March 12, 2003

Mr. Joseph E. Venable
Vice President Operations
Entergy Operations, Inc.
17265 River Road
Killona, LA 70066-0751

SUBJECT: WATERFORD STEAM ELECTRIC STATION, UNIT 3 - ISSUANCE OF AMENDMENT RE: DESIGN BASIS CHANGE REGARDING REALIGNMENT OF REFUELING WATER STORAGE POOL (RWSP) BOUNDARY ISOLATION VALVES TO RWSP PURIFICATION SYSTEM (TAC NO. MB1688)

Dear Mr. Venable:

The Commission has issued the enclosed Amendment No. 186 to Facility Operating License No. NPF-38 for the Waterford Steam Electric Station, Unit 3. The amendment consists of changes to the Updated Final Safety Analysis Report in response to your application dated April 2, 2001, as supplemented by letters dated September 24, 2001, and February 27, July 31, and December 19, 2002.

The change revises the design position of two normally closed valves in the RWSP system to normally open valves. These manually operated valves act as the system boundary isolation between the safety related RWSP, which is the suction source for the emergency core cooling system pumps, and the non-safety RWSP Purification System.

A copy of our related Safety Evaluation is also enclosed. The Notice of Issuance will be included in the Commission's next biweekly *Federal Register* notice.

Sincerely,

/RA/

N. Kalyanam, Project Manager, Section 1
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-382

Enclosures: 1. Amendment No. 186 to NPF-38
2. Safety Evaluation

cc w/encls: See next page

Mr. Joseph E. Venable
Vice President Operations
Entergy Operations, Inc.
17265 River Road
Killona, LA 70066-0751

March 12, 2003

SUBJECT: WATERFORD STEAM ELECTRIC STATION, UNIT 3 - ISSUANCE OF AMENDMENT RE: DESIGN BASIS CHANGE REGARDING REALIGNMENT OF REFUELING WATER STORAGE POOL (RWSP) BOUNDARY ISOLATION VALVES TO RWSP PURIFICATION SYSTEM (TAC NO. MB1688)

Dear Mr. Venable:

The Commission has issued the enclosed Amendment No. 186 to Facility Operating License No. NPF-38 for the Waterford Steam Electric Station, Unit 3. The amendment consists of changes to the Updated Final Safety Analysis Report in response to your application dated April 2, 2001, as supplemented by letters dated September 24, 2001, and February 27, July 31, and December 19, 2002.

The change revises the design position of two normally closed valves in the RWSP system to normally open valves. These manually operated valves act as the system boundary isolation between the safety related RWSP, which is the suction source for the emergency core cooling system pumps, and the non-safety RWSP Purification System.

A copy of our related Safety Evaluation is also enclosed. The Notice of Issuance will be included in the Commission's next biweekly *Federal Register* notice.

Sincerely,
/RA/
N. Kalyanam, Project Manager, Section 1
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-382

Enclosures: 1. Amendment No. 186 to NPF-38
2. Safety Evaluation

cc w/encls: See next page
DISTRIBUTION:

PUBLIC	RidsOgcRp	RidsRgn4MailCenter (AHowell)
PDIV-1 Reading	GHill(2)	
RidsNrrDlpmPdiv (HBerkow)	JFair	
RidsNrrDlpmPdivLpdiv1 (RGramm)	JGolla	
RidsNrrPMNKalyanam	JBongarra	
RidsNrrLADJohnson	NSaltos	
RidsAcrsAcnwMailCenter	RDennig, DRIP/RORP (RLD)	*No legal objections w/comments
Accession No.:ML030760620	The SEs from the Staff noted below were used with minor changes	

OFFICE	PDIV-1/PM	PDIV-1/LA	SPLB/EMEB/SPSB/IEHB	OGC*	PDIV-1/SC
NAME	NKalyanam	DJohnson	SWeerakodi/ KManoly/ MReinhart/ DTrimble	AHodgdon	RGramm
DATE	3/3/03	3/3/03	01/07/03; 02/24/03; 11/09/01; 08/21/02	3/7/03	3/12/03

OFFICIAL RECORD COPY

ENTERGY OPERATIONS, INC.

DOCKET NO. 50-382

WATERFORD STEAM ELECTRIC STATION, UNIT 3

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 186
License No. NPF-38

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Entergy Operations, Inc. (EOI) dated April 2, 2001, as supplemented by letters dated September 24, 2001, and February 27, July 31, and December 19, 2002, complies with the standards andrequirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended to approve changes to the Updated Final Safety Analysis Report (UFSAR) Section 3.2.1 and Tables 3.2-1 and 3.9-9, as set forth in the application for amendment by Entergy Operations, Inc., dated April 2, 2001, as supplemented by letters dated September 24, 2001, and February 27, July 31, and December 19, 2002. Entergy Operations, Inc. shall update the UFSAR to reflect the revised licensing basis authorized by this amendment in accordance with 10 CFR 50.71(e).

3. This license amendment is effective as of its date of issuance and shall be implemented within 60 days from the date of issuance. Implementation of the amendment is the incorporation into the UFSAR changes to the description of the facility as described in the licensee's application dated April 2, 2001, as supplemented by letters dated September 24, 2001, and February 27, July 31, and January 19, 2002, and evaluated in the staff's Safety Evaluation attached to this amendment.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Robert A. Gramm, Chief, Section 1
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Date of Issuance: March 12, 2003

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 186 TO

FACILITY OPERATING LICENSE NO. NPF-38

ENTERGY OPERATIONS, INC.

WATERFORD STEAM ELECTRIC STATION, UNIT 3

DOCKET NO. 50-382

1.0 INTRODUCTION

By application dated April 2, 2001, as supplemented by letters dated September 24, 2001, and February 27, July 31, and December 19, 2002, Entergy Operations, Inc. (the licensee), submitted a request for changes to the Waterford Steam Electric Station, Unit 3, (Waterford 3) Updated Final Safety Analysis Report (UFSAR).

