April 1, 2003

Mr. James F. Klapproth, Manager
Engineering & Technology
GE Nuclear Energy
175 Curtner Avenue
San Jose, CA 95125

SUBJECT: REVIEW OF GENERAL ELECTRIC NUCLEAR ENERGY LICENSING TOPICAL REPORT NEDC-32938P, "GENERIC GUIDELINES AND EVALUATIONS FOR GENERAL ELECTRIC BOILING-WATER REACTOR THERMAL POWER OPTIMIZATION" (TAC NO. MA9537)

Dear Mr. Klapproth:

By letter dated July 11, 2000, and supplements dated June 1 and 6, 2001, September 21, 2001, October 5, 2001, August 7, 2002, and March 21, 2003, GE Nuclear Energy (GENE) requested that the NRC staff review and approve its licensing topical report (LTR) NEDC-32938P, "Generic Guidelines for General Electric Boiling Water Reactor Thermal Power Optimization." By letter dated November 5, 2002, GENE submitted Revision 1 to the LTR. Revision 1 incorporates changes from NRC requests for additional information (RAI) responses that affected the document and changes to proprietary markings. The LTR establishes an agreed-upon process and scope for the evaluation and analysis to support increasing the licensed operating thermal power to account for improvements in the thermal power measurement uncertainty. The staff reviewed the proposed content of the plant-specific applications, the evaluation approach, and the supporting generic evaluations and dispositions provided in the LTR. The staff finds the proposed approach specified in NEDC-32938P, as supplemented, is acceptable for referencing in licensing applications to the extent specified under the limitations delineated in the report and in the NRC's associated safety evaluation (SE). The enclosed SE defines the basis for acceptance of the topical report.

We do not intend to repeat our review of the matters described in the subject report, and found acceptable, when the report appears as a reference in an individual application for a license amendment, except to ensure that the material presented applies to the specific plant involved. Our acceptance applies only to matters approved in the report.

In accordance with the guidance provided on the NRC website , we request that GENE publish an accepted version of the LTR within three months of receipt of this letter. The accepted version shall incorporate (1) this letter and the enclosed SE between the title page and the abstract, (2) the clarification noted in Section 6.0 of the SE, and (3) a "-A" (designating "accepted") following the report identification symbol.

Pursuant to 10 CFR 2.790, we have determined that the safety evaluation provided as Enclosure 1 contains proprietary information. Proprietary information contained in Enclosure 1 is indicated by marginal lines. We have prepared a non-proprietary version of the safety evaluation (Enclosure 2) that we have determined does not contain proprietary information.

However, we will delay placing Enclosure 2 in the public document room for a period of ten (10) working days from the date of this letter to provide you with the opportunity to comment on the proprietary aspects only. If you believe that any information in Enclosure 2 is proprietary, please identify such information line by line and define the basis pursuant to the criteria of 10 CFR 2.790.

Should our criteria or regulations change so that our conclusions as to the acceptability of the report are invalidated, GENE and/or the licensees referencing the LTR will be expected to revise and resubmit their respective documentation, or submit justification for the continued applicability of the LTR without revision of their respective documentation.

If you have any questions, please contact Alan Wang, GENE Project Manager, at (301) 415-1445.

Sincerely,

/RA/

Herbert N. Berkow, Director
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Project No. 710

Enclosures: 1. Proprietary Safety Evaluation
2. Non-proprietary Safety Evaluation

cc w/encl 2: See next page

However, we will delay placing Enclosure 2 in the public document room for a period of ten (10) working days from the date of this letter to provide you with the opportunity to comment on the proprietary aspects only. If you believe that any information in Enclosure 2 is proprietary, please identify such information line by line and define the basis pursuant to the criteria of 10 CFR 2.790.

Should our criteria or regulations change so that our conclusions as to the acceptability of the report are invalidated, GENE and/or the licensees referencing the LTR will be expected to revise and resubmit their respective documentation, or submit justification for the continued applicability of the LTR without revision of their respective documentation.

If you have any questions, please contact Alan Wang, GENE Project Manager, at (301) 415-1445.

Sincerely,

/RA/

Herbert N. Berkow, Director
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Project No. 710

Enclosures: 1. Proprietary Safety Evaluation
2. Non-proprietary Safety Evaluation

cc w/encl 2: See next page

*

DISTRIBUTION:
PUBLIC **(No DPC Folder for 10 working days)**
PDIV-2 Reading
RidsNrrDlpmLpdiv (HBerkow)
RidsNrrPMAWang
RidsNrrLAEPeyton
RidsOgcRp
RidsAcrsAcnwMailCenter
SWeerakkody (NRR/DSSA/SPLB)
CHolden (NRR/DE/EEIB)
EMarinos (NRR/DE/EEIB)
KManoly (NRR/DE/EMEB)
RCaruso (NRR/DSSA/SRXB)
SCoffin (NRR/DE/EMCB)
MReinhart (NRR/DSSA/SPSB)
LLund (NRR/DE/EMCB)

* For previous concurrences see attached ORC
****** Concurrence received by telecon

Package No.: ML031060223
Safety Evaluation (Proprietary Version) No.: ML031060155
ADAMS (Non-Proprietary Version) Accession No.: ML031050138 NRR-106

OFFICE	PDIV-2/PM	PDIV-2/LA	SPLB/SC *	EEIB/SC *	EEIB/SC **	EMEB/SC *
NAME	AWang	EPeyton	SWeekakkody	CHolden	EMarinos	KManoly
DATE	3/27/03	3/27/03	2/03/03	1/27/03	2/4/03	1/8/03
OFFICE	SRXB **	EMCB/SC **	SPSB/SC **	OGC - NLO With Comments	PDIV-2/SC	PDIV:D
NAME	RCaruso	SCoffin	MReinhart	RWeisman	SDembek	HBerkow
DATE	1/27/03	1/26/03	1/26/03	2 March 2003	3/31/03	4/1/03

DOCUMENT NAME: G:\PDIV-2\GE\TPO SE.wpd

OFFICIAL RECORD COPY

cc:

Mr. George B. Stramback
Regulatory Services Project Manager
GE Nuclear Energy
175 Curtner Avenue
San Jose, CA 95125

Mr. Charles M. Vaughan, Manager
Facility Licensing
Global Nuclear Fuel
P.O. Box 780
Wilmington, NC 28402

Mr. Glen A. Watford, Manager
Nuclear Fuel Engineering
Global Nuclear Fuel
P.O. Box 780
Wilmington, NC 28402

LIST OF ACRONYMS

AC	- alternating current
ACP	- activated corrosion products
ADS	- automatic depressurization system
ALARA	- as low as is reasonably achievable
ANSI	- American National Standards Institute
AOO	- anticipated operational occurrence
AOP	- abnormal operating procedure
APRM	- average power range monitor
ARI	- alternate rod insertion
ART	- adjusted reference temperature
ASME	- American Society of Mechanical Engineers
AST	- alternate source term
ATWS	- anticipated transient without scram
AV	- allowable value
BOP	- balance of plant
BHP	- brake horse power
BWR	- boiling water reactor
BWRVIP	- Boiling Water Reactor Vessel and Internals Project
CCW	- component cooling water
CDF	- core damage frequency
CFDS	- condensate filtration and demineralization system
CGCS	- combustible gas control system
COLR	- Core Operating Limits Report
CPPU	- constant pressure power uprate
CRD	- control rod drive
CRDA	- control rod drop accident
CRDM	- control rod drive mechanism
CS	- containment spray
CSC	- containment spray cooling
CST	- condensate storage tank
DBA	- design-basis accident
DC	- direct current
ECCS	- emergency core cooling system
EMA	- equivalent margins analysis
EOP	- emergency operating procedure
EPU	- extended power uprate
EQ	- environmental qualification
ESFAS	- engineered safety feature actuation system
FAC	- flow accelerated corrosion
FHA	- fuel handling accident
FIV	- flow induced vibration
FW	- feedwater
GDC	- general design criteria
GENE	- GE Nuclear Energy
GESTAR II	- General Electric Standard Application for Reactor Fuel
GL	- generic letter

