May 10, 2004

Mr. Kenneth Putnam, Chairman
BWR Owners Group
Nuclear Management Company
Duane Arnold Energy Center
3277 DAEC Rd.
Palo, IA 52324

SUBJECT: DRAFT SAFETY EVALUATION FOR LICENSING TOPICAL REPORT (LTR) NEDO-33091, "IMPROVED BPWS CONTROL ROD INSERTION PROCESS" (TAC NO. MB9642)

Dear Mr. Putnam:

On June 6, 2003, the Boiling Water Reactors Owners Group (BWROG) submitted LTR NEDO-33091, "Improved BPWS Control Rod Insertion Process," to the staff for review. Enclosed for the BWROG's review and comment is a copy of the staff's draft safety evaluation (SE) for the LTR.

Twenty working days are provided to you to comment on any factual errors or clarity concerns contained in the SE. The final SE will be issued after making any necessary changes and will be made publicly available. The staff's disposition of your comments on the draft SE will be discussed in the final SE.

To facilitate the staff's review of your comments, please provide a marked-up copy of the draft SE showing proposed changes and provide a summary table of the proposed changes.

If you have any questions, please contact Bo Pham at (301) 415-8450.

Sincerely,

/RA/
Stephen Dembek, Chief, Section 2
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Project No. 691

Enclosure: Draft Safety Evaluation

cc w/encl: See next page

May 10, 2004

Mr. Kenneth Putnam, Chairman
BWR Owners Group
Nuclear Management Company
Duane Arnold Energy Center
3277 DAEC Rd.
Palo, IA 52324

SUBJECT: DRAFT SAFETY EVALUATION FOR LICENSING TOPICAL REPORT (LTR) NEDO-33091, "IMPROVED BPWS CONTROL ROD INSERTION PROCESS" (TAC NO. MB9642)

Dear Mr. Putnam:

On June 6, 2003, the Boiling Water Reactors Owners Group (BWROG) submitted LTR NEDO-33091, "Improved BPWS Control Rod Insertion Process," to the staff for review. Enclosed for the BWROG's review and comment is a copy of the staff's draft safety evaluation (SE) for the LTR.

Twenty working days are provided to you to comment on any factual errors or clarity concerns contained in the SE. The final SE will be issued after making any necessary changes and will be made publicly available. The staff's disposition of your comments on the draft SE will be discussed in the final SE.

To facilitate the staff's review of your comments, please provide a marked-up copy of the draft SE showing proposed changes and provide a summary table of the proposed changes.

If you have any questions, please contact Bo Pham at (301) 415-8450.

Sincerely,
/RA/
Stephen Dembek, Chief, Section 2
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Project No. 691

Enclosure: Draft Safety Evaluation

cc w/encl: See next page

DISTRIBUTION:

PUBLIC	JWermiel
PDIV-2 Reading	FAkstulewicz
HBerkow (RidsNrrDlpmLpdiv)	SLu
BPham (RidsNrrPMBPham)	RidsOgcMailCenter
EPeyton (RidsNrrLAEPeyton)	RidsAcrsAcnwMailCenter

ACCESSION NO.: ML041330526 **NRR-106** ***SE Input**

OFFICE	PDIV-2/PM	PDIV-2/LA	SRXB*	PDIV-2/SC
NAME	BPham	EPeyton	FAkstulewicz	SDembek
DATE	5/7/04	5/7/04	4/26/04	5/10/04

File: C:\ORPCheckout\FileNET\ML041330526.wpd

OFFICIAL RECORD COPY

cc:
Mr. Joseph E. Conen
Vice Chairman, BWR Owners Group
DTE Energy – Fermi 2
200 TAC
6400 N. Dixie Highway
Newport, MI 48166

Mr. J. A. Gray, Jr.
Regulatory Response Group Chairman
BWR Owners Group
Entergy Nuclear Northeast
440 Hamilton Avenue Mail Stop 12C
White Plains, NY 10601-5029

Mr. H. Lewis Sumner
Southern Nuclear Company
40 Inverness Center Parkway
P.O. Box 1295
Birmingham, AL 35242

Mr. Carl D. Terry
Vice President, Nuclear Engineering
Nine Mile Point - Station
OPS Building/2nd Floor
P.O. Box 63
Lycoming, NY 13093

Mr. Thomas G. Hurst
GE Nuclear Energy
M/C 782
175 Curtner Avenue
San Jose, CA 95125