The licensee, pursuant to 10 CFR 50.59, "Changes, tests, and experiments," requested Nuclear Regulatory Commission (NRC) review and approval of changes to the Waterford 3 design basis as described in the UFSAR that would create the possibility of a malfunction of a structure, system, or component important to safety with a different result than any previously evaluated in the UFSAR, (10 CFR 50.59(c)(2)(vi)). The change concerns design requirements for the alignment of the Refueling Water Storage Pool (RWSP) boundary isolation valves to the RWSP purification system. The proposed change revises the design position of two isolation valves (FS-423 and FS-404) from normally closed to normally open. These manually operated valves act as the system boundary isolation between the safety related RWSP, which is the suction source for the Emergency Core Cooling System (ECCS) pumps, and the non-safety RWSP purification system.

The September 24, 2001, and February 27, July 31, and December 19, 2002, supplemental letters provided clarifying information that did not change the scope of the original Federal Register notice (66 FR 27176, dated May 16, 2001) or the original no significant hazards consideration determination.

2.0 BACKGROUND

The primary safety function of the RWSP is to provide borated water to the suction of the ECCS and Containment Spray System (CSS) pumps during the initial (injection) phase of a loss-of-coolant accident (LOCA). The RWSP purification system provides a means of maintaining the purity and clarity of the water contained in the RWSP. The RWSP purification system pumps the water from the RWSP through a filter to remove particles, through an ion exchanger to remove ionic material, and then through a wye strainer, which prevents transportation of resin beads through the system. The RWSP purification system also serves as an alternate make-up

path to the Spent Fuel Pool (SFP) and as a source of fill water to the refueling cavity during refueling outages. The RWSP boundary isolation valves are Safety Class 3 components and serve as a safety to non-safety class boundary, separating the RWSP from the RWSP purification system.

In 1996 the licensee identified a concern regarding the RWSP purification system. The RWSP purification system, for the most part, is not seismically qualified. The system can be aligned to the safety related RWSP for extended periods of time. The RWSP purification system isolation valves (also termed as RWSP Boundary Valves), FS-423 and FS-404, are manually operated and therefore do not automatically close to isolate the system in the event of a LOCA. If a LOCA were to occur simultaneously with a RWSP purification system pipe break while the RWSP purification system is aligned to the RWSP, or a LOCA were to occur while aligned for make-up to the SFP, this could potentially result in an insufficient volume in the RWSP and render it incapable of performing its safety function. The licensee documented this issue in a Condition Report and performed an operability determination. The systems were declared operable based on the implementation of various administrative controls.

The RWSP and the piping from the RWSP nozzles, up to and including the valves FS-423 and FS-404, are safety related and seismically qualified, while the majority of the remaining portion of the RWSP purification system is non-safety related and not seismically qualified. The RWSP and the valves FS-423 and FS-404 were designed in accordance with General Design Criteria 2 of 10 CFR Part 50, Appendix A. The RWSP purification system boundary isolation valves are built to American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section 3, Class 3 specifications. These isolation valves serve as a safety class to non-safety class boundary.

The RWSP purification system was not originally intended to be run continuously, but rather to be used intermittently. However, in order to maintain personnel exposure as low as reasonably achievable, the licensee's current practice is to operate the RWSP purification system aligned to the RWSP approximately 50 percent of the time, alternating with operation of the system to provide make-up to the SFP. Additionally, it is the licensee's current practice to operate the RWSP purification system aligned to the RWSP continuously for 90 days prior to the start of a refueling outage. By doing this, the RWSP is purified prior to outages. The licensee stated that this has resulted in a 41 percent dose rate reduction to every individual who enters the ECCS Pump Room areas.

The licensee's proposed change is to revise the design position of the RWSP suction (FS-423) and return (FS-404) boundary isolation valves from normally closed to normally open. Section 3.2.1 of the Waterford 3 UFSAR states that the seismic classifications are consistent with the recommendations of Regulatory Guide (RG) 1.29, "Seismic Design Classification," August 1973. The RG states that the system boundary for systems required for emergency core cooling includes those portions of the system required to accomplish the specified safety function and connected piping up to and including the first valve that is either normally closed or capable of automatic closure when the safety function is required. The proposed design basis change represents an exception to the RG in that the boundary valves FS-423 and FS-404 are manual valves that would now be maintained normally open. The licensee is proposing that their function as both a safety class boundary and seismic Category 1 boundary will be satisfied

by crediting manual actions to close the valves. This would be done in the event of a leak in the purification loop system concurrent with a LOCA, or while providing makeup to the SFP concurrent with a LOCA.

3.0 REGULATORY EVALUATION

The staff evaluation of the licensee submittals consisted of four distinct areas, namely: response of the non-safety related piping in the RWSP purification system to a seismic event, response of the system during postulated incidents, review of the risk assessment information provided from a probabilistic perspective, and review of the required operator reactions from a human performance aspect. The regulatory requirements for the four distinct areas are discussed below.

Seismic Analysis

RG 1.29, Position C.2 states, “Those portions of structures, systems, or components whose continued function is not required but whose failure could reduce the functioning of any plant feature included in items 1.a through 1.q above [1.c specifies systems or portions of systems that are required for emergency core cooling] to an unacceptable safety level...should be designed and constructed so that the SSE [safe shutdown earthquake] would not cause such failure.” The RWSP purification system piping was not designed and constructed so that the SSE would not cause such failure to the performance of the safety function of the RWSP, i.e., it was not seismically designed and qualified. For the circumstances presented by the licensee’s submittal, then, it must be shown by analysis that either a pipe break in the RWSP purification system piping would not cause failure to the RWSP such that it would reduce the efficacy of safety function or, by additional analysis, it must be shown that all portions of the RWSP purification system are “seismically adequate” such that only a pipe crack need be postulated for the system in safety analyses.