GNF	- Global Nuclear Fuel
HCU	- hydraulic control unit
HELB	- high energy line break
HPCI	- high pressure coolant injection
HPCS	- high pressure core spray
HWC	- hydrogen water chemistry
IASCC	- irradiation assisted stress corrosion cracking
ICA	- interim corrective action
ILBA	- instrument line break accident
IORV	- inadvertent opening of a relief valve
IPE	- individual plant examination
IPEEE	- individual plant examination of external events
LTR	- licensing topical report
LHGR	- linear heat generation rate
LOCA	- loss of coolant accident
LTS	- long term solution
LOFW	- loss of feedwater
LOFWF	- loss of feedwater flow
LPCI	- low pressure coolant injection
LPCS	- low pressure core spray
LERF	- large early release frequency
LOOP	- loss of offsite power
LTR	- licensing topical report
MELLLA	- maximum extended load limit line analysis
MEOD	- maximum extended operating domain
MCPR	- minimum critical power ratio
MAPLHGR	- maximum average planar linear heat generation rate
MSLBA	- main steam line break accident
MSIV	- main steam isolation valve
MVAR	- reactive power
MOS	- main offgas system
NSSS	- nuclear steam supply system
NPSH	- net positive suction head
NMIP	- noble metals injection process
OLTP	- original licensed thermal power
OLMCPR	- operating limit minimum critical power ratio
OPRM	- oscillation power range monitor
OOS	- out-of-service
PUSAR	- power uprate safety analysis report
PRFO	- pressure regulator failure to open
P-T	- pressure temperature
PCT	- peak cladding temperature
PRA	- probabilistic risk assessment
RPT	- reactor pressure temperature
RHR	- residual heat removal
RCS	- reactor coolant system
RIPD	- reactor internal pressure differences
RPV	- reactor pressure vessel
RCPB	- reactor coolant pressure boundary
RCIC	- reactor core isolation cooling

RWCU	- reactor water cleanup
RCIS	- rod control and information system
RTP	- rated thermal power
RWL	- rod withdrawal limiter
RPS	- reactor protection system
SE	- safety evaluation
SRLR	- Supplemental Reload Licensing Report
SAFDL	- specified acceptable fuel design limit
SLMCPR	- safety limit minimum critical power ratio
SBO	- station blackout
SRV	- safety relief valve
SRP	- Standard Review Plan
SCCR	- spent condensate cleanup resins
SLC	- standby liquid control
SPC	- suppression pool cooling
SDC	- shutdown cooling
SGTS	- standby gas treatment system
STS	- standard technical specifications
TAF	- top-of-active fuel
TPO LTR	- thermal power optimization licensing topical report
TSAR	- thermal power optimization safety analysis report
TTNBP	- turbine trip no bypass
TCV	- turbine control valve
TS	- technical specification
UFSAR	- updated final safety analysis report
USE	- upper shelf energy

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

GE NUCLEAR ENERGY LICENSING TOPICAL REPORT NEDC-32938P,

"GENERIC GUIDELINES AND EVALUATIONS FOR GENERAL ELECTRIC BOILING WATER

REACTOR THERMAL POWER OPTIMIZATION"

PROJECT NO. 710

1.0 INTRODUCTION

In a letter dated July 11, 2000 (Reference 1), GE Nuclear Energy (GENE) submitted Licensing Topical Report (LTR) NEDC-32938P, "Generic Guidelines and Evaluations for General Electric Boiling Water Reactor Thermal Power Optimization" (TPO), for review by the Nuclear Regulatory Commission (NRC). GENE subsequently supplemented the TPO LTR in response to the staff's requests for additional information (RAIs) on June 1 and 6, 2001, September 21, and October 5, 2001, and August 7, 2002 (References 2, 3, 4, 5, and 6). By letter dated November 5, 2002, GENE submitted Revision 1 to the LTR. Revision 1 incorporates changes from NRC requests for additional information (RAI) responses that affected the document and changes to proprietary markings.

Many of the safety analyses and evaluations supporting current boiling water reactor (BWR) operating licenses incorporate a thermal power measurement uncertainty of 2 percent or greater, in accordance with the requirements in Appendix K to Title 10, Part 50, of the Code of Federal Regulations (CFR), and as described in Regulatory Guide (RG) 1.49, "Power Levels of Nuclear Power Plants." This 2 percent adjustment was incorporated into the regulations to account for uncertainties in the assessment of reactor thermal power, as provided for in 10 CFR Part 50, Appendix K, "ECCS Evaluation Models," and described in RG 1.49. Improvements in analytical techniques based on more realistic assumptions and models, plant performance experience, and the current fuel designs have shown that the 2 percent adjustment could be reduced while continuing to maintain adequate safety margins. A revision to 10 CFR Part 50, Appendix K (issued January 1, 2001), authorized licensees to use less than the accepted 2 percent power measurement uncertainty value, provided that the actual magnitude of the power measurement instrumentation uncertainty is accounted for. Instead of reducing the 2 percent -adjustment, a TPO uprate would increase the rated thermal power (RTP) by an amount less than or equal to the reduction in assessment uncertainty.

In the TPO LTR, GENE has proposed a TPO uprate program, which involves a power uprate up to 101.5 percent of the current licensed thermal power (CLTP), applying the actual thermal-power-uncertainty, which could be less than the 2 percent uncertainty stipulated by Appendix K. The final revised rule by itself does not allow an increase in licensed power levels. Because maximum power is set in the license, and is connected to technical specification limits, each power uprate proposal must be reviewed by the staff under the license amendment process. GENE therefore submitted this TPO LTR which provides generic guidelines for licensees to request NRC approval to implement a TPO uprate by applying a reduced reactor thermal power uncertainty (less than the historical allowance of 2 percent). The objective of the TPO uprate program is to provide safety evaluations and advice to support a licensee's request to increase reactor thermal power up to 101.5 percent of CLTP consistent with the magnitude of the thermal power measurement uncertainty reduction achievable. The magnitude of the plant-specific reduction in thermal power measurement uncertainty via the TPO uprate program and, therefore, the value of the power uprate will depend on several factors specific to the plant, including the system design of the plant feedwater (FW) flow measurement, its accuracy, and other associated instrumentation.

The LTR provides generic guidelines for preparing and submitting license amendments to the NRC for uprating General Electric (GE) BWRs based on the proposed TPO program; a generic approach for applying the licensing criteria; an uprating process; an evaluation methodology; and the work scope for plant-specific submittals. In addition, the LTR provides generic evaluations of the impact of the proposed TPO power uprate on the suitability and functional capability of numerous generic plant systems. GENE's generic evaluations conclude that by applying the reduced thermal power uncertainty, power uprate up to 101.5 percent of CLTP can be justified without changing the boundaries of the current operating licensed analyses. A proposed TPO uprate would increase steam flow by <2 percent of its current value, and is also expected to increase final FW temperature by <2°F. The TPO LTR states that most effects of the proposed power increase can be bounded by previous generic and plant-specific analyses.

2.0 PURPOSE

The TPO LTR describes the generic guidelines, evaluations, criteria, process, and scope of work that would be needed to support increasing the licensed operating thermal power to account for improvements in thermal power measurement uncertainty. The TPO LTR addresses the safety aspects of a plant that are affected by an increase of up to 1.5 percent in the thermal power level, including the nuclear steam supply system (NSSS) and balance-of-plant (BOP) systems. Some of the safety analyses and evaluations performed at 102 percent of the currently licensed thermal power may still be applicable for a TPO power uprate. However, other supporting safety and engineering analysis and evaluations were performed at nominal power levels without an addition for thermal power uncertainty or statistical treatment of the power uncertainty. GENE states that the purpose of the TPO LTR is to establish an agreed-upon scope and depth for plant-specific TPO uprate applications. The TPO LTR defines the methodology, analysis assumptions and acceptance criteria to be used in the plant-specific TPO uprate safety analysis report (TSAR) for an individual license amendment application.

3.0 LICENSING APPROACH

Appendix A to the TPO LTR presents the proposed format of the plant-specific TSAR. The proposed format, scope, and content of the TPO LTR is similar to previous GE generic power uprate licensing topical reports (References 7 and 8). The plant-specific applications would reference the NRC-approved methods and codes used to perform the safety analyses and evaluations, including the methods and codes used by the applicable non-GE fuel vendors. As a result of the Maine Yankee Atomic Power Station Lessons Learned Report, the TSAR will provide a list of the computer codes used to perform the analyses and indicate the NRC-approval status.

The TPO LTR provides an assessment of BWR plant safety, system and component performance analyses, and evaluations to establish the areas that are affected by a TPO uprate and areas that are insignificantly affected by a small change in the licensed thermal power. GENE states that, where applicable, the TPO LTR provides generic bounding evaluations for specific areas of the BWR plant safety design to reduce the content of the plant-specific TSAR. In Section 4.2.1 and Appendix B to the TPO LTR, GENE proposes categorizing the evaluations supporting a TPO uprate as follows:

1. Bounded by the Current Licensed Thermal Power (CLTP) Analyses and Evaluations

   The existing evaluations or analyses were performed at 102 percent of the CLTP and bound the TPO uprate conditions. The plant-specific submittals will confirm that the CLTP evaluations and safety analyses bound the TPO operating conditions.

2. Generically Dispositioned

   The generic evaluations in the TPO LTR are applicable to the plant-specific conditions. The TPO LTR dispositions some of the safety analyses and system performance assessments by determining that they are not significantly affected by the uprate, or the generic TPO LTR evaluations are applicable and bounding. Based on analytical studies and equipment evaluations from previous uprates, GENE evaluated and generically dispositioned certain topics of the BWR plant safety design. The TPO LTR identified the topics that could be generically dispositioned or deferred to the standard reload analysis and provided corresponding justification in the appendices to the TPO LTR. The plant-specific applications will identify those safety analyses or system and component performance evaluations that are generically evaluated and confirm that the generic evaluations are applicable.

