal, draining, refilling and venting of fluid systems, heat-up of lube oil and jacket water to standby temperatures, and post-maintenance testing. In total, these activities require approximately 1.5 days to complete, which are applicable to both of the major inspections. Therefore, the estimated EDG outage duration is 4.5 days for an 18-month inspection, and 6.5 days for a 5-year inspection. The requested 10 day allowed outage time would provide additional margin for emergent work and other contingencies.

Question 5

The staff believes that certain compensatory measures are needed during the extended EDG AOT to assure safe operation of the plant. Provide a discussion of how you would address each of the conditions listed below as they relate to Waterford 3. [Questions 5a through 5d listed below]

Question 5a

The TS should include verification that the required systems, subsystems, trains, components, and devices that depend on the remaining EDG as a source of emergency power are operable before removing an EDG for preventive maintenance (PM). In addition, positive measures should be provided to preclude subsequent testing or maintenance activities on these systems, subsystems, trains, components, and devices while the EDG is inoperable.

Question 5a Response

Our current Technical Specifications (TS) 3.8.1.1.d ACTION statement ensures that required systems, subsystems, trains, components, and devices that depend on the remaining operable diesel generator as a source of emergency power are also operable prior to removing an EDG for maintenance.

In addition, positive measures exist in the form of administrative controls and guidelines that reinforce the TS requirement to ensure systems, subsystems, trains, components, and devices on the opposite train are operable prior to removing the EDG from service; and preclude subsequent testing or maintenance activities on these systems, subsystems, trains, components, and devices while the EDG is inoperable. With a EDG train inoperable for maintenance, if any testing or maintenance on equipment in the operable EDG train renders the equipment unable to perform its intended safety function, then the equipment/system must be declared inoperable and the appropriate TS ACTION statement would be entered. If the remaining operable EDG was declared inoperable, then TS 3.8.1.1.f ACTION statement would be entered to demonstrate the operability of the two offsite power sources within one hour, and restore one of the inoperable EDGs to operable status within 2 hours or action would be initiated to be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours. These administrative controls and guidelines are as follows:

- Procedure OP-100-014, "Technical Specifications and Technical Requirements Compliance", Attachment 6.6, directs Operations to review the equipment out of service on the opposite train to ensure equipment is able to perform safe

shutdown and Design Basis Accident requirements prior to removing the other train from service. These controls also caution that a EDG train will not be willfully removed from service when required components are inoperable in the opposite train. In addition, section 5.1.18 directs Operations to consider the following criteria prior to voluntarily entering an LCO ACTION statement to perform preventive maintenance (PM).

- While performing a PM on-line, avoid removing both trains of redundant equipment from service.
- If the equipment is Operable, but is degraded or is trending towards a degraded condition, then its redundant equipment should not be removed from service for a routine PM.
- While performing an on-line PM, avoid performing testing or maintenance that would increase the risk of a transient.

- Waterford 3 Station On-Line Maintenance Guidelines, section 5.1.1.1, requires continuous and thorough evaluations of planned out-of-service components and systems. These guidelines provide the following:
  - Qualitative reviews are performed on equipment out-of-service and combinations of equipment out-of-service considering items such as; the potential for a plant trip, potential to affect generation, ALARA effect while on-line, environmental conditions, and manpower available. The Work Week Manager, the Work Management Center Supervisor, and other departmental representatives contribute risk insights to the proposed maintenance activities under consideration at the work week countdown meetings.
  - Quantitative reviews are also performed using the Equipment-Out-Of-Service (EOOS) program to determine the effect on core damage frequency with the scheduled equipment out of service. The EOOS computer monitor is used to perform the PSA calculations in support of risk assessments for on-line maintenance activities. As part of the review process, a safety train analysis is performed to ensure that adequate separation of out-of-service ESF/Safety equipment is maintained.
  - Entergy also implements a Protected Train Concept at Waterford 3 that serves to prevent accidentally causing standby/required safety equipment to be inoperable/unavailable due to scheduling or personnel errors. Section 5.1.1.3 specifies that protected train weeks shall be respected when scheduling safety system outages and opposite train work should be minimized.