Systems Analysis

Section 3.2.2 of the Waterford 3 UFSAR states that system components important to safety are classified in accordance with American National Standards Institute (ANSI) N18.2-1973, "Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants," and ANSI N18.2a-1975, "Revision and Addendum to Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants." These standards provide design criteria for safety to non-safety class fluid system interfaces. In accordance with ANSI N18.2-1973, a Safety Class 3 component (the isolation valves) may be connected to components of a differing class (the non-seismic RWSP purification system). However, the active failure of the Safety Class 3 component (failure for any reason to close manual boundary isolation valves FS-423 and FS-404) combined with failure of any lower class component (leak in the RWSP purification system piping during a LOCA or diversion of water from the RWSP to the SFP during refueling outages) cannot prevent achievement of the minimum safety system function of the higher class system (cannot draw down RWSP inventory below its analytical limit). The licensee therefore evaluated the change (from normally closed to normally open) of the RWSP isolation valves, and the potential impact of pipe rupture of the non-safety RWSP purification system, on the safety-related RWSP in accordance with ANSI N18.2-1975. This requires regulatory review under 10 CFR 50.59, based on the possibility of creating a malfunction of equipment important to safety of a different type than any previously evaluated.

Risk-informed Analysis

An acceptable approach to risk-informed decision making is to show that the proposed change to the licensing basis meets several key principles defined in Regulatory Guide (RG)1.174. One of these principles is to show that the proposed change results in an increase in risk, in terms of core damage frequency (CDF) and large early release frequency (LERF), which is small and consistent with the Commission's Safety Goal Policy Statement. Acceptance guidelines for meeting this principle are presented in RG 1.174. The licensee's analysis follows the approach outlined in RG 1.174. The mean yearly increases in CDF and LERF, due to the proposed change, were assessed and compared to the acceptance guidelines of RG 1.174.

In addition, the staff reviewed the quality of the submitted risk assessment to ensure that (1) no risk significant scenarios have been omitted and (2) the assumptions made and data used in the analysis are realistic or conservative.

Human Factors Analysis

The staff's review criteria are based on an adaptation of existing NRC review guidance for human factors engineering as found in:

- NUREG-0800, "Standard Review Plan" (1996)
- NUREG-0711, Revision 1, "Human Factors Engineering Program Review Model," (2002)
- NUREG-0700, Revision 2, "Human-System Interface Design Review Guideline," (2002)
- Information Notice (IN) 97-78, "Crediting of Operator Actions in Place of Automatic Actions and Modifications of Operator Actions, Including Response Times," (1997)
- NUREG/CR-6689, "Proposed Approach for Reviewing Changes to Risk-Important Human Actions," (2000)
- RG 1.174 (1998)
- RG 1.177, "An Approach for Plant-Specific, Risk-Informed Decision Making: Technical Specifications" (1998)
- IN 91-18, "Information to Licensees Regarding Two Inspection Manual Sections On Resolution of Degraded and Non-Conforming Conditions and on Operability" (1991)

4.0 TECHNICAL EVALUATION

4.1 Scenarios Evaluated

With the proposed open position of the RWSP purification system boundary valves, the consequences of a loss of RWSP inventory through any postulated failure of the RWSP purification system must be considered. Two separate conditions are postulated: 1) a through-wall leak in the RWSP purification piping, and 2) a diversion of RWSP inventory when the RWSP purification system is aligned to provide makeup to the SFP. Additionally, the different safety functions of the RWSP in Modes 1 through 4 and Modes 5 and 6 must be assured. The following four specific cases are the only times where safety related operator action is required to isolate the RWSP purification system.

Case 1, Modes 1 through 4

In this case, it is assumed that either a moderate energy line break or a seismic event initiates a through-wall crack in the RWSP purification system piping. The safety function of the RWSP is to provide a source of borated water to the ECCS and CSS pumps during the initial phase of a LOCA. The difference between the technical specification (TS) required minimum level of 83 percent (of indicated level in the RWSP) and the analytical level of 76.4 percent (based on ensuring an adequate volume of borated water is transferred to the Safety Injection Sump (SIS) such that the Net Positive Suction Head (NPSH) requirements for the ECCS pumps following re-alignment to the SIS are established), is 38,072 gallons. (It is noted that the licensee's engineering assessment indicates that 478,793 gallons is equivalent to 83 percent of indicated level in the RWSP compared against TS 3.5.4 value of 475,500 gallons corresponding to the same indicated level.) Therefore, this volume of water (38,072 gallons) is available in the RWSP beyond that credited in accident mitigation.

The licensee postulated a through-wall crack in the RWSP purification system piping at the worst location, downstream of the purification pump, providing the highest static head and developed head of the pump when it is running. Additionally for conservatism, the pump suction piping losses were ignored. Using the methodology outlined in UFSAR Section 3.6.2.1.5.c, the crack opening was calculated to be equal to a 0.53-inch diameter circular opening. A crack this size with highest static head results in a leak of approximately 48 gallons per minute (gpm). At this leakage rate, it would take about 13 hours and 13 minutes to reach the analytical level assumed in analyses, plus the uncertainties.

Case 2, Modes 1 through 4

The safety function of the RWSP remains the same as in Case 1, Modes 1 through 4. The volume available between the analytical and TS level is still 38,072 gallons.

In this case, a diversion of RWSP inventory through the RWSP purification system is postulated concurrent with a LOCA. Even though make-up to the SFP is normally provided from the Condensate Storage Pool to account for water loss due to evaporation, for the purpose of this evaluation, the RWSP purification system is aligned for make-up to the SFP. With this alignment, water could be diverted from the RWSP to the SFP at a rate of 150 gpm through the RWSP purification pump. This would result in an allowance of about 4 hours and 14 minutes to secure the RWSP purification system prior to reaching the volume needed to meet accident mitigation.