3. Plant Specific Evaluation

   Those safety analyses or system performance evaluations that cannot be generically dispositioned or justified as bounded by the current analysis-of-record will require plant-specific evaluations. Based on **[ ]** and analysis results, the TPO LTR projected the impact of a TPO power uprate on this category of safety analyses and system performance reviews. For some of the topics, GENE developed **[ ]** criteria to assess whether the plants have sufficient margin and capability to support a TPO uprate operation. Individual applicants will perform plant-specific evaluations and demonstrate that their facilities have sufficient margin or perform plant-specific analysis at the TPO power level. The proposed criteria are reviewed in the applicable sections of this safety evaluation (SE). The plant-specific submittal will identify those topics requiring plant-specific evaluation. It will state whether the plant has sufficient margin. If it does not, plant-specific TPO evaluations or analyses will be performed.

The applicable SE sections discuss the staff's review of the proposed approach, justifications and disposition of the safety analyses, and system performance evaluations. The SE also identifies the applicable TPO LTR sections and the corresponding appendices that address each topic of review. (See attached proposed Table of Contents).

3.1 Licensing Criteria

Appendix B to the TPO LTR states that the licensing evaluations and reviews of the TPO uprate of a BWR plant will be conducted in accordance with the following criteria:

1. All safety aspects of a plant that are affected by an increase of up to 1.5 percent in the thermal power level will be evaluated, including the NSSS and BOP systems.

2. Evaluations and reviews will be based on the licensing criteria, codes, and standards applicable to the plant at the time of the TSAR submittal; there is no change in the previously established licensing basis for the plant, except for the increased power level.

3. Evaluations and/or analyses will be performed using NRC-approved analysis methods for the safety analysis report (SAR) accidents and transients affected by a TPO uprate.

4. Evaluations and reviews of the NSSS systems and components, containment structures, and BOP systems and components will show continued compliance with the codes and standards applicable to the current plant licensing basis (i.e., no changes to comply with more recent version of codes and standards will be proposed as a result of the TPO uprate).

5. NSSS components and systems will be reviewed to confirm that they continue to comply with the functional and regulatory requirements specified in the SAR and/or applicable reload analyses.

6. No safety-related hardware changes are needed for a TPO uprate beyond potential setpoint changes. Any required (non safety-related) plant modifications will be minor in nature and will be designed to applicable design requirements and implemented in accordance with 10 CFR 50.59.

7. All plant systems and components affected by an increased thermal power level will be reviewed to ensure that there is no significant increase in challenges to the safety systems.

8. A review will be performed to assure that increased thermal power level continues to comply with the existing plant environmental regulations.

9. An assessment, as defined in 10 CFR 50.92(c), will be performed to establish that no significant hazards consideration exists as a result of operation at the increased power level.

10. The individual plant license amendment submittal will request an increase in core thermal power of up to 1.5 percent of the currently licensed thermal power. However, some analyses may be performed at conservatively higher power levels at the request of individual utilities. All such cases will be identified and documented in the plant-specific SAR.

11. A review of the latest Updated Final Safety Analysis Report (UFSAR) and design changes/safety evaluations that have been implemented, but are not yet shown in the UFSAR, will be performed to ensure an adequate evaluation of the licensing basis for the effect of a TPO uprate through the date of that evaluation. Additionally, safety evaluations for changes not yet implemented will be reviewed to determine their effects on the licensing basis at the increased power level.

Because the licensing criteria address the topics, issues and processes that are important to safety assessment of the power uprate, the staff finds the licensing criteria appropriate. The staff included these criteria in this SE to highlight the objectives of the criteria.

4.0 GENERAL APPROACH AND APPLICABILITY

An increase in the electrical output of a BWR is primarily accomplished by supplying a higher steam flow to the turbine generator. Most BWRs, as originally built and licensed, have as-designed equipment and system capability to accommodate steam flow rates at least 5 percent above the original rated power. In addition, improved analytical techniques and computer codes, plant operating experience, and improved fuel designs have resulted in a significant increase in the design and operating margins between the results of the safety analysis calculations and the licensing limits. The increased margins, combined with the excess capacity of as-designed equipment, systems, and components, have allowed many BWRs to increase their thermal power ratings by 5 percent (stretch uprate) without modifying any NSSS hardware.

4.1 Applicability of the TPO LTR to Uprates Greater than 1.5 Percent.

In the TPO LTR, GENE stated that BWRs, as currently licensed, have safety system and component capability with the potential for operation up to 1.5 percent above the current licensed power level. During the development of the TPO LTR, GENE anticipated that the achievable thermal power uncertainty would be equal to or greater than 0.5 percent. Consequently, the generic evaluations and discussions in the TPO LTR are based on a power uprate of less than or equal to 1.5 percent. However, plant-specific applications could request a higher TPO uprate (e.g., 1.7 percent), depending on the plant-specific feedwater flow measurement uncertainty. In Section 4.2.1 of the TPO LTR, GENE stated that any plant-specific TPO uprate submittal that is based on a power level uncertainty of less than 0.5 percent will provide justification for the use of the generic TPO LTR evaluations, or will provide a plant-specific evaluation in the TPO uprate application. The staff finds this approach acceptable, because the applicability of the TPO LTR to uprates greater than 1.5 percent will be addressed on a plant-specific basis. The submittal will also confirm the validity and applicability of the generic evaluations in the TPO LTR.

4.2 Applicability of the TPO LTR to Extended Power Uprate (EPU)

To date, a number of BWRs have already implemented power uprates of approximately 20 percent above their original licensed thermal power (with modifications in the NSSS hardware). Such an amendment would necessarily include the 5-percent stretch uprate which is described above. Implementing an EPU could reduce a plant’s pressure relief capacity as a percent of rated steam flow and system capability and performance. A plant’s response to design-basis and special events, as defined in the LTR, could also become more limiting, including response to events analyzed at nominal conditions. For a licensee that has implemented a TPO uprate, an additional EPU request would be supported by safety and system performance analyses performed at the combined new power level. For a plant that has already implemented an EPU, a TPO uprate application will rely on the TPO LTR approach in terms of topics identified as in-scope and the disposition of these topics.

The TPO LTR however does not address or discuss the potential differences in the response of plants that are operating at the original licensed thermal power (OLTP) compared to EPU plants. The 5 percent power "stretch" uprates involved increases in the dome pressure and corresponding safety relief valve (SRV) setpoint increases, affecting a plant's response to pressurization events. An EPU also affects a plant's response to pressurization events (e.g., ASME overpressure and anticipated transients without scram [ATWS]), due to the core design changes necessary to achieve the EPU and the higher steam generation, while the pressure relief capacity remains fixed. In addition, for EPU plants, the higher decay heat also increases the boil off rate, which affects the plant's response to SDC[1] and SBO.[2]

Consequently, for plants that have implemented previous power uprates, some of the generically dispositioned evaluations in the TPO LTR may require a plant-specific evaluation and a justification to assess the impact of a TPO uprate. For example, to support an additional TPO uprate to an EPU, including a power stretch, the plant-specific submittal may need to include an SLC[3] system relief valve margin evaluation and recirculation and reactor core isolation cooling (RCIC) systems performance evaluations, all of which the TPO LTR generically dispositions. The TPO LTR **[ ]** criteria and the **[ ]** studies are based on generic evaluations from **[ ]** above the OLTP. In an RAI, the staff asked GENE to consider the combined effects of an EPU and a TPO uprate and determine if (1) additional evaluations or analyses may be necessary, and (2) the TPO LTR evaluations and **[ ]** studies would remain applicable.

In its August 7, 2002, RAI response, GENE stated that the TPO LTR is based, in large part, on ELTR1 and ELTR2 (References 9 and 10), which considered increases in licensed power up to 120 percent of OLTP. **[.]** The safety analyses performed at 102 percent of the uprated CLTP or higher would continue to be applicable to the TPO uprate. The remaining evaluations that are based on nominal conditions would require plant-specific consideration. GENE stated that plants seeking to apply a TPO uprate to a previous uprate that would result in licensed thermal power (LTP) in excess of 120 percent of the OLTP must provide plant-specific evaluations for those evaluations not performed at 102 percent CLTP. In addition, the RAI response also stated that the plant-specific submittal will include an SLC system relief valve margin evaluation. The applicable sections of this SE address the generically dispositioned topics that may require plant-specific evaluation.

---

[1]Shutdown cooling (SDC) mode of the residual heat removal (RHR) system.

[2]Station blackout event (SBO).

[3]Standby liquid control (SLC) system

The staff finds the proposed approach acceptable, since for EPU plants the TSAR will either confirm that analyses and evaluations performed at the CLTP bound the TPO operating condition, or provide plant-specific justification and evaluation or analyses.