- A Configuration Risk Management Program (CRMP) is proposed with this requested TS change to support risk-informed TS. The CRMP will ensure that a

proceduralized PRA-informed process is in place that assesses the overall impact of plant maintenance on plant risk. The CRMP will enable appropriate actions to be taken or decisions to be made to minimize and control risk when performing on-line maintenance for systems, structures, and components with a risk-informed completion time, such as the proposed change to TS 3.8.1.1 Action b. The CRMP is a proposed change to Waterford 3 TS 6.16.

Question 5b

Voluntary entry into a limiting condition for operation action statement to perform PM should be contingent upon a determination that the decrease in plant safety is small enough and the level of risk is acceptable for the period and is warranted by operational necessity.

Question 5b Response

Entergy has demonstrated through prior operation at Waterford 3 that Administrative Procedure, OP-100-014, "Technical Specifications and Technical Requirements Compliance", section 5.1.18, and the Waterford 3 Station On-Line Maintenance Guidelines provide assurance that voluntary entries into LCO action statements to perform PM is based on the determination that the decrease in plant safety is small enough, the level of risk is acceptable for the PM period, and the PM is warranted by operational necessity. This process will be further enhanced by the CRMP implementation, as specified in the response to question 5a above.

The CRMP will be implemented by quidance contained in administrative controls. A risk assessment will be performed prior to entering the LCO ACTION statement for preplanned activities. The CRMP assessment may use any combination of quantitative and qualitative input.

Question 5c

Removal from service of safety systems and important non-safety equipment should be minimized during the extended outage of the EDG.

Question 5c Response

The Waterford 3 Station On-Line Maintenance Guidelines and Administrative Procedure PLG-009-007, "Routine Scheduling of Station Activities" provide assurance that removal of safety systems and important non-safety equipment from service will be minimized during scheduled maintenance outages. The Waterford 3 Station On-Line Maintenance Guidelines uses both qualitative and quantitative

reviews to assess risk impact of removing safety systems and important non-safety equipment from service during maintenance outages.

The Waterford 3 twelve-week repeating schedule is used to coordinate the performance of planned maintenance activities that consist of surveillance tests required by plant TS, system/component outages for preventative and corrective maintenance tasks, and plant modifications. The twelve-week schedule is designed to control plant risk to acceptable levels during on-line maintenance by scheduling safety train work that yields minimal or acceptable risk impact to the plant based on the plant configuration (equipment alignment and components, trains or systems out of service) and minimize the time in higher risk situations. Control of plant risk to acceptable levels is implemented through the twelve-week repeating schedule by not scheduling increased risk impact activities such as Emergency Core Cooling System trains and the EDG during the same outage period.

Other systems or components may be removed from service to address unanticipated deterioration of component or system conditions that create an emergency, require plant shutdown within 72 hours, or significantly jeopardize continued power operation. These activities would be considered emergent work and would be reviewed for risk impact, either qualitatively by management or quantitatively via the EOOS system. If these emergent work activities increase risk, steps would be taken to restore any equipment that impacts plant safety. PLG-009-007 specifies that high-risk balance of plant (BOP) activities will be avoided during safety equipment outages.

The implementation of the CRMP will also have provisions for assessing the need for additional actions after the discovery of additional equipment out of service conditions while in the LCO ACTION statement or evaluating the risk impact of equipment being removed from service.

Question 5d

Component testing or maintenance that increases the likelihood of a plant transient should be avoided; plant operation should be stable during the extended outage of the EDG.

Question 5d Response

Procedure OP-100-014, "Technical Specifications and Technical Requirements Compliance", section 5.1.18.4, and the Waterford 3 Station On-Line Maintenance Guidelines provide assurance that component testing or maintenance that

increases the likelihood of a plant transient are avoided; and that plant operation should be maintained stable during the extended outage of the EDG.

Procedure OP-100-014, section 5.1.18.4 directs Operations to consider avoiding the performance of testing or maintenance that would increase the risk of a transient prior to voluntarily entering an LCO Action to perform on-line PM.