Mr. Thomas A. Green
GE Nuclear Energy
M/C 782
175 Curtner Avenue
San Jose, CA 95125

Mr. James Meister
Exelon
Cornerstone II at Cantera
4300 Winfield Road
Warrenville, IL 60555

Mr. William A. Eaton
ENTERGY
Grand Gulf Nuclear Station
P.O. Box 756
Port Gibson, MS 39150

Mr. Mark Reddeman
Vice President Engineering
Point Beach Nuclear Plant
6610 Nuclear Road
Two Rivers, WI 54241

Mr. Richard Libra
DTE Energy
Fermi 2
M/C 280 OBA
6400 North Dixie Highway
Newport, MI 48166

Mr. James F. Klapproth
GE Nuclear Energy
M/C 706
175 Curtner Avenue
San Jose, CA 95125

DRAFT SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

LICENSING TOPICAL REPORT NEDO-33091, "IMPROVED BPWS CONTROL

ROD INSERTION PROCESS"

BOILING WATER REACTOR OWNERS GROUP (BWROG)

PROJECT NO. 691

1.0 INTRODUCTION

By letter dated June 6, 2003, the BWROG requested the NRC to review its licensing topical report (TR) NEDO-33091, "Improved BPWS [Banked Position Withdraw Sequence] Control Rod Insertion Process." Both the original BPWS process previously approved by the staff and the proposed improved process, are designed to minimize reactivity insertion during a postulated design basis control rod drop accident.

Throughout its operating cycle, a boiling water reactor (BWR) experiences various startup, normal, and shutdown operations. Control rods are also moved due to fuel burn-up, power maneuvers, and normal operational occurrences. This rod movement could potentially result in a decoupled control rod that's stuck in the core, followed by a subsequent control rod drop, which would lead to a high reactivity insertion in a small region of the core. For large loosely coupled cores, a significant shift in the spatial power generation could occur during the course of this excursion. Utilizing rod pattern control systems, i.e., rod worth minimizer, rod sequence control system or rod pattern controller, the BPWS was developed to reduce the maximum control rod worth during the startup and shutdown processes. The current BPWS process requires control rods to be moved in banked positions, even during the shutdown process after the low power set point (LPSP) is reached. This requirement results in the control of rod movement through many steps, when there is an extremely low possibility for the control rod to drop out of the core. Therefore, the improved BPWS proposes the one-step full insertion of control rods without banking after the reactor power is below LPSP.

2.0 REGULATORY BASIS

Control rod drop accident (CRDA) is the design basis accident for the subject LTR. In order to minimize the impact of a CRDA, the BPWS process was developed to minimize control rod reactivity worth for BWR2-6. The proposed improved BPWS further simplifies the control rod insertion process, and in order to evaluate it, the staff followed the guidelines of Standard Review Plan Section 15.4.9, and referred to General Design Criterion 28 of Appendix A to 10 CFR Part 50 as its regulatory requirement.

3.0 TECHNICAL EVALUATION

The original BPWS was developed to minimize the control rod worth and prevent a CRDA from occurring during startup, because of frequent control rod movements. This procedure also directly applied to the control rod insertion sequence during the shutdown routine, after power is lower than the LPSP. The BWROG and GE Nuclear Energy (GENE) found that this approach, while conservative, requires unnecessary control rod movements during the shutdown process. The procedural requirements on the operator also increases the risk of incorrect control rod movement, and causes additional wear on the rod and rod drive hardware systems. Since the possibility of having a decoupled control rod extremely low during the shutdown process, GENE is proposing the improved BPWS, which allows control rods to be fully inserted in a single step during the shutdown process.

The improved BPWS proposes the following changes to the operational procedures:

1. Before reducing power to the LPSP, operators shall confirm control rod coupling integrity for all rods that are fully withdrawn. Control rods that have not been confirmed coupled and are in intermediate positions must be fully inserted prior to power reduction to the LPSP. No action is required for fully-inserted control rods.

   If a shutdown is required and all rods, which are not confirmed coupled, cannot be fully inserted prior to the power dropping below the LPSP, then the original/standard BPWS must be adhered to.