Case 3, Modes 5 and 6

In this case, it is assumed that when the plant is in Mode 5 or 6, either a moderate energy line break or a seismic event initiates a through-wall crack in the RWSP purification system piping. To ensure reactivity control capability in Modes 5 and 6, TS 3.1.2.7 requires either a Boric Acid Makeup Tank or the RWSP, with an indicated level of 12 percent (65,465 gallons), be available. However, based on the assessments performed by the licensee, 12 percent of the RWSP is equivalent to 69,223 gallons. The analytical limit is 6.2 percent (35,765 gallons). The RWSP will provide its safety function as long as the volume of borated water is at or above the analytical limit, including instrument uncertainties of 3.18 percent (9.38 percent or 54,109 gallons). Therefore, there are approximately 15,114 gallons of conservative volume available in the RWSP.

As in Case 1, Modes 1 through 4, the estimated flow rate through a crack is 48 gpm. Therefore, the operator has approximately 5 hours and 14 minutes to isolate the leak.

Case 4, Modes 5 and 6

In this case, a diversion of RWSP inventory through the RWSP purification system is postulated, as described in Case 2. In Modes 5 and 6, as described in Case 3, the margin between the analytical limit and TS limit for the RWSP is 15,114 gallons.

As in Case 2, the estimated flow rate while aligned to the SFP is 150 gpm. At this flow rate, the margin between the analytical and TS limit available would be depleted in 1 hour and 40 minutes. Also, as in Case 2, it will take the operator no more than 54 minutes (8,100 gallons or 1.4 percent) to isolate the RWSP. Therefore, sufficient volume remains in the RWSP to allow operator action and assure the safety function of the RWSP.

Filling the SFP from the low level to the hi level requires less than 1 percent volume of the RWSP, and anytime the SFP is being filled, the Operations procedure requires stationing a dedicated operator at the SFP to monitor level. Therefore, with the existing procedural guidance and limited amount of makeup required to fill the SFP, the above stated time for operator action, 54 minutes, is very conservative.

4.2 Seismic Evaluation

4.2.1 Evaluation

The licensee's initial application dated April 2, 2001, assumes a crack in the RWSP purification piping and demonstrates that the efficacy of the RWSP safety function is not reduced. The licensee elected to demonstrate the seismic adequacy of the RWSP purification system piping.

The licensee performed a review and evaluation of the integrity of the RWSP purification system based on original stress calculations and a comparison to similar plant components. The portion of the review that utilized original stress calculations concentrated on the components of the system from the RWSP nozzles to the isolation valves. This portion of the system was originally designed to be seismically qualified. The licensee's review concluded that the components in this section of the system will remain in place during and after a seismic event. The portion of the system and components that were not originally analyzed were evaluated by comparison with similar seismic Category 1 piping and components, and found by the licensee to be acceptable. The licensee's conclusion was, based on its engineering judgment, that during a design basis seismic event the RWSP purification system will not experience a catastrophic failure and deplete the ECCS supply from the RWSP during RWSP purification operation. The staff expressed concerns regarding the licensee's use of engineering judgment to demonstrate seismic adequacy of the RWSP purification system piping.

The licensee provided the results of its additional evaluation of the RWSP purification piping in supplemental letters dated July 31 and December 19, 2002. The purpose of the evaluation was to demonstrate that the piping is "seismically adequate" such that a seismic event will not cause a pipe break. The licensee described the analysis methods in the supplemental letter dated July 31, 2002, and the significant aspects of the licensee's evaluation are discussed below.

The licensee indicated that piping was originally constructed but not analyzed to ANSI B31.1 requirements, and deadweight, thermal, and seismic loads were applied and analysis performed to the criteria as ASME Class 3 safety related pipe. The ASME Class 3 criteria provide allowable stress limits for design basis earthquake (DBE) loads that are greater than the allowable stress limits contained in ANSI B31.1. The ASME Code allowable stress limits are intended to assure pressure boundary integrity of the piping components constructed in accordance with provisions of the ASME Code. However, the licensee does not have to assure pressure boundary integrity for this piping, since the licensee has already evaluated the consequences of a moderate energy line crack in the piping. As a result, it is only necessary that the criteria provide adequate margin to prevent pipe rupture during a seismic event. The staff finds the ASME Code allowable stress limits provide adequate margin for that purpose.

The licensee also indicated that ASME Code Case N-411 damping was used in the seismic analysis. By letter dated October 6, 1986, the staff approved the use of N-411 damping for Waterford 3 piping analyses, subject to the conditions contained in RG 1.84, Revision 24. The staff finds the use of N-411 damping, subject to the conditions contained in its October 6, 1986, letter, acceptable for the evaluation of the RWSP purification piping.

The licensee, by supplemental letter dated December 19, 2002, indicated that it has completed the seismic evaluation of the remaining non-analyzed portions of the RWSP purification system, and the method of evaluation was the same as described in its supplemental letter dated July 31, 2002, and used ASME Code Case N-411 damping and the maximum calculated stress in the piping is below the ASME Code allowable stress. The licensee's supplemental letter also indicated that the uplift loads were calculated to occur at two rod hangers. Since rod hangers are not designed to resist uplift loads, the licensee performed additional analyses of the piping system with these rod hangers removed from the model. The licensee indicated that the additional analyses demonstrated that the adjacent supports could sustain the loads and that the pipe stresses remain below the ASME Code allowable limits.