The Waterford 3 Station On-Line Maintenance Guidelines, section 5.1.1.1, require qualitative and quantitative reviews to be performed on equipment out-of-service and combinations of equipment out-of-service considering items such as: the potential for a plant trip, potential to affect generation, ALARA affect while on line, environmental conditions, and manpower available. In addition, Waterford 3 implements a Protected Train Concept that serves to prevent accidentally causing standby/required safety equipment to be inoperable/unavailable due to scheduling or personnel errors.

Question 6

The purpose of the requested amendment is to allow an increased outage time during plant power operation for performing EDG inspection, maintenance, and overhaul, which would include disassembly of the EDG. EDG operability verification after a major maintenance or overhaul may require a full load rejection test. If a full load rejection test is performed at power, the following should be addressed: [Questions 6a through 6d listed below]

Full-Load Rejection Test Response

The routine inspections (18-month and 5-year inspections) expected to be accomplished during an extended maintenance outage normally do not require a post-maintenance full load rejection test to verify operability since disassembly is primarily for access and not for overhaul of major components. However, the answers provided to the following questions should not be interpreted as a commitment to perform such a full load rejection test when not required by procedures.

Question 6a

What would be the typical and worse case voltage transients on the 4160-V safety buses as a result of a full-load rejection?

Question 6a Response

A full load rejection test at Waterford 3 requires the EDG to be operating in parallel with offsite power and at 100% load. The EDG output breaker is then opened, which strips the EDG of its load and isolates it from the 4160-Volt vital (ESF) bus. The load is simultaneously picked up by the offsite power source. The major transient is experienced by the EDG itself. Review of Waterford 3 full-load rejection test data from Refueling Outage 9 indicated that voltage on the 4160 Volt safety buses dropped approximately 2% and stabilized in about 0.5 seconds. This is a relatively minor transient and well within the capability of the loads on the vital (ESF) buses.

Question 6b

If a full-load rejection test is used to test the EDG governor after maintenance, what assurance would there be that an unsafe transient condition on the safety bus (i.e., load swing or voltage transient) due to improperly performed maintenance or repair of a governor would not occur?

Question 6b Response

Maintenance testing, as part of routine inspections, is performed in accordance with Maintenance procedure ME-004-021, Emergency Diesel Generator. This maintenance testing includes several unloaded EDG runs. These runs are used to verify proper operation of the electrical and mechanical governors and the voltage regulator. The initial loaded run of the EDG is performed by synchronizing the EDG with offsite power and slowly loading the EDG in accordance with the normal Diesel Generator operating procedure to support the manufacturer's recommended post-maintenance 18-month or five year Emergency Diesel Engine Inspection engine analysis. Proper frequency and voltage response is verified prior to connecting the EDG to the 4160-Volt safety buses and again while loading the EDG. Diesel generator operability is satisfactorily assured through performance of TS 4.8.1.1.2.a.4 surveillance tests that demonstrate the EDG is capable of performing its intended safety functions.

Question 6c

Using maintenance and testing experience on the EDG, identify possible transient conditions caused by improperly performed maintenance on the EDG governor and voltage regulator. Discuss the electrical system response to these transients.

Question 6c Response

Maintenance and testing experience has been incorporated into EDG test procedures as described in the response to questions 6b and 6d. This testing is designed to identify maintenance-induced problems while the EDG is separated from the electrical system, thus preventing system transients from occurring. Based on our review of past events involving the operation of the diesel generator, Waterford 3 has not experienced any electrical system transients caused by improperly performed maintenance on the EDG governor or the voltage regulator.

Question 6d

Also, the licensee should provide the tests to be performed after the overhaul to declare the EDG operable and provide justification of performing those tests at power.

Question 6d Response

For the inspections expected to be performed during an extended AOT, a timed EDG start and 4-hour load-run in accordance with the TS surveillance tests would be sufficient to ensure operability of the EDG. These tests are also performed at power to satisfy TS requirements.