4.3 Applicability of the TPO LTR to Mixed or Non-GE Fuel Cores

GENE proposes to apply the TPO LTR to plants loaded with GE fuel, fuel from a vendor other than GE, or mixed fuel from different vendors. However, all fuel vendors (GNF[4], Framatome, and Westinghouse) must demonstrate that their fuel and core design can meet the established NRC-approved fuel design acceptance criteria and the facility, as loaded, can operate safely and meet all NRC regulatory requirements. For mixed cores, the individual licensee is responsible to demonstrate that the newly introduced fuel is neutronically and thermal-hydraulically compatible with the resident fuels, such that the fuel and core design can meet the fuel design acceptance criteria during steady-state operation, abnormal operating occurrences (AOO), or accident conditions. (See Sections 4.2 and 4.3 of the NRC's Standard Review Plan (SRP) and the applicable general design criteria (GDC) of Appendix A to 10 CFR Part 50.) Therefore, for all fuel vendors, the general approach, processes and acceptance criteria necessary to establish the thermal limits and demonstrate fuel and core design performance are similar. For those fuel-dependent analyses performed during a reload, the mixed core affects would be accounted for.

However, different vendors' fuel characteristics and response may not be identical. The specific details of the reload and fuel introduction analyses performed and the analytical methods and codes used and the licensing methodology could also be different. The TPO LTR generic dispositions and the **[ ]** criteria (e.g., emergency core cooling system (ECCS), loss-of-coolant accident (LOCA), ATWS, SBO and Appendix R) are based on the GNF fuel characteristic, response, analytical methods and codes. (The **[ ]** criteria is used to determine if a plant has sufficient margin or whether an analysis at the TPO uprate is required.)

In the August 7, 2002, RAI response, GENE stated that:

> For cases where the plant contains some or all non-GE fuel, the TPO license application will provide information regarding the vendor analytical methods, results, and fuel specific acceptance criteria. Changes in the vendor cycle license methodology may not be equivalent and may require supplemental information to support the transition. For example, vendor analyses may be based on an arbitrary equilibrium cycle or on a cycle specific design. Regardless, the licensing basis for mixed core evaluation will be clearly defined in the license application.

Therefore, in those cases where a fuel supplier other than GE is involved, the plant-specific applications will provide additional supplemental justifications, evaluations or analyses to support the fuel-dependent licensing basis topics of evaluations. Specifically, the plant-specific submittal will identify the current fuel-dependent licensing basis analyses that were performed at a bounding power level and provide analyses or justifications to support fuel-dependent

[4]Global Nuclear Fuel (GNF) is the fuel supply division of GENE.

licensing basis analyses performed at nominal conditions. For example, licensees will justify the applicability of the TPO LTR ATWS **[ ]** criteria **[**

.]

Since the plant-specific application will provide justifications or the results of analyses for fuel-dependent analyses and evaluations (performed at the TPO conditions) that will support the TPO uprate, the staff finds it acceptable that the TPO LTR is applicable to uprate applications involving a fuel supplier other than GE. The applicable sections of this SE will discuss areas where such fuel vendors' evaluations may be involved.

5.0 EVALUATION

The core thermal-hydraulic design and fuel performance characteristics are evaluated for each reload fuel cycle. The following sections address the effect of a TPO uprate on fuel design performance, thermal limits, the power/flow map, and stability.

5.1 Uprated Plant Operating Condition

One of the tasks of any power uprate effort is to establish the thermal-hydraulic parameters for the plant at the uprated thermal power level. The following sections address the effect of a TPO uprate on the reactor heat balance, previously implemented reactor performance improvement features, and fuel thermal margin monitoring.

5.1.1 Reactor Heat Balance

The values of thermal-hydraulic parameters, including the reactor vessel pressure and the feedwater temperature, define the operating conditions of the plant at the uprated power level. A reactor and turbine generator heat balance will be performed to establish values of the TPO uprate thermal-hydraulic operating parameters. The plant-specific applications will provide a comparison of the values of operating thermal-hydraulic parameters for the pre-TPO and TPO operating conditions. A TPO uprate is expected to be accomplished with no increase in the vessel operating dome pressure, with the turbine pressure regulator and the turbine control valve (TCV) providing the necessary reactor pressure control. Accordingly, the staff agrees that the acceptable system pressure control can be demonstrated during TPO uprate implementation testing. Section 5.1 and Appendix C of the TPO LTR discuss establishing the reactor operating condition for the TPO uprate conditions.

5.1.2 Reactor Performance Improvement Features

Some licensees have incorporated operating flexibility options (e.g., involving safety relief valve, feedwater heaters, recirculation pumps). Such options already adopted by licensees will be analyzed at the TPO uprated conditions as part of the transient analyses. This includes the end-of-cycle (EOC) final feedwater temperature reduction (FFWTR) option, which will be reanalyzed at the TPO uprate power level if previously licensed. If such options are not included in a particular plant's licensing basis, they will not be included in the TPO uprate evaluation.

Since the currently licensed operating features will be assumed and analyzed during the TPO uprate implementation cycle at the uprated conditions, and new operating flexibility features (e.g., FFWTR) will require an additional amendment request, the staff finds this approach acceptable.

5.1.3 Fuel Thermal Margin Monitoring

The power level above which fuel thermal margin monitoring is required may change. The original plant operating licenses typically set this monitoring threshold at 25 percent of rated thermal power. **[**

.] A change in the fuel thermal monitoring threshold also requires a corresponding change to the technical specification (TS) reactor core safety limit for reduced pressure or low core flow. The TPO LTR states that the threshold will be maintained (in most cases) for the TPO uprated conditions. Unless additional justification is provided, the same value expressed as an absolute power level will be maintained. Section 5.8 and Appendix F.4 of the TPO LTR discuss the fuel thermal margin monitoring.

Since the thermal power monitoring threshold will be either maintained at 25 percent of the original rated thermal power or the plant-specific application will justify monitoring the minimum critical power ratio (MCPR) operating limits at 25 percent of the uprated thermal power, the staff finds this approach acceptable.

5.2 Power/Flow Map

The TPO power uprate will maintain the previously licensed rod line, and the power uprate will be achieved by increasing the core flow along the licensed extended load limit line analysis (ELLLA) or maximum extended load limit line analysis (MELLLA) rod line. Since previous safety analyses support operation along the licensed operating domain up to 102 percent power, the TPO power uprate is limited to the previously established and analyzed operating domain and rod line up to the TPO power level. Maintaining the previously licensed rod line also ensures that the reactor power is not increased at the low-flow conditions in order to avoid changes in the plants' response to ATWS and instability. Extending the licensed rod line up to the TPO power level will slightly reduce the core flow range in the full power portion of the operating window. Figure 5-1 of the TPO LTR provides a TPO power/flow map that demonstrates the TPO uprate strategy and the associated instrumentation actuation. In Section 5.2 of the TPO LTR, GENE confirmed that a plant-specific application will provide a power/flow map that clearly substantiates that the previously licensed upper rod line (ELLLA or MELLLA) is maintained but extended up to the TPO uprate power level. The TSAR power/flow map will also identify the pre- and post-uprate power in MWt. Section 5.2 and Appendix C of the TPO LTR also discusses changes to the power/flow map and the bases for the TPO uprate strategy.

Since the TSAR will clearly specify the TPO uprate approach on the power/flow map, allowing the staff to confirm that the uprate will be accomplished along the currently licensed rod line, the staff finds this approach acceptable.

5.3 Accidents and Transients

As part of the TPO uprate licensing process, the applicable plant UFSAR analyses are to be evaluated. Many BWR transient and accident safety analyses already include an allowance for power uncertainty which bounds the range of the power increase being sought in this generic TPO uprate program (<1.5 percent).

5.3.1 ECCS-LOCA Performance Analyses

The ECCS is designed to provide protection against postulated LOCAs caused by ruptures in the primary system piping. The ECCS performance under all LOCA conditions and the analysis models must satisfy the requirements of 10 CFR 50.46 and Appendix K to 10 CFR Part 50.

5.3.1.1 ECCS-LOCA Codes and Methodology

For the GENE analytical methods and codes, the ECCS-LOCA analysis is performed in accordance with the NRC-approved methodology specified in GE's licensing document denoted as GESTAR II. For each plant, a base ECCS-LOCA analysis, with a full-scope break spectrum, forms the initial SAFER/GESTR-LOCA analysis-of-record for the rated power level. For introduction of a new fuel design, the licensee performs an ECCS-LOCA analysis (a subset of the full-scope spectrum) in accordance with Amendment 22 of GESTAR II to demonstrate compliance with requirements of 10 CFR 50.46 and Appendix K to10 CFR Part 50 or the licensee demonstrates that the existing fuel design ECCS-LOCA analysis remains applicable and bounding. During reload analyses, the licensee evaluates the cycle-specific maximum average planar linear heat generation rate (MAPLHGR) limits to confirm that the MAPLHGR limit based on the ECCS-LOCA analysis-of-record remains bounding.