The primary concern regarding uplift loads at rod hangers is the potential for either the rod hanger to disengage from the piping or the rod hanger to fail due to impact during the downward motion of the pipe. A pipe impact on the hanger would cause additional stresses in the pipe. Failure of the hanger would also cause additional deadweight stresses in the piping and additional deadweight loads on adjacent deadweight supports. The licensee's analysis, with rod hangers removed from the model, demonstrates the piping and adjacent supports can sustain the additional seismic and deadweight loads without exceeding allowable limits. The staff considers the licensee's analyses, with and without the rod hangers in the model, provide a reasonable estimate for the maximum seismic stresses in the pipe and seismic loads on adjacent supports. However, the staff was concerned that failure of the rod hangers would cause a dynamic deadweight load transfer to the adjacent supports that was not bounded by the licensee's analyses.

During a conference call on February 5, 2003, the staff requested that the licensee provide additional clarification regarding its analyses. The licensee indicated that maximum loads calculated on the supports adjacent to the rod hangers where pipe uplift is predicted to occur is less than half of the allowable load limit, and that the maximum calculated pipe stress is substantially less than the ASME Code allowable limit. These results are the bounding values for the case with the rod hangers in the model and the case with the rod hangers removed from the model. Failure of the rod hangers would result in a dynamic transfer of deadweight load to the adjacent hangers that was not included in the licensee's analyses. The licensee's

deadweight analysis was performed statically. The maximum dynamic load on the piping system could be double the amount calculated from the static application of the deadweight load. As discussed above, there is sufficient margin in the adjacent rod hangers to accommodate the potential load increase caused by a dynamic load transfer of deadweight if the rod hangers should disengage or fail during the seismic event. In addition, there is sufficient margin in the calculated pipe stresses to accommodate a dynamic load transfer of the deadweight.

4.2.2 Summary

The staff concludes that the licensee has provided sufficient information to demonstrate that a SSE would not cause rupture of the RWSP purification system piping.

4.3 Systems Evaluation

4.3.1 Scenarios

The licensee's evaluation that, during RWSP purification operation and a design basis seismic event, and with a leak through a pipe crack (as against a pipe break) postulated in the RWSP purification system, the RWSP can still perform its safety related function is reviewed here.

The licensee's evaluation is comprised of 4 cases, described above in Section 4.1, that include different RWSP purification system line-ups and failures which may allow water to be diverted from the RWSP coincident with an accident or an event. The cases are evaluated to determine if there is adequate time for operator action to isolate the RWSP purification system from the RWSP or initiate reactor shutdown before reaching the analytical level in the RWSP.

Case 1

The staff reviewed the licensee's analysis for this case and found that it was adequate because the piping was shown to be capable of withstanding the DBE and because it was shown that over 13 hours are available to close the RWSP boundary isolation valves before reaching the analytical limit in the RWSP. It was shown by the licensee that operations personnel can isolate these valves within 54 minutes of accident initiation.

Case 2

The staff reviewed the analysis considering operator response time, ensuing loss of level in the RWSP, and time to reach the minimum level in the RWSP required for accident mitigation at the stated loss rate of 150 gpm. The staff finds that ample time is available to secure from this alignment in the event of a LOCA prior to reaching the analytical limit in the RWSP.

Case 3

The staff reviewed the licensee's analysis and found that it was adequate because the piping was shown to be capable of withstanding the DBE and because it was shown that over 5 hours is available to isolate the RWSP boundary isolation valves before reaching the analytical limit of the RWSP.

Case 4

For Case 4, the licensee calculated that there would be 1 hour and 40 minutes available to isolate the RWSP purification system before reaching the analytical limit in the RWSP of 6.2 percent. The staff analysis shows that, at a loss of RWSP inventory of 150 gpm through the purification pump, the time for operator action to close manual isolation valves FS-423 and FS-404, conservatively estimated at 54 minutes, is adequate.

4.3.2 Summary

Based on the analysis presented for Cases 1, 2, 3, and 4 above, the staff concludes that the licensee would have adequate time to isolate the RWSP either from a pipe crack in the RWSP purification system concurrent with a LOCA or from draw-down by the RWSP purification system aligned to the SFP during a LOCA, before reaching the analytical limit of the RWSP. The licensee analyzed the RWSP purification system and determined that it would withstand a DBE, and has shown adherence to the intent of RG 1.29 and the intent of ANSI N18.2-1975 regarding criteria for safety to non-safety class fluid system interfaces. That is, the active failure of a Safety Class 3 component (postulated failure to close boundary isolation valves FS-423 and FS-404), combined with failure of any lower class component (pipe crack in the RWSP purification system or diversion of water to the SFP) cannot prevent achievement of the minimum safety system function of the higher class system (cannot draw down RWSP level below its analytical limit). The staff finds the technical evaluation acceptable and the licensee's request for a design basis change to the normal position of RWSP isolation valves, FS-423 and FS-404, from normally closed to normally open also acceptable.

4.4 Probabilistic Safety Assessment

4.4.1 Objective and Evaluation Criteria

This section reviews the risk assessment information submitted by the license in support of its request to reposition valves FS-423 and FS-404 from normally closed to normally open. The licensee uses risk-informed arguments to show that the function of these valves, as both a safety related boundary and seismic category 1 boundary, will be satisfied by crediting manual actions.

4.4.2 Evaluation

The licensee has adequately considered the two line-ups of the RWSP purification system, the consideration of the scenarios (small LOCA, seismic event, "random failure" of the non-safety related piping), and all Modes of operation in the risk assessment. These four cases have already been detailed in Section 4.1 of this Safety Evaluation. The results of these cases, together with major assumptions made in the analysis, are summarized and evaluated below.

Case 1

The licensee estimated that the operator would need about 54 minutes to isolate such a leak and that this action would have to be completed within about 13 hours. This sequence of events is assumed to divert enough borated water from the ECCS pump suction such that the NPSH requirements for the ECCS pumps, following re-alignment to the sump, will not be established. The licensee estimated that this scenario leads to core damage with a frequency

smaller than 5E-9/year.