Question 7

The condition of offsite sources of electrical power prior to and during the extended EDG outage time has additional importance. Discuss what considerations should be given to not performing the extended maintenance when the offsite grid condition or configuration is degraded or when adverse or extreme weather conditions (e.g., high winds, lightning, icing conditions) are expected. Discuss how planning of the extended EDG maintenance should consider the time needed to complete the extended EDG maintenance and the ability to accurately forecast weather conditions that are expected to occur during the maintenance. Discuss what, if any, contingency plans should be developed to restore the inoperable EDG in the event of unanticipated adverse weather or degraded grid conditions occurring which can significantly increase the probability of losing offsite electrical power.

Response

Procedure OP-100-014, "Technical Specifications and Technical Requirements Compliance", section 5.1.18, and the Waterford 3 Station On-Line Maintenance Guidelines provide guidance in evaluating proposed maintenance outage

schedules. Prior to voluntarily entering an LCO Action to perform preventive maintenance (PM), procedure OP-100-014 requires Operations to consider if the equipment is Operable, but is degraded or is trending towards a degraded condition, then its redundant equipment should not be removed from service for a routine PM. In addition, there should be a high degree of confidence in the Operability of the redundant train prior to voluntarily entering an LCO ACTION statement to perform PM.

The Waterford 3 Station On-Line Maintenance Guidelines direct both qualitative and quantitative reviews to be performed on proposed schedules to verify that the scheduled activities represent an acceptable risk to both personnel and plant safety. These reviews are performed for potential risk impacts for a plant trip, potential to affect generation, ALARA effect while on line, and environmental conditions. Current and projected environmental and grid conditions are evaluated against planned maintenance through the use of combining PSA quantitative results with qualitative engineering judgement and operating experience. When less stable conditions exist or are forecasted to occur, evolutions that increase plant risk may be cancelled or rescheduled based on the evaluation process. In performing these evaluations, the type of maintenance to be performed, as well as the scheduled duration are considered. As there are a tremendous number of variables in potential weather conditions, it would be unreasonable to establish definitive guidelines for when a scheduled out-of-service project could or could not occur. The evaluation process must be employed to make determinations on a case-by-case basis.

Planning of the extended EDG maintenance using procedural guidance in the Waterford 3 Station On-Line Maintenance Guidelines and the proceduralized implementation of CRMP will consider operational factors such as grid conditions and weather conditions. Prior to voluntarily entering the LCO Action to perform extended EDG maintenance and during the outage, grid and environmental conditions would be evaluated to ensure the maximum time possible is available for restoration, when needed. The intent will be to minimize the time when the EDG is out-of-service under conditions that could significantly threaten the offsite power sources. The qualitative engineering judgement and operating experience provide additional realistic analysis of the safety impact and plant response due to potentially adverse weather.

Although Waterford 3 is in an area affected by hurricanes, the relatively slow approach of hurricanes offers time to take precautions, such as a plant shutdown, before the potential for a loss of offsite power occurs. The Waterford 3 area, moreover, has a decreased frequency of tornadoes and winter storms relative to

other parts of the country. Waterford 3 has never experienced a weather-related total LOOP event.

There may be times when an EDG is disassembled for extended outages and weather or grid conditions degrade or threaten to degrade to a point where off-site power could be lost. In accordance with Waterford 3 Off Normal Procedure OP-901-521, "Severe Weather and Flooding", the following actions would take place in the event the National Weather Service issues a Hurricane, Tropical Storm, or Tornado Watch or Warning for the New Orleans area: (1) the Duty Plant Manager would be notified; (2) the Shift Superintendent would evaluate ongoing maintenance using EOOS; and (3) the vital plant systems and components would be expeditiously restored to service. Per discussions with the National Weather Service, a Hurricane or Tropical Storm Watch will generally be issued to an area projected to be in its path 48 to 36 hours prior to landfall and a Warning issued within 24 hours of landfall. In addition, in anticipation of a Loss of Offsite Power, OP-901-521 requires commencement of a plant shutdown followed by a cooldown to Mode 5 twelve hours prior to the arrival of hurricane conditions onsite, as projected by the National Weather Service.

The evaluation of ongoing maintenance and the expeditious restoration of vital plant systems and components to service would generally include: (1) the present status of the maintenance in progress and estimated time of completion; 2) consideration of additional planned maintenance and its impact on the restoration of the EDG with an estimated time for completion; and 3) consideration of sufficient time for post maintenance retesting of the EDG. The evaluation may also consider the placement of a temporary backup power supply on-site.