Section 5.3.1 and Appendix D of the TPO LTR address the ECCS-LOCA performance evaluation for operation at the TPO power level. For the GENE analytical methods, the Appendix K ECCS-LOCA analyses are performed at 102 percent of the CRTP and the peak linear heat generation rate (LHGR) of the high-powered bundles are also initialized at 102 percent of the LHGR limit for the applicable fuel type. Therefore, the licensing basis ECCS-LOCA calculations, derived from the Appendix K ECCS-LOCA methodology, bound operation at the TPO uprate power, and are generically dispositioned. GENE's nominal/upper bound SAFER/GESTR-LOCA analysis however, is performed at rated thermal power and core flow conditions, which would not be bounding for the TPO uprate conditions. Table D-1 of the TPO LTR provides **[ ]**, and these calculations yield an estimate of an upper bound peak cladding temperature (PCT) change of **[ ]** for the TPO uprate.

In the September 21, 2002, RAI response, GENE presented **[ ]** and revised the **[ ]** criterion to determine when plant-specific ECCS-LOCA analysis will be necessary. As set forth in the TPO LTR, GENE proposed that if the current upper bound PCT margin to the 1600°F limit that the staff used for GE fuel in its approval of NEDC-23785P, is at least **[ ]**, additional ECCS-LOCA analysis would not be necessary for a particular TPO uprate. However, if the current upper bound PCT is within **[ ]** of the upper bound PCT limit for a given plant, a plant-specific upper bound ECCS-LOCA performance calculation will be performed. The

RAI response dated August 7, 2001, also provided additional ECCS-LOCA information supporting the proposed ECCS-LOCA **[ ]** criteria.

Since the ECCS-LOCA **[**
]; the ECCS-LOCA analyses assume that the core is operating at the thermal limit, with the high-powered bundles at 102 percent of the LHGR; and the licensing basis PCT (Appendix K) calculation was performed at 102 percent of the CLTP, the staff finds the proposed ECCS-LOCA **[ ]** criteria are bounding, and provide adequate bases to determine if a plant-specific ECCS-LOCA analysis is necessary to support the TPO uprate.

For the TPO uprate, none of the licensed operating flexibility options (e.g, automatic depressurization system (ADS) - out-of-service (OOS)) that may impact the ECCS-LOCA performance of the plant will change. If these options are changed, however, additional ECCS-LOCA performance analysis based on these options would be provided. Any change in the currently licensed and analyzed operating flexibility options will be explicitly reported in the TSAR. In addition, if any of the factors that affect the system inventory and energy (such as the initial operating pressure, steam flow, feedwater flow, and temperature) assumed in the ECCS-LOCA do not bound plant-specific TPO uprate conditions, additional justification will be provided. The TPO LTR states that the values of key parameters in the CRTP reactor heat balance (based on 102 percent of the CLTP) bound the TPO uprate conditions; therefore, the key initial conditions assumed in the ECCS-LOCA analysis will remain bounding.

In Appendix D.2.6 of the TPO LTR, GENE presented the process that will be used to evaluate the ECCS-LOCA performance for another vendor's fuel for a TPO uprate, as follows.

1. If GENE performed the analysis-of-record for the other vendor's fuel using the SAFER-GESTR-LOCA methodology, the TPO approach described in the TPO LTR is directly applicable.

2. If the analysis-of-record is based on an Appendix K evaluation model, then the ECCS-LOCA analysis performed at the CRTP for the fuel type will be directly applicable. The Appendix K evaluation model analyses are performed at 102 percent of the licensed operating power.

3. If the ECCS-LOCA analysis of record is based on an evaluation model that uses the approach described in SECY-83-472 (i.e., an approach similar to SAFER/GESTR-OCA), the licensing-basis PCT should be directly applicable to the TPO uprate conditions. The SECY-83-472 evaluation model must comply with the Appendix K power uncertainty requirements. The plant-specific application will confirm this approach with the fuel vendor and ensure that all conditions required for application of the evaluation model are satisfied.

4. If the ECCS-LOCA performance analysis-of-record is based on a best estimate evaluation model (i.e., evaluation model that uses the approach described in RG 1.157), the plant-specific application will provide the ECCS-LOCA performance evaluation for the other vendor's fuel to support the TPO uprate.

The plant-specific TSAR will (1) specify the ECCS-LOCA results for all of the resident fuel, (2) confirm the approach used in the ECCS-LOCA evaluation, and (3) reference the documents that specify the NRC-approved ECCS-LOCA analysis and methods. The other fuel vendors (Framatome and Westinghouse) also perform ECCS-LOCA analyses based on NRC-approved methods and codes. In addition, NRC-approved topical reports specify the reload fuel design and safety analysis methodologies for all fuel vendors. For new fuel introduction, fuel vendors other than GE also perform fuel design analyses, including ECCS-LOCA analyses, to demonstrate compliance with Chapter 4 of the SRP.

Based on the fact that for all resident fuel, the ECCS-LOCA performance evaluation will be (1) confirmed to be bounded by the analysis-of-record; (2) justified to meet the TPO LTR **[ ]** criteria for the applicable fuel type; or (3) superseded by a new ECCS-LOCA analysis that will be performed to support the TPO uprate, the staff finds the proposed ECCS-LOCA performance approach, described in the TPO LTR, acceptable.

5.3.2 <u>LOCA Containment Performance Analyses</u>

In Sections 5.3.2, 5.4, and 5.10.2 and Appendices G and H of the TPO LTR, GENE discusses containment capability for the TPO with no increase in reactor operating pressure. GENE states that the containment response (peak pressure, temperature, and loads) and radiological evaluation of a postulated LOCA event have been performed considering at least 102 percent of current licensed power, and therefore no re-analysis is needed either generically or on a plant-specific basis.

Based on the review of GENE’s rationale and NRC's experience gained from the review of power uprate applications for previous BWR plants, the staff agrees with GENE’s determination and concludes that plant-specific evaluation in the TSAR is not necessary. However, if the containment system analysis was not performed at 102 percent of CLTP or a higher power, then a plant-specific justification must be provided.

5.3.3 <u>Transient Analyses</u>

AOOs are transients that are expected to occur one or more times in the life of a plant and are initiated by a malfunction, a single failure of equipment, or a personnel error. The applicable acceptance criteria for the AOOs are based on GDC 10, 15, and 20, as defined in Appendix A to 10 CFR Part 50.[*/]

GDC 10 requires that the reactor core and associated coolant, control, and protection systems must be designed with sufficient margin to ensure that the SAFDLs[5] are not exceeded during normal operation, including the effects of AOOs.

[*/]Some plants were designed before the issuance of the GDC, and the GDC may not apply to such facilities. Applicants should verify that the GDC apply to their facilities, or that the plant-specific principal design criteria (PDC) do not establish design requirements beyond those in the GDC.

[5] Specified acceptable fuel design limits (SAFDL).

GDC 15 stipulates that the RCS and certain associated systems must be designed with sufficient margin to ensure that the design conditions of the reactor coolant pressure boundary (RCPB) are not exceeded during normal operating conditions, including AOOs.

GDC 20 specifies, in part, that a protection system must be designed to automatically initiate the operation of appropriate systems to ensure that the SAFDLs are not exceeded during AOOs.

Sections 4.2 and 4.3 of the SRP provide the following additional guidelines:

1. Pressure in the reactor coolant and main steam system should be maintained below 110 percent of the design values according to the ASME Code, Section III, Article NB-7000, "Overpressure Protection."

2. Fuel cladding integrity should be maintained by ensuring that the reactor core is designed to operate with appropriate margin to specified limits during normal operating conditions including AOOs.

3. An incident of moderate frequency should not generate a more serious plant condition unless other faults occur independently.

4. An incident of moderate frequency, in combination with any single active component failure or single operator error, should not result in the loss of function of any fission product barrier other than the fuel cladding.

A limited number of fuel cladding perforations are acceptable under these guidelines.

The plant UFSAR typically sets forth evaluations of a wide range of potential transients. Chapter 15 of the UFSAR contains the design-basis analyses that evaluate the effects of an AOO resulting from changes in the values of system parameters, such as (1) a decrease in core coolant temperature, (2) an increase in reactor pressure, (3) a decrease in reactor core coolant flow rate, (4) reactivity and power distribution anomalies, (5) an increase in reactor coolant inventory, and (6) a decrease in reactor coolant inventory.

Plant responses to the most limiting transients are analyzed during each reload cycle and are used to establish the thermal limits. A potentially limiting event is an event or an accident that has the potential to affect the core operating and safety limits.