2. After the reactor power drops below the LPSP, rods may be inserted from notch position 48 to notch position 00 without stopping at intermediate positions. However, GENE recommends that operators should insert rods in the same order as specified for the standard BPWS as much as reasonably possible. If a plant is in the process of shutting down following improved BPWS with the power below the LPSP, no control rod shall be withdrawn unless the control rod pattern is in compliance with standard BPWS requirements.

All other control rod operational requirements are unchanged and continue to apply. The proposed changes may alter the technical specifications of certain plants; GENE has identified the potentially affected areas in the standard technical specifications. The specific changes for each plant implementing the improved BPWS will be determined on a case-by-case basis.

The basis of the improved BPWS is the assumption that a CRDA can only be caused by a stuck rod which is decoupled from the control rod drop (CRD). No single failure of a BWR CRD mechanical or hydraulic system can cause a control rod to drop completely out of the reactor core during the reactor shut-down process. In its April 21, 2004, response to the staff's request for additional information (RAI), the BWROG/GENE referred the staff to Final Safety Analysis Report (FSAR) sections, isometric drawings, and hydraulic schematics describing CRD hydraulic unit design, control rod assembly configuration, and postulated CRD failure modes and effects scenarios from the FSARs for Oyster Creek (BWR/2), Monticello (BWR/3), Limerick (BWR/4), LaSalle (BWR/5), and Perry (BWR/6). The staff's review considered CRD hydraulic systems from plants of various BWR designs, and found that the CRD systems of BWR/2 through BWR/6 designs are very similar with respect to the mechanisms for rod insertion,

withdrawal, and locking. The staff found that during a reactor shutdown process for all operating BWRs when each control rod is given an insert signal, there exists no single failure of the CRD hydraulic or mechanical system that could result in a control rod withdrawal out of the core of more than six inches (equivalent to one CRD index tube drive notch length). Therefore, the staff agrees with the BWROG/GENE's assessment regarding the possible cause of a CRDA during the shutdown process after reactor power reaches below the LPSP since the technical basis, as cited above, is sound and acceptable.

Implementation of the improved BPWS requires two major operating procedure changes. The requirement for operators to confirm control rod coupling integrity for all rods fully withdrawn will assure proper coupling during the control rod insertion process and any possible rod withdrawal after reactor power drops below LPSP. The proposed procedure for the full insertion of all unconfirmed control rods prior to LPSP will prevent the possibility of a decoupled control rod dropping out during the control rod maneuvers. If all unconfirmed control rods cannot be fully inserted prior to the LPSP, the use of the standard BPWS will become the conservative fall back position, since the risk of a CRDA occurring using the improved BPWS will be no different than the standard BPWS using this procedure.

After reactor power drops below the LPSP, the improved BPWS allows the full insertion of each control rod without banking. This simplification of the control rod insertion process helps to reduce the number of control rod insertion steps. Since all unconfirmed control rods have been inserted, it is highly unlikely for a CRDA to occur while confirmed rods are being inserted without banking. Therefore, the improved BPWS will have the same level of safety assurance as the previously approved standard BPWS process. Should the operator decide to reverse the shutdown process, the improved BPWS does not allow for the withdrawal of any control rods, unless the control rod pattern meets the standard BPWS requirements. This ensures that all control rods are always banked for withdrawal.

The improved BPWS's single step full insertion also reduces the insertion time of each rod, which may induce a necessary increase in other procedures or processes to accommodate this rapid change. During telephone conferences, the staff requested additional information from the BWROG/GENE regarding the impact of the accelerated shut-down process on other procedures. The BWROG/GENE examined its process and requirements, and concluded in its RAI response on April 21, 2004, that the improved BPWS process does not adversely affect the normal shutdown processes, since the operating procedures will remain to be bounded by the most limiting (fastest negative reactivity) control rod insertion scenario (RAI #3). In addition, pressure-temperature effects, as in the cooldown process for example, are accounted for and controlled by controlling reactor dome pressure, coolant flow and coolant temperature.

4.0 CONCLUSIONS

The BWROG/GENE has proposed an improved BPWS process which allows for the single step full insertion of control rods during shutdown, when the reactor power is lower than the LPSP. The staff has completed its review of the subject LTR, and concluded that the proposed change is acceptable and applicable to BWR/2-6 with standard BPWS already implemented. Plants

electing to implement the improved BPWS must reflect the changes in their operating procedure. If the technical specification of a plant is impacted or needs to be updated, an amendment submittal to the NRC will be required.

Principal Contributor: Shanlai Lu

Date: May 10, 2004