Question 8

The Bases section should be modified to support the change and include the compensatory measures.

Response

Based on the responses to the RAI questions, additional changes to the proposed Bases changes were considered, but judged to be unwarranted. Any compensatory measures or conditions/restrictions to performing the EDG extended maintenance outage would be more appropriately specified under our administrative controls.

Question 9

The Combustion Engineering (CE) Joint Application Report CE NPSD-996 and the subsequent request for additional information response provide substantial information applicable to the proposed change. The following topics need to be discussed and resolved to complete the probabilistic risk assessment (PRA) portion of the review. [Questions 9a through 9e listed below]

Question 9a Risk impact for the proposed change

The incremental conditional core damage probability (ICCDP) was above 1E-6 for either preventative or corrective maintenance. This is higher than the 5E-7 guideline in the RG 1.177. In such a case, the staff becomes more careful with the review and performs a more in-depth review. Waterford should provide the necessary assurance that the actual plant operation with the proposed change would still be within the acceptable risk range.

Question 9a Response

The risk values submitted for the EDG AOT extension were based on a previous revision of the Waterford PSA model. A new revision of the PSA model has had a direct impact on the results of the EDG AOT. Some of the changes incorporated into the new model, relative to the EDG risk values, were as follows: the inclusion of EDG dependency on DC power, the incorporation of a more detailed convolution method of calculating offsite power recovery factors, the updating of the loss of offsite power initiating event frequency, and the updating of the plant specific EDG failure rates with the latest failure data. The risk values (ICCDP) have been recalculated based on the current model and are as follows:

Corrective Maintenance:
ICCDP, 3 days: 5.60E-7
ICCDP, 10 days: 1.87E-6 Increase above current AOT: 1.31E-6

Preventative Maintenance:
ICCDP, 3 days: 1.97E-7
ICCDP, 10 days: 6.55E-7 Increase above current AOT: 4.59E-7

Reg. Guide 1.177 provides a guideline value for an AOT risk increase as 5E-7 and defines ICCDP as the difference between the conditional CDF with the equipment in question out of service and the baseline CDF, multiplied by the duration of the single AOT under consideration. This is the manner in which the above ICCDP values were calculated. As shown, the preventative maintenance values are near

the 5E-7 guideline, but the corrective maintenance ICCDP is above the guideline at 1.87E-6. However, the risk value for corrective maintenance is very conservative. In calculating this value, following the CEOG Joint Report (CE NPSD-996) guidelines, the common cause factor assumed is the value of the beta factor throughout the entire period of the AOT.

Per the Waterford 3 Technical Specification 3.8.1.1.b ACTION statement, when one EDG is declared inoperable due to any cause other than an inoperable support system, an independently testable component, or preplanned preventative maintenance/testing, the other EDG must be demonstrated operable (unless it has been successfully tested in the last 24 hours) within 8 hours by performing specified surveillance tests, unless the absence of any potential common mode failure for the remaining EDG can be demonstrated. If the other EDG is declared inoperable, or a common mode failure is found, then, since two EDGs are inoperable, Entergy must enter TS 3.8.1.1.f ACTION statement to demonstrate the operability of the two offsite power sources within one hour, and restore one of the inoperable EDGs to operable status within 2 hours or action would be initiated to be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours. Because Entergy must perform an immediate assessment for a common cause failure, the beta factor only applies to the 8 hours allowed for this investigation. At the end of the 8 hours, if a common cause failure is found, the remaining operable EDG is declared inoperable and TS 3.8.1.1.f ACTION statement is entered (two EDGs inoperable), which is not affected by this AOT extension request. If no common cause failure is found, then the beta factor should have been zero for the entire AOT period, making the risk due to corrective maintenance the same as that for preventative maintenance.

Therefore, because the Waterford 3 Technical Specifications require confirmation within 8 hours that a common cause failure does not exist in the operable EDG, the above ICCDP for corrective maintenance is not realistic, is overly conservative, and should not be used. Removing the common cause factor from the corrective maintenance risk calculation results in values that are identical to the preventative maintenance values, which remain near the 5E-7 ICCDP guideline value.