Case 2

The licensee estimated that the operator would need about 54 minutes to isolate such a leak and that this action would have to be completed within about 4 hours and 14 minutes. This sequence of events is assumed to divert enough borated water from the ECCS pump suction to the SFP such that there would not be adequate volume of borated water for reactivity control. The licensee estimated that this scenario leads to core damage with a frequency of about 2.5E-8/year.

Case 3

The licensee estimated that the isolation action would have to be completed within about 5 hours and 14 minutes instead of about 13 hours. However, because the probability of a LOCA in Modes 5 and 6 is lower than at power, this scenario leads to core damage with a frequency comparable to the one assessed for Case 1 (i.e., about 5E-9/year).

Case 4

The licensee estimated that the isolation action would have to be completed within about 1 hour and 40 minutes instead of about 4 hours and 14 minutes required for Case 2. However, because the plant is in this configuration for the least amount of time (i.e., in Modes 5 and 6 as opposed to Modes 1 through 4) and the probability of a LOCA in Modes 5 and 6 is lower than at power, this case was assessed to lead to core damage with a frequency of about 5E-9/year.

One of the staff's review objectives was to ensure that no risk significant scenarios have been omitted in the risk assessment submitted by the licensee. Two additional cases were examined by the staff and discussed with the licensee. The first of these two scenarios is similar to the above described Case 1, with the exception that it is initiated by a seismic event of high enough magnitude to cause both the LOCA and the RWSP purification system pipe break. The second additional case involves a break in the RWSP purification system piping (without a concurrent LOCA), which could flood areas where safety equipment is located, thus having the potential to initiate a reactor scram and at the same time cause several safety system failures. The staff concluded that the risk impact of these two additional scenarios is very small (well below the RG 1.174 acceptance guidelines which are 1E-6/yr and 1E-7/yr for CDF and LERF, respectively). Furthermore, these two additional scenarios are bounded by scenarios that have been previously assessed and included in the plant's baseline risk documented in the plant's Probabilistic Risk Assessment (PRA). Thus, such scenarios do not contribute significantly to any risk increases associated with the proposed change.

Another objective of the staff's review was to ensure that the assumptions made and data used in the analysis are realistic or conservative so that the assessed risk impact is not underestimated. The staff review focused on assumptions and data which could have a significant impact on the results of the analysis. The staff review revealed that in most cases such assumptions and data are realistic or conservative. In the few cases where it has been determined that there may be uncertainty associated with some numerical values used in the analysis, sensitivity studies have indicated that the results of the analysis are not sensitive to reasonable changes in such numerical values. Some examples are:

- The probability of failure of the RWSP purification line following a small LOCA is based on a conservative assumption regarding the failure exposure time (it is assumed that it takes 12 hours to reach recirculation during a small LOCA).

- The results of the analysis are not sensitive enough to reasonable changes in several assumed values (e.g., small LOCA frequency, purification line failure rate, the frequency of an earthquake that causes failure of the purification line, and the frequency and duration of RWSP alignment to the SFP) to change the conclusions.

- The time available to the operator to close the isolation valves was based on certain conservative assumptions regarding the water level in the RWSP at the beginning of the postulated accident scenarios. Furthermore, the results of the analysis are not sensitive enough to reasonable decreases in such a time window to change the conclusions.

The staff finds that the assumptions made and data used in the analysis produced results that can safely be used to draw conclusions about the proposed change.

The above summarized results of the licensee's analysis indicate that the mean yearly increases in CDF and LERF due to the proposed change would be well below the RG 1.174 acceptance guidelines, which are 1E-6/yr and 1E-7/yr, respectively.

It is also noted that the licensee identified and implemented several compensatory actions and administrative controls, which further reduce the risk impact of the proposed change. Compensatory actions were included in operating procedures that direct the operator to take actions to isolate the RWSP from the RWSP purification system in the event of any type of leakage in the RWSP purification system piping, a LOCA, or a seismic event. In addition, administrative controls have already been established when the RWSP purification system is aligned to the RWSP to ensure that the safety function of the RWSP is maintained.

4.4.3 Risk Significance of Failure to Isolate the RWSP

In the proposed change, the licensee also uses risk-informed arguments to support not crediting the single failure of manual valve FS-404. As previously stated, there are two line-ups of the RWSP purification system that may allow water to be diverted from the suction of the ECCS pumps during a LOCA. One is when the RWSP purification system is aligned to the RWSP; the other is when it is aligned to the SFP. While closure of one manual valve (FS-423) is required to isolate the RWSP purification system when the system is aligned to the SFP, closure of both manual valves, FS-423 and FS-404, is required when the RWSP purification system is aligned to the RWSP. When FS-423 fails to close, the operator can close FS-425 or FS-428 as a contingency. However, there is no contingency when FS-404 fails to close. The licensee does not credit this single failure in the analysis due to the negligible increase in CDF (about 2E-12 per year) associated with the failure of FS-404 to close.

The staff reviewed the approach used by the licensee to assess the risk significance of the failure to isolate the RWSP. The assessed CDF increase of about 2E-12 per year seems reasonable because closure of the manual valve FS-404 is not needed when the RWSP purification system is aligned to the SFP (the lineup which, as explained above in Case 2, is associated with the highest risk increase). The assessed CDF increase, due to failure of FS-404 to close, is based on Case 1, which involves a small LOCA with subsequent failure of the purification line and failure to close manual valve FS-404. Due to the lack of sufficient data

to estimate a plant-specific probability, the licensee used generic industry data for the value of the failure to close probability of a manual valve (3.5E-4). However, even if this probability was assumed to be an order of magnitude or more higher, the conclusion would not change. Therefore, the staff finds acceptable the risk assessment showing that there is a negligible risk impact associated with the single failure of manual valve FS-404.

4.4.4 PRA Quality

The risk assessment performed by the licensee in support of the proposed change to the design basis is not based on accident scenarios that have been modeled in the plant's PRA. Therefore, the "quality" of the plant PRA does not have a significant impact on the "quality" of the submitted risk assessment. The "quality" of the submitted risk assessment has been addressed and documented in Sections 4.4.2 and 4.4.3 of this Safety Evaluation.