Section 5.3.3 of the TPO LTR assessed the effects of a TPO uprate on all of the AOO categories of events and classified the events as follows:

1. <u>Currently not limiting for any BWR</u>. A TPO uprate is not expected to make a nonlimiting event limiting; therefore, the TPO LTR generically dispositioned these categories of events for the TPO uprate.

2. <u>Limiting thermal margin events that are generically dispositioned as being insignificantly affected by the TPO uprate based on the GE fuel characteristics and performance determined</u> **[   ]**. These limiting events establish the operating

thermal limits and will be analyzed at the TPO power level or at the most limiting state points depending on the characteristic response of the transient during the TPO uprate implementation reload analysis.

3. Limiting for establishing the flow and power-dependent adjustments to the operating thermal (MCPR, LHGR, and/or MAPLHGR) limits for the rated conditions. The power and flow dependent limits will be confirmed during the TPO uprate implementation reload analysis.

4. Limiting in terms of pressurization and fuel-dependent, but analyzed at 102 percent of the CLTP and bounds the TPO uprate condition. The limiting pressurization event (e.g., MSIV closure with flux scram) is analyzed during the reload to demonstrate meeting the ASME overpressure limit and will be analyzed before TPO uprate implementation.

5. Limiting loss of water level transients analyzed at 102 percent of the CLTP. These are non-limiting in terms of fuel thermal margin, but are analyzed to assess system performance to maintain core coverage and cooling (design-basis loss of feedwater (LOFW) for RCIC and high pressure coolant injection (HPCI) as backup). These transients are not analyzed during the reload, and the TPO implementation reload analysis will not include this event if the current analysis was performed at 102 percent of CLTP.

Appendix E to the TPO LTR discussed the GENE analytical methods and codes used to perform the transient analyses and presented the changes in the OLMCPR **[.]** Based on the observed changes in the MCPR **[ ]**, the TPO LTR states that changes attributable to the TPO uprate would be insignificant. Consequently, GENE proposed that the limiting transient analyses be deferred to the TPO uprate cycle reload analysis and no transient assessment is needed in the plant-specific application. Based on our review of the evaluation and justifications provided in the TPO LTR as discussed above for dispositioning all of the categories of AOO and assessing the impact of the TPO power uprate, the staff finds the proposed approach acceptable.

As discussed in Section 1.2.3 of this SE, the TPO LTR is applicable to cores loaded with GENE fuel, fuel from other vendors, or mixed fuel from different vendors. For all fuel vendors' methods, the reload analyses will account for the thermal-hydraulic and neutronic characteristics of all resident fuel. The reload analyses for all fuel vendors are also similar in approach, and for plants with a TPO cycle vendor other than GENE (i.e., Framatome or Westinghouse), the transient analyses would be performed using NRC-approved methods and codes. The applicable BWR fuel design and reload analyses documents would be referenced in the application.

However, the TPO LTR AOO disposition and evaluations are limited to GENE analytical methods, codes, and **[ ]** studies, which are dependent on GENE fuel characteristics and responses. The plant-specific submittal will provide additional justification for evaluating and dispositioning the AOOs based on the other fuel vendor's NRC-approved methodology. Depending on the fuel vendor's method and codes, the AOOs could be performed at

102 percent power or greater or at nominal conditions. Therefore, for fuel vendors other than GE, the plant-specific application will provide the basis for dispositioning all of the analyses of AOOs performed at nominal conditions and deferring analyses of the limiting AOOs to the TPO reload cycle.

Therefore, the plant-specific application will provide bases for dispositioning all of the AOO analyses performed at nominal conditions and for deferring the analyses of limiting AOOs to the TPO uprate reload cycle. This submittal will provide sufficient information for the staff to assess the impact of the TPO uprate (for applications involving non-GE fuel supplier), and this approach is acceptable.

5.3.4 Thermal-Hydraulic/Neutronic Stability

Appendix A to 10 CFR Part 50, GDC 12, "Suppression of Reactor Power Oscillations," states that, "The reactor core and associated coolant, control, and protection systems shall be designed to assure that power oscillations which can result in conditions exceeding specified acceptable fuel design limits are not possible or can be reliably and readily detected and suppressed."

Long-term stability solutions for BWRs are discussed in NEDO-31960-A, "BWR Owners' Group Long-Term Stability Solutions Licensing Methodology," and in Supplement 1 (Reference 11), which was published in April 1996. In accordance with the licensing methodology specified in GESTAR II, the stability response of a new fuel design is evaluated during the fuel introduction analyses. Plant-specific evaluations are also performed for each fuel cycle to ensure that the applicable long-term solution stability criteria are met.

For the TPO power uprate, plants will maintain the currently licensed highest flow control line. Therefore, the high-power/low-flow portion of the power flow map susceptible to instabilities will be unchanged. With the same upper rod line boundary (ELLLA or MELLLA), there will be minimal impact on stability performance beyond the normal cycle-to-cycle reload core characteristic variations. Any TPO uprate application that involves changes to the previously licensed upper boundary of the power/flow map (constant void content upper rod line) will require a separate application and additional justification. The TPO LTR states that with the constraints on the maximum operating rod line, the TPO uprate will not have a detrimental effect in terms of stability response and the same stability protection as the pre-uprate condition can be maintained. The stability response for each reload core configuration is evaluated in accordance with the applicable stability solution methodology. The exclusion region boundary will be rescaled as necessary in order to maintain the current absolute power and core flow boundaries. The reload stability evaluations will continue to ensure acceptable stability performance and protection for future cores operating at the TPO uprate power. Section 5.3.4 and Appendix C of the TPO LTR discuss the stability response constraints and approach for the TPO uprate.

Fuel vendors other than GE will perform similar reload stability evaluations to ensure that the fuel and core stability response for the TPO uprate will meet the applicable plant-specific long-term stability protection criteria.

In view of the above, the TPO uprate core design changes, by themselves, are not expected to change the stability response of the plants. Therefore, with no change in the upper licensed rod line, the staff finds that the proposed approach is acceptable. If the licensed upper rod line is changed, the TPO application will provide a plant-specific instability evaluation.

5.3.5 Anticipated Transient Without Scram

An ATWS is defined as an AOO with failure of the reactor protection system (RPS) to initiate a reactor scram to terminate the event. The requirements for ATWS are specified in 10 CFR 50.62, which requires BWR facilities to have the following mitigating features for an ATWS event:

1. An SLC system with the capability to inject a borated water solution with reactivity control equivalent to the control obtained by injecting 86 gpm of a 13 weight-percent sodium pentaborate decahydrate solution at the natural boron-10 isotope abundance into a reactor vessel with an inside diameter of 251 inches.

2. An alternate rod insertion system that is designed to perform its function in a reliable manner and that is independent from the reactor trip system from sensor output to the final actuation device.

3. Equipment to trip the reactor coolant recirculation pumps automatically under conditions indicative of an ATWS.

BWR performance during an ATWS is also compared to the criteria used in the development of the ATWS safety analyses described in NEDO-24222, "Assessment of BWR Mitigation of ATWS," Volume II (Reference 12). The criteria include (1) limiting the peak vessel bottom pressure to less than the ASME Service Level C limit of 1500 psig, (2) ensuring that the PCT remains below the 10 CFR 50.46 limit of 2200°F, (3) ensuring that the cladding oxidation remains below the limit specified in 10 CFR 50.46, (4) limiting peak suppression pool temperature (based on the LOCA results), and (5) limiting the peak containment pressure to the maximum containment design pressure.

Sections 5.3.5 and L.3 of Appendix L to the TPO LTR evaluate the ATWS response and disposition for the TPO uprates. Plant performance during limiting ATWS events is characterized by a rapid increase in reactor vessel and nuclear system pressure and core power. The pressure and power increase is mitigated by automatic recirculation pump trip (RPT), and SRV actuation for pressure and power control. The plant operating staff will identify and respond to confirmed ATWS symptoms in accordance with the plant's emergency operating procedures (EOPs) to mitigate the event. Section L.3.2, "Operator Actions," of the TPO LTR discussed typical operator actions specified in the EOPs to mitigate an ATWS event. The ATWS operator actions include manual initiation of the SLC system after confirming ATWS symptoms to inject neutron-absorbing boron solution into the reactor to achieve hot shutdown and bring the reactor to subcritical condition.

The ATWS analyses are performed at nominal conditions which will not bound the TPO uprate power level. However, the key operating parameters that affect ATWS response (e.g, the initial operating reactor dome pressure and the pressure actuation setpoints for the safety features such as the main steam isolation valve (MISV) closure, ATWS RPT and SRVs) will not change. In addition, the TPO uprate will be implemented along the currently-licensed absolute upper flow control/rod line, which would limit changes in the plant's response to an ATWS event, including ATWS instability response.