Further, the actual increase in risk for the proposed AOT is the risk differential between the current 3-day AOT and the proposed 10-day AOT. This seven day increase is the actual change being proposed. For the preventative maintenance case, the increase in risk, above the current AOT, is 4.59E-7, which is within the guideline value of 5E-7.

The risk decrease due to not having an EDG out of service for extended periods during refuel outages should also be considered. This risk decrease would partially

and may completely offset the proposed risk increase, thus decreasing the risk increase. Waterford does not currently have a shutdown risk model, however, San Onofre Nuclear Generating Station, a similarly designed plant, calculated that their net risk would actually be decreased by performing EDG maintenance on line. Waterford understands that the SONGS calculation was plant specific and the values determined cannot be used at Waterford, however, the risk decrease from the increased EDG availability during outages would certainly decrease the net risk increase at Waterford, and should therefore be a consideration.

Finally, through the implementation of the CRMP at Waterford 3, the risk while in the EDG AOT will be closely evaluated. One purpose of the CRMP is to control plant risk to acceptable levels and minimize the time in higher risk situations. The EOOS program is already in use for scheduling maintenance and provides risk values to the work week managers. The CRMP will provide an added assurance that plant risk will be properly controlled while in and out of the proposed AOT.

Question 9b PSA Quality

Question 9b.1 Has your PSA been updated since the development of individual plant examination (IPE) and individual plant examination of externally initiated events (IPEEE)?

Question 9b.1 Response

The Waterford 3 PSA model has been updated since the development of the IPE in accordance with the "living model" philosophy at Waterford and in the industry. The Waterford 3 IPE is considered to be Revision 0 of the Waterford 3 PSA model. The model is currently at Revision 2, Change 1. Some of the major changes that have been incorporated since the IPE submittal are as follows: the elimination of asymmetries across multiple train systems (allowing the swing trains to recover either A or B trains, rather than only one) , the inclusion of additional DC power dependencies on applicable systems, the incorporation of a detailed convolution methodology of calculating offsite power recovery factors, and the updating of some failure rate data. Also included were some minor changes that have occurred to the plant since IPE submittal, such as the enhancement of certain simplified assumptions and the correction of minor errors found over the years (e.g. misclassification of a valve as a MOV instead of an AOV, or basic event description changes).

Question 9b.2 If yes, were there any independent peer reviews performed on the updates?

Question 9b.2 Response

Three levels of reviews were performed on the original Waterford 3 IPE submittal. The first was a basic Quality Assurance review carried out by the organization that developed the analysis. A qualified individual with knowledge of PSA methods and plant systems performed an independent review of all assumptions, calculations, and results for each task and the system models in the Level 1 analysis. Waterford 3 plant personnel not involved in the development of the PSA performed the second level of review. This review group consisted of individuals from Operations, Licensing, Engineering, and Training; providing diverse expertise with plant design and operations knowledge to review the system fault trees for accuracy. The third level of review was performed by PSA experts from ERIN Engineering. ERIN provided broad insights on techniques and results based on experience from other plant PSAs. They reviewed the overall PSA methodology, accident sequence analyses, system fault trees, Level 1 results, and the human failure and recovery analysis.

Every change to the PSA model since the IPE has been prepared by one of the Waterford 3 PSA engineers, reviewed by a separate, independent PSA engineer, and approved by the Manager, Safety & Engineering Analysis.

A cross comparison of the Waterford 3 risk-related results that support the EDG AOT extension was made with the other CEOG plants, as part of the generic CE-NPSD-996, "Joint Applications Report for Emergency Diesel Generators AOT Extension." This provided another level of review for the Waterford 3 results.

The week of 1/17/00, a PSA Certification Team reviewed the Waterford 3 PSA Model. The certification was scheduled through CE Owner's Group participation. The team was made up of a lead from Combustion Engineering and four experienced PSA peers from other CE plants. The team identified some concerns, most of which had been previously identified by Entergy personnel. The team also identified some conservatisms. Entergy will develop a plan to prioritize all of the PSA Certification Team's concerns and implement the necessary improvements. Entergy has performed a preliminary, bounding, sensitivity study of the concerns related to the EDG AOT extension that shows the ICCDP results will not significantly deviate from those specified herein.