4.4.5 Summary

The staff reviewed the risk assessment information submitted by the licensee in support of its request to reposition valves FS-423 and FS-404 from normally closed to normally open. These manually operated valves act as the system boundary isolation between the safety related RWSP, which is the suction source for the ECCS pumps, and the non-safety RWSP purification system. The licensee uses risk-informed arguments to show that the function of these valves, as both a safety related boundary and seismic category 1 boundary, will be satisfied by crediting manual actions. Manual actions are needed to close these valves should a LOCA occur simultaneously with an RWSP purification pipe break or should a LOCA occur while the RWSP purification system is aligned to the SFP.

The major findings of the staff's review are summarized below:

- The mean yearly increases in CDF and LERF due to the proposed change would be well below the RG 1.174 acceptance guidelines, which are 1E-6/yr and 1E-7/yr, respectively.

- The assumptions made and data used in the risk analysis produced results that can safely be used to draw conclusions about the proposed change.

- The licensee identified and implemented several compensatory actions and administrative controls which further reduce the risk impact of the proposed change.

- The risk assessment supports not crediting the single failure of manual valve FS-404.

The staff concludes that the risk information included in the application supports the proposed change.

4.5 Human Performance Assessment

4.5.1 Objective

In this section, the required operator actions are reviewed to ensure that they can be reliably performed as proposed by the licensee in their amendment request.

4.5.2 Evaluation

The proposed change will revise the design position of two valves, FS-423 and FS-404, from normally closed to normally open. The proposed "open position" of the RWSP purification system boundary valves requires evaluation of the consequences of a loss of RWSP inventory through any postulated failure of the RWSP purification system.

The four specific cases, already discussed, are examined from a safety-related operator action required to isolate the RWSP purification system.

Case 1

For this case, the licensee estimated that a through-wall leak at 48 gpm would take about 13 hours and 13 minutes for the RWSP to reach its analytical level. If the crack cannot be isolated and assuming no make-up, the RWSP level would continue to drop and the low-low level alarm would actuate at 82.9 percent, rendering the RWSP inoperable in accordance with the TS level requirement. At this point, using the Annunciator Response Procedures, control room operators would restore the RWSP level by securing the valve alignment to the RWSP purification system, if aligned. The operators also would add inventory to the RWSP. If, after one hour, the inventory cannot be restored to the TS limit (83 percent), the plant is placed in hot standby within six hours and cold shutdown within the next 30 hours. In this case, new operator actions are not credited in the licensee's analysis nor is there a change to already-credited operator actions.

Case 2

The licensee indicates that about 4 hours and 14 minutes are available to secure the RWSP purification system before reaching the volume needed to reach accident mitigation. The licensee further stated that, "...[t]he actual expected operator response time to terminate this scenario is less than 54 minutes...." If the isolation valves are closed within 54 minutes, no more than about 1.0 percent of the RWSP would be depleted. Filling the SFP from the RWSP from the low level to the high level requires less than 1.0 percent of the RWSP volume. Whenever the SFP is being filled, a dedicated operator is stationed at the SFP to monitor level. The licensee indicated that, "...with the existing procedural guidance and limited amount of makeup required to fill the SFP, the above stated time for operator action, 54 minutes, is very conservative."

Case 3

The licensee's analysis indicated that "...[t]he RWSP will provide its safety function as long as the volume of borated water is at or above the analytical limit including all uncertainties (9.38 [percent], 54,109 gallons). Therefore, there is approximately 15,114 gallons of conservative volume available in the RWSP." The estimated flow rate through the crack is

48 gpm. The licensee stated that, "...the operator has approximately 5 hours and 14 minutes to isolate the leak. This is ample time for the operator to take action to stop the leak before potentially depleting below the required analytical volume."

Case 4

In this most limiting condition, there are approximately 15,114 gallons of conservative volume available in the RWSP. At a flow rate of 150 gpm, the RWSP volume would be depleted in 1 hour and 40 minutes. Since it will take the operator no more than 54 minutes to isolate the RWSP, sufficient volume remains in the RWSP to allow operator action and assure the safety function of the RWSP. Filling the SFP from the RWSP from the low level to the high level requires less than 1.0 percent of the RWSP volume. Whenever the SFP is being filled, a dedicated operator is stationed at the SFP to monitor level. The licensee indicated that, "...with the existing procedural guidance and limited amount of make-up required to fill the SFP, the above stated time for operator action, 54 minutes, is very conservative."

The licensee estimated the time needed for an operator to take the actions required to isolate the RWSP purification system using guidance contained in ANSI/ANS Standard 58.8-1984, "Time Response Design Criteria for Nuclear Safety Related Operator Actions." In estimating the time requirements, the licensee included the conservatism of having valve FS-423 failing to operate and sustaining an incapacitating injury to the operator, which necessitates sending another operator to complete the valve closures by closing either contingency valve FS-425 or FS-428. Additionally, the licensee addressed environmental restrictions that might prevent successful operator performance by indicating that adequate emergency lighting is available along the access routes and where the actions are performed; operators are also required to carry flashlights; the Reactor Auxiliary Building and areas where the components are located are equipped with phones and the operators also carry radios to communicate with the control room; and radiation exposure to the operator performing the task would not exceed required limits because valves FS-423 and FS-404 are accessible before any condition of high radiation would occur or, if a high radiation condition were to occur when the RWSP reaches the Recirculation Actuation Signal or when Shutdown Cooling is placed in service, the RWSP would have already fulfilled its safety function. In addition, the licensee indicated that the operator could isolate the RWSP purification system before the RWSP inventory drops below the level credited for accident mitigation. If the level drops below the TS limit, actions are taken to restore the level or the plant is shut down.