To project the potential changes to the peak values of parameters relevant to ATWS for operation at the TPO power level, the TPO LTR presented the changes in such values in the ATWS analyses performed **[.]** GENE examined the results and developed ATWS **[ ]** criteria to determine whether a TPO plant has sufficient margin in terms of the peak values of ATWS parameters, or whether a plant-specific ATWS analysis is required. A sufficient margin is defined as **[.]** The ATWS **[ ]** criteria for dispositioning the plant-specific ATWS evaluation is as follows:

1. <u>Peak Reactor Vessel Pressure</u>

   The TPO LTR predicts that based on the GENE fuel characteristics, fuel response, and analytical methods, a TPO uprate may result in a **[ ]** As stated in the October 5, 2001, RAI response, the predicted pressure change is based on a relief capacity of at least 65 percent of the pre-TPO uprate steam flow. Therefore, to generically disposition the ATWS peak vessel pressure analysis, the plant-specific application must demonstrate that the peak vessel pressure is within the **[ ]** criteria of **[ ]** to generically disposition the ATWS pressurization analysis. If the ATWS analysis-of-record for the GENE fuel does not have a **[ ]**, the TSAR will include an ATWS pressurization analysis at the TPO power level.

2. <u>Suppression Pool Temperature</u>

   Based on the suppression pool temperature calculations **[ ]**, GENE estimates that a generic pool temperature **[ ]** would bound the effect of operation at the TPO power level on the suppression pool temperature. Therefore, a plant-specific ATWS suppression pool temperature analysis will be required if a margin **[ ]** is not available. For plants with a margin of less than **[ ]**, the TSAR will provide a plant-specific analysis to demonstrate the plant's ability to meet the suppression pool temperature limit for operation at the TPO power level.

The TPO LTR ATWS **[ ]** criteria were developed for only those key parameters whose values are expected to increase and maintain sufficient margin in the values of these key parameters to ensure that the other less affected parameters (e.g., ATWS peak PCT) will also have sufficient margin. In addition, since these margins are estimated, **[ ]** provides conservatism that will ensure that plants whose key ATWS parameters are close to the peak limits will be analyzed. Based on the discussion given above and the technical evaluations provided in the September 2001, RAI response, the staff finds that the proposed ATWS **[ ]** criteria is acceptable.

Since the ATWS **[ ]** criteria and disposition are based on the characteristics and response of GE fuel and cores, and were analyzed with GE methods, plant-specific applications with mixed vendor cores cannot be generically dispositioned based on the proposed **[ ]** criteria. For fuel vendors that perform ATWS analyses using actual cycle-specific core configurations, the plant-specific application will contain the ATWS pressurization analysis to support operation at the TPO uprate or justification for bounding analyses or applicable margin criteria. For TPO uprate fuel vendors that perform ATWS analyses based on equilibrium cores, the plant-specific submittal will contain additional justification for the mixed-core effects. Because of the reasons stated above, the staff accepts the proposed ATWS approach for applications with mixed-cores and fuel from vendors other than GE.

5.4 Radiological Consequences

Radiological consequences due to postulated design basis accident (DBA) events, as documented in the UFSAR (typically Chapter 15), were previously evaluated and analyzed assuming 102 percent rated thermal power to show compliance with the acceptance criteria of 10 CFR Part 100 and 10 CFR Part 50, Appendix A, GDC-19, "Control Room." GENE asserts that the radiological consequences associated with postulated DBAs from TPO uprate conditions would be bounded by these previous analyses since the increase in power is limited to 1.5 percent or less.

5.4.1 Evaluation of Radiological Analyses

The staff has reviewed Section 5.4, Appendix H, and Section J.2.3.8 of the TPO LTR that are relevant to the evaluation of the radiological consequences of design basis accidents for showing compliance with 10 CFR Part 100 and 10 CFR Part 50, Appendix A, GDC-19.[*/]. See footnote on page 12.

A DBA radiological consequence analysis evaluates the radiation doses to persons offsite and onsite due to exposure to radioactive fission products released from the reactor by the postulated accident. The size of the fission product inventory in the reactor core is essentially proportional to rated thermal power. Similarly, the concentrations of radioactive materials in the reactor coolant system during normal operations are dependent, in part, on the rated thermal power. An increase in rated thermal power will result in a proportional increase in core inventory and the reactor coolant specific activity. Increasing the rated thermal power would increase the radioactive materials postulated to be available for release to the environment. Since the previous radiological consequence analyses were done at 102 percent rated thermal power, increases of less than or equal to 1.5 percent as proposed by GENE in the TPO LTR would not result in an increase in the previously analyzed radiological consequences, provided measurement uncertainty is correspondingly reduced, and all other analysis assumptions and inputs are the same.

An increase in the electrical output level at a BWR power station is primarily accomplished by supplying higher steam flow to the turbine-generator. The TPO LTR provides that the current BWR operating domain (power/core flow map) will continue to be used with the rated thermal power being the only parameter change. The power increase would be achieved by increasing the core flow within the current operating domain, but less than the currently licensed maximum core flow value. The normal operating pressure of the vessel dome will be maintained equal to the pre-TPO uprate pressure. As such, the thermodynamic parameter values that are input to the radiological consequence analyses are not expected to change from the values assumed in the current radiological analyses. However, if licensees pursuing a TPO uprate do revise analysis assumptions or inputs as a means of incorporating other design basis changes or to upgrade analyses to reflect the as-built and as-operated facility, the affected analyses would need to be revised to support the TPO uprate and the other requested changes. This is considered outside the scope of the TPO LTR and would require staff review beyond the generic guidelines of the TPO LTR.

The staff agrees with GENE's conclusion that compliance with habitability requirements for the control room and emergency response facility is not affected by the TPO uprate to the extent that the prior evaluations were done at 102 percent of currently licensed power. The staff does note that it is currently evaluating regulatory approaches to resolve concerns related to observed deficiencies in the evaluation of control room habitability, including the validity of assumed unfiltered inleakage values. There is also an industry initiative related to these concerns (NEI 99-03). The staff will generally not expect TPO uprates to address these concerns due to the minimal possible increases in dose. However, should the staff evaluation of this issue result in the staff's requesting action on a generic basis, licensees may need to take various actions to resolve the staff concerns to improve control room boundary integrity, quantify unfiltered inleakage, and address deficiencies in habitability analyses (e.g., plant as-built and as-operated configuration not reflected in analysis assumptions and inputs, limiting accident not considered, etc.).

Based on the information provided by GENE in the TPO LTR related to the TPO power uprates, the staff finds that there is reasonable assurance that there would be no increase in the radiological consequences of anticipated accidents if the previous analyses of these consequences were based on 102 percent of the current licensed power and if all other analysis assumptions, inputs, and methodologies are unchanged. As such, the postulated doses will be less than the dose guidelines of 10 CFR Part 100 and the criteria of 10 CFR Part 50, Appendix A, GDC-19 and Section 6.4 of the SRP.

5.5 NSSS Components

GENE has stated that a comprehensive evaluation of plant specific NSSS components and systems will be performed to confirm the acceptability of the small additional duty effects identified in this document for operation at TPO uprated conditions. This evaluation is designed to confirm the expectation that there is no significant effect of a $\leq$1.5 percent increase of licensed power level and the associated increases in steam and feedwater flow rates. GENE notes that, as result of a TPO uprate, no change in vessel dome pressure is planned, and there are no significant changes in system temperatures.

5.5.1 Reactor Vessel Internals

The reactor pressure vessel (RPV) structure and support components form a pressure boundary to contain the reactor coolant and moderator, and form a boundary against leakage of radioactive materials into the drywell. The RPV also provides structural support for the reactor core and internals. Many reactor vessel components are not significantly impacted by a TPO uprate. For components where there is no increase in flow, temperature, reactor internal pressure difference (RIPD) and other mechanical loads as a result of a TPO uprate, no further evaluation is necessary. For components experiencing an increase in flow and temperature, the plant specific evaluation will be performed consistent with the methods documented in Appendix I of the TPO LTR. Plant-specific evaluations will report the maximum stresses and fatigue usage factors (CUFs) or the existing stress and CUF margins that justify evaluation for the limiting reactor vessel and internal components, to meet the allowable limits in accordance with the design basis. In cases where permanent structural modifications or permanent repairs have been performed to the reactor vessel components or internals, the modified configuration and the corresponding documentation will form the design basis, in conjunction with the original design basis, as applicable.

In its response dated September 21, 2001, to the staff's RAI, GENE indicated that the postulated AOO for the control rod drive (CRD) design assumes a failure of the CRD system pressure-regulating valve that applies the maximum pump discharge pressure to the CRD mechanism internal components. The reactor operating condition for a TPO uprate does not affect the CRD pump discharge pressure. Therefore, the staff concurs with GENE's conclusion that the maximum calculated stress for the limiting control rod drive mechanism (CRDM) component is not affected by a TPO power uprate.

For the reasons set forth above, the staff finds GENE's methodology acceptable and concludes that the performance of the plant-specific evaluations would provide the basis to determine the acceptability of stresses and CUFs of the limiting reactor vessel and internal components when compared against the allowable code limits as a result of plant operation at the TPO conditions. The staff's evaluation of flow induced vibration (FIV) is provided below in Section 5.5.1.3.

5.5.1.1 Reactor Coolant Hydraulics and Internal Pressure Differences

Evaluations were performed for the current licensed power as well as at 102 percent of the current power and maximum flow conditions for all in-vessel equipment. These analyses were used to determine the effects of core coolant hydraulics and pressure drop loads on all in-vessel equipment during plant transients and accidents. Appendix I of the TPO LTR noted that the internal component analysis considered normal, upset, emergency, and faulted conditions. The staff examined Table I-1, which documents the reactor internals pressure drop **[ ]**, and has concluded that there are no significant changes in core coolant hydraulics and reactor internal pressure differences resulting from a TPO power increase.

5.5.1.2 Structural Assessment

GENE has assessed the effect of increased power and proposes to include selective limiting individual component evaluations in the plant specific TSAR to document the justification for compliance at the uprated conditions. A plant specific review is to be performed for limiting components to ensure that the reactor vessel internals design continues to comply with the existing structural requirements at the uprate conditions. The results of the system/component evaluations will be presented in the TSAR. Based on this proposed action and the plant-specific information provided in Subsection 5.5.1.2 of the TPO LTR, the staff concludes that the structural assessment as result of the TPO will provide the basis to determine the acceptability of components.

5.5.1.3 Reactor Vessel Internals Vibration Assessment

The TPO LTR evaluated the effect of FIV on RPV internal components using the recorded FIV data of all instrumented internal components for extrapolation of the TPO uprate vibration levels. Components in the lower plenum and core region are not affected by the TPO uprate since the core flow remains unchanged. Components that are affected by FIV due to the increase in feedwater and steam flow will be evaluated on a plant specific basis. Components such as feedwater sparger, steam dryers, and steam separators are evaluated for the TPO power uprate based on available vibration data from the specific plant and/or from another plant of the same or similar design. The plant-specific evaluation includes assessment of plant startup data, dynamic structural analysis and, if necessary, fatigue usage determination.

On the basis of its review, the staff concludes that the performance of a plant specific FIV evaluation, and if necessary, a fatigue determination will provide the basis to determine the acceptability of components affected by an increase in flow during TPO.

5.5.1.4 Reactor Vessel Overpressure Protection

The design pressure of the reactor vessel and RCPB remains at 1250 psig. The ASME Code peak pressure for the reactor vessel and RCPB is 1375 psig (110 percent of the design pressure of 1250 psig), which is the acceptance limit for pressurization events.

The TPO uprate will not involve any change in the operating pressure, the number of SRV-OOS assumed in the ASME overpressure analysis of the pre-TPO uprate reload cycle, or the SRV setpoints. Since the ASME overpressure analyses are performed at 102 percent of the CLTP, the current ASME overpressure analysis will bound the TPO uprate conditions. In addition, the TPO uprate cycle reload analysis will include an ASME overpressure analysis based on the cycle-specific core configuration. Because the plant-specific applications will confirm that the pre-TPO uprate ASME overpressure analysis bounds the TPO uprate condition for all vendor reload methods, the staff finds this approach acceptable.

5.5.1.5 Reactor Vessel Fracture Toughness

Increased fluence from a power uprate would cause an increase in the adjusted reference temperature, RT_{NDT}, for the effective full power year (EFPY) specified for the current pressure-temperature (P-T) limits. Since GENE did not propose a limit on RT_{NDT} shift, to which licensees could refer in justifying their continued use of the current P-T limits after uprating, an individual licensee requesting a TPO uprate must demonstrate compliance with 10 CFR 50.61. In order to demonstrate such compliance, an applicant would perform a plant-specific calculation of the RT_{NDT} shift using the limiting beltline material of its reactor vessel and justify the continued use of the current P-T limits after uprating.

5.5.1.6 Steam Separators and Steam Dryer

Steam separator and steam dryer loads have been evaluated and found to have negligible impact as result of the small (less than 2 percent) steam flow increase from the TPO. Plant specific confirmation of the applicability of this assessment for plant-specific equipment will be documented in the TSAR. Because the plant-specific applications will confirm that the change to the steam separator and steam dryer loads as result of the TPO uprate will be small, the staff finds this approach acceptable.

5.5.2 NSSS Piping and BOP Piping

The piping evaluation addresses the effects of a TPO uprate on the RCPB and the BOP piping systems and components due to increases in flow rate, temperature and pressure. The components evaluated included equipment nozzles, anchors, guides, penetrations, pumps, valves, flange connections, pipe whip restraints, and pipe supports (including snubbers, hangers, and struts). The RCPB piping systems consist of safety related piping subsystems that move fluid through the reactor and other safety systems. The BOP piping systems consist of piping subsystems that move fluid through systems that are not evaluated in conjunction with the RCPB piping systems.

The RCPB piping evaluations compare the values of design parameters such as flow, pressure, temperature, and mechanical loads in the current existing design basis and the TPO uprate conditions. For most RCPB piping systems such as the recirculation piping system, the values of these design parameters will not increase. Consequently, there will be no change in pipe stress, pipe support loads (snubbers, hangers), and fatigue evaluations. However, the staff concurs with GENE that confirmation of the acceptability of recirculation piping vibration associated with small changes in core pressure drop at the TPO uprate power is to be included in the plant specific TPO submittal. For other safety related piping systems such as the main steam, feedwater, and associated branch piping that are affected by a TPO uprate, an increase in the flow, pressure, temperature and mechanical loads will be evaluated on a plant-specific basis consistent with the methods specified in Appendix K of the TPO LTR. Plant-specific evaluations are necessary to demonstrate that the calculated stresses and fatigue usage factors are less than the code allowable limits in accordance with the requirements of the applicable code of record in the existing design basis stress report. As such, the staff concludes that, where needed, plant-specific analysis for a TPO uprate would provide the basis to ensure that the RCPB piping systems and supports will continue to meet code requirements and maintain the structural and pressure boundary integrity at the TPO uprate condition.

The evaluation of the BOP piping and appropriate components, connections and supports will be performed in a manner similar to the evaluation of the RCPB piping systems and supports. Small changes in operating temperatures (<2°F) and pressures (<5 psi) are not expected to have significant effects on the BOP piping systems due to a TPO power uprate. However, plant-specific confirmations will be performed to demonstrate that the original values of BOP design input parameters of pressure, temperature and flow bound the slight changes of the corresponding values at the 1.5 percent TPO uprated power, or that the calculated stresses and fatigue usage factors are less than the allowable limits in accordance with the requirements of the applicable code of record in the existing design basis stress report. The plant specific evaluation will also include confirmation of the acceptability of existing high energy line break locations and pipe whip restraint hardware capabilities at the TPO power uprate condition. As such, the staff concludes that the plant-specific analysis for the BOP piping systems will provide the basis to ensure that BOP piping will continue to maintain its structural and pressure boundary integrity at the TPO uprate condition.

The plant-specific evaluation will be performed to address the effects of a TPO uprate on the capacity and performance of safety and relief valves, air-operated-valves, motor-operated-valves and other safety related valves. In its response dated September 21, 2001, to the staff's RAI, GENE indicated that the plant-specific assessment will include effects of a TPO uprate on the plant-specific response and commitments to Generic Letter (GL) 95-07, "Pressure Locking and Thermal Binding of Safety Related Power Operated Gate Valves," GL 89-10 for the plant motor operated valve (MOV) program, and GL 96-06 for the overpressurization of penetration piping segments. The staff concurs with the TPO LTR statement that individual applicants will perform plant-specific evaluations relating to GL 89-10, GL 95-07 and GL 96-06 for their requested TPO uprates.

On the basis of the above review, the staff concludes that although the method for the evaluation is consistent with Appendix K of the TPO LTR, the adequacy of affected piping, piping components, and their supports will be dependent on the plant-specific design and as-built information to demonstrate the structural and pressure boundary integrity of the RCPB and BOP piping systems and supports for the TPO uprate condition.

5.5.2.1 Flow Accelerated Corrosion (FAC)

FAC occurs in carbon steel components exposed to flowing single or two-phase water. These components may be located in the NSSS or BOP. Therefore, all plants are recommended to have adequate FAC programs for managing any potential effects of FAC in these systems. FAC depends on several plant parameters, including fluid flow velocity and temperature. The steam and feedwater flow rates and temperatures increase due to a 1.5 percent TPO uprate and this could affect FAC in some NSSS and BOP piping. Although the expected effect is relatively small, plant specific evaluations will be performed on affected portions of the feedwater lines, main steam lines, and piping connected to the feedwater and main steam lines. Also, the licensee will provide a plant specific evaluation of FAC in the BOP piping to confirm the acceptability of current pipe monitoring programs. The staff concludes that the actions described above will adequately evaluate the effects, if any, of the 1.5 percent power uprate on FAC.