Question 9b.3 If not, what justifies that the IPE/IPEEE still represent the as-built and as-operated condition of the plant. Explain what significant modifications have since been made to the plant.

Question 9b.3 Response

No response required.

Question 9b.4 What PSA quality control process do you have to represent the as-built and as-operated condition of the plant?

Question 9b.4 Response

Assurance that changes to the as-built and as-operated condition of the plant are incorporated into the PSA model is provided by the required review of all design changes by the Safety & Engineering Analysis Group. This allows design changes to be screened for impact on the model.

When CRMP implementation is completed, a documented methodology for PSA update (based on the existing site calculation procedure) will be instituted. This will proceduralize a consistent, repeatable methodology for model update, and a consistent reflection of plant and operating changes. It also provides guidance on PSA applications, which may need to be re-reviewed for impact after updates, such as AOT extension inputs. In addition, incorporation of PSA related questions on the screening checklists located in the Engineering Request and Procedure Development Procedures is being considered. These screening questions will trigger the preparer to have a PSA review for any change that may affect the as-built or as-operated condition of the plant.

Question 9c External Event Contribution

The core damage frequency (CDF) contribution from fire was estimated to be 7.0E-6/yr in your IPEEE analysis. The value is still substantial (almost 50% of internal CDF of 1.5E-5/yr) as compared with the CDF contribution from internal initiating events. Therefore, the risk impact of the proposed change would be higher than what was reported in your application. In particular, the ICCDP for a single outage would be greater than the already-high value of 3.8E-6 for a corrective maintenance outage.

Question 9c Response

The Waterford 3 IPEEE fire analysis used a conservative screening process (EPRI FIVE), with a simplified fire PSA-like approach for unscreened areas, to determine whether there were any fire risk vulnerabilities. The fire CDF values reported in the IPEEE were produced by the simplified fire PSA. Because of the complexity of fire ignition, growth, damage, suppression, etc., a number of conservatisms were made

in the fire IPEEE analysis that contributed to the conservatism of the fire CDF number. These conservatisms include:

1. In general, all safe-shutdown trains, except Emergency Feedwater (EFW), with essential cables in a fire area were assumed to fail, regardless of whether they were wrapped or separated, whether fire damage to the cables could actually cause functional failure, or whether detection and suppression was successful. Only EFW was generally treated with fire modeling to determine actual failure scenarios.
2. The peak heat release rate was assumed to occur instantaneously (instantaneous fire growth). This conservatism makes the time to fire damage unrealistically short, thus excluding the possibility of suppression in some areas.
3. Several mitigating systems without cable routing data were assumed to be failed, regardless of the location of the associated cables.

The fire PSA was not developed to the same level of detail as the internal events analysis and the results are very conservative. Therefore, the fire CDF reported in the IPEEE should not be combined with the internal analysis results.

Question 9d Level 2 Risk Impact

The staff uses Δlarge early release frequency/incremental conditional large early release probability (LERF/ICLERP) for a single outage as another acceptance threshold in accordance with applicable Regulatory Guides. The CEOG report (CE NPSD-996) attempted to address the issue generically for all CE plants; however, the staff finds that plant specific results will generally be needed to complete the review.

Question 9d Response

A plant-specific ICLERP was developed using a simplified method similar to that described in the CEOG response to questions on the HPSI AOT Joint Applications Report (Letter, Ralph Phelps (CEOG) to Stewart L. Magruder (NRC), "Response to Request For Additional Information Regarding CE NPSD-1041," No. CEOG-99-135, May 5, 1999). The method assumes that LERF includes the following contributors: 1) bypass events, 2) core damage events with failure of containment isolation, and 3) containment failure resulting from core damage with high pressure reactor vessel failure (high pressure melt ejection and direct containment heating). Since bypass events are primarily steam generator tube ruptures and interfacing system LOCAs, which are not sensitive to EDG unavailability (since offsite power is not assumed lost), the impact of EDG unavailability on bypass LERF events is

negligible. The typical range of containment isolation failure probabilities described in the HPSI response was 0.001 to 0.005. Multiplying the ICCDP values from the response to Question 9a above by the upper bound 0.005 containment isolation failure probability gives the following ICLERP values for core damage with failure of containment isolation:

	CM	PM
ICCDP	1.87E-6	6.55E-7
ICLERP	9.34E-9	3.28E-9

Finally, by conservatively assuming that all the risk increase estimated for the proposed EDG AOT change is associated with high RCS pressure at reactor vessel failure (although the results actually include some low pressure scenarios) and applying the conditional probability of containment failure given high RCS pressure at reactor vessel failure and no containment heat removal from the Waterford 3 Level 2 PSA model (0.025), the following bounding ICLERP values for high pressure, energetic containment failure events result:

	CM	PM
ICCDP	1.87E-6	6.55E-7
ICLERP	<4.67E-8	<1.64E-8

Adding the two ICLERP values gives a total ICLERP of <5.60E-8 for CM and <1.97E-8 for PM. Since the PM value is a better representation of the EDG AOT risk, as discussed in the response to Question 9a above, and the conservative ICLERP of <1.97E-8 is less than the acceptance value of 5E-8, the proposed EDG AOT has only a small impact on Level 2 risk.

Question 9e Other Miscellaneous Issues

Question 9e.1 Waterford 3 stated that their EDG failure-to-run probability is overly conservative because the failure to run was assumed to occur instantly at the time of EDG demand. It means that the potential for recovery of offsite power was not modeled upon the run failure following a successful start. The staff finds, however, that the proposed change relates mainly to how sensitive the extension of EDG unavailability would be as compared to the change in reliability. Please explain.

Question 9e.1 Response

While Waterford agrees that the proposed change is most sensitive to the unavailability of the EDG, the reliability also affects the proposed change in that it affects the EDGs' contribution to total plant CDF. The higher the EDG contribution to CDF, the more sensitive the risk results will be to increased EDG unavailability. The conservatism discussed in this question has been removed through the incorporation of a more detailed convolution method of calculating offsite power recovery factors. This method integrates the run failure rate over the model mission time. Therefore, the conservatism, which previously existed through assuming the run failure occurs instantly at EDG demand, no longer exists. However, even through the use of the convolution method, conservatism remains through the use of a constant time to core uncovery following the failure of the last EFW pump. This use of a constant time is conservative because, as time goes on and decay heat decreases, the time to core uncovery and subsequent damage is longer. As more time is allowed, the probability of recovery prior to core uncovery increases and the contribution of EDG failures to the overall core damage frequency at Waterford 3 decreases.

Question 9e.2 The expected actual unavailability of an EDG per year was 200 hours. Given that, the increase in CDF was estimated to be 14 percent above the baseline CDF. Please explain the 200 hours by describing your experience the last several years.

Question 9e.2 Response

The current Maintenance Rule unavailability limit for each EDG is 100 hours. Actual EDG unavailability has rarely approached this limit, as shown in the following table depicting the hours of on-line unavailability per EDG:

Year	EDG A (hours)	EDG B (hours)
1993	24.58	37.58
1994	96.25	21.05
1995	12.3	17.72
1996	28.5	81.78
1997	25.68	73.01
1998	41.79	20.53
1999	17.9	37.57

Once the AOT extension is approved, the actual unavailability is expected to increase due to the performance of some preventative maintenance on-line,

rather than during the refuel outage. The 18 month and 5-year inspections are planned to be moved out of the refueling outage to on-line maintenance. The 18 month inspection is estimated to take 4.5 days (~108 hours). The 5-year inspection is estimated to take 6.5 days (~156 hours). The performance of this maintenance on-line is expected to increase EDG reliability, as concluded in the Combustion Engineering Owner's Group "Joint Applications Report for Emergency Diesel Generators AOT Extension," CE NPSD-996. In the end, the expected total unavailability per EDG should be less than 200 hours per year per train. This limit will be monitored and enforced through the Waterford 3 Maintenance Rule program.