The licensee further indicated that the operator response time of 54 minutes, estimated using ANSI/ANS 58.8-1984 (and using the 1994 version for comparison, which estimated 58 minutes), is very conservative. Based on an actual plant walkdown, the time needed to isolate both valves FS-423 and FS-404 was approximately 11 minutes. In the licensee's February 27, 2002, response to the staff's request for additional information, the licensee clarified that the walkdown was performed by a single Shift Manager (licensed Senior Reactor Operator). During the walkdown, it was assumed that the FS-423 failed to close and that flow was secured by having the operator stop the RWSP purification system pump by opening its associated breaker at the motor control center. The licensee indicated that the breaker is located two levels above the FS-423 and FS-404 isolation valves, in a different work location from the valves, and requires more time to access than the time it takes to walk between FS-423 and FS-404. Therefore, the time to perform this action (11 minutes) is more conservative than the time required walking from one valve to the next. No special tools or actions are required to manipulate the valves to their closed positions. While the Shift Manager had prior

knowledge of the task to be accomplished, no pre-walkdown was performed to familiarize him with the components to be manipulated.

As a further basis for supporting the operator action times, the licensee performed two walkdowns with Nuclear Auxiliary Operators (NAO) (non-licensed operators) who recorded their travel times to and between the valves starting from their office outside the plant's Controlled Access Area but inside the Protected Area. No actual valve manipulations were performed during these walkdowns, though one minute was assumed for each valve operation in the total time estimate. Results from these walkdowns were 4 minutes, 52 seconds and 4 minutes, 35 seconds, which represent the times to travel from the NAO office to FS-404, closure of FS-404, travel to FS-423, attempted closure of FS-423 (assumed failure), travel to FS-428 (contingency valve), and closure of FS-428. All three demonstrated times were well within the time required to perform the actions, as estimated using the guidance in ANSI/ANS-58.8 (1984 and 1994) and well within the time limits identified before system safety functions are challenged.

In response to the staff's request, the licensee, in their February 27, 2002, supplemental letter, committed to validate the procedure being developed to implement the proposed change. The procedure will be validated by the time the change is implemented to ensure that the required operator actions can be reliably performed within the time limits documented in the licensee's analysis.

4.5.3 Summary

The staff reviewed the operator actions proposed to be credited by the licensee in support of its request to reposition valves FS-423 and FS-404 from normally closed to normally open. These manually operated valves act as the system boundary isolation between the safety related RWSP, which is the suction source for the ECCS pumps, and the non-safety RWSP purification system. Manual actions are needed to close these valves if a LOCA occurs simultaneously with an RWSP purification pipe break or if a LOCA occurs while the RWSP purification system is aligned to the SFP.

The major findings of the staff's review are:

- The limiting condition identified by the licensee postulates a diversion of RWSP inventory through the RWSP purification system during Modes 5 and 6. The RWSP volume would be depleted in 1 hour and 40 minutes (100 minutes).

- Using ANSI/ANS-58.8 (1984), together with assumed conservatism, the licensee estimated 54 minutes to be the time required to manually isolate make-up to the SFP from the RWSP.

- The licensee, using walkdowns together with assumed conservatism, demonstrated that the required actions to close the RWSP purification isolation valves can be accomplished in less than the estimated 54 minutes and well within the time limits identified before system safety functions are challenged.

- The procedure being developed to implement the proposed change will be validated by the time the change is implemented to ensure that the required operator actions can be reliably performed within the time limits documented in the licensee's analysis

The staff concludes that the information included in the Waterford 3 amendment request related to crediting of operator actions supports the proposed change.

During a telephone call on January 22, 2002, the NRC staff requested that the procedure, being developed to implement this design basis change once approved, be validated to ensure the operator actions specified can be accomplished within the time (54 minutes) documented in the submittal dated April 2, 2001. The licensee committed that the validation will be completed by the implementation of the requested change.

The NRC staff finds that reasonable controls for the implementation and for subsequent evaluation of proposed changes pertaining to the above regulatory commitment are best provided by the licensee's administrative processes, including its commitment management program. The above regulatory commitments do not warrant the creation of regulatory requirements.

5.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Louisiana State official was notified of the proposed issuance of the amendment. The State official had no comments.

6.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration and there has been no public comment on such finding (66 FR 27176 dated May 16, 2001). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

7.0 CONCLUSION

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

Principal Contributors: J. Bongarra, J. Fair, J. Golla, N. Saltos

Date: March 12, 2003

Waterford Generating Station 3

cc:

Mr. Michael E. Henry, Administrator
and State Liaison Officer
Department of Environmental Quality
P. O. Box 82135
Baton Rouge, LA 70884-2135

Vice President, Operations Support
Entergy Operations, Inc.
P. O. Box 31995
Jackson, MS 39286-1995

Director
Nuclear Safety Assurance
Entergy Operations, Inc.
17265 River Road
Killona, LA 70066-0751

Wise, Carter, Child & Caraway
P. O. Box 651
Jackson, MS 39205

General Manager Plant Operations
Waterford 3 SES
Entergy Operations, Inc.
17265 River Road
Killona, LA 70066-0751

Licensing Manager
Entergy Operations, Inc.
17265 River Road
Killona, LA 70066-0751

Winston & Strawn
1400 L Street, N.W.
Washington, DC 20005-3502

Resident Inspector/Waterford NPS
P. O. Box 822
Killona, LA 70066-0751

Regional Administrator, Region IV
U.S. Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 1000
Arlington, TX 76011

Parish President Council
St. Charles Parish
P. O. Box 302
Hahnville, LA 70057

Executive Vice President
& Chief Operating Officer
Entergy Operations, Inc.
P. O. Box 31995
Jackson, MS 39286-1995

Chairman
Louisiana Public Services Commission
P.O. Box 91154
Baton Rouge, LA 70825-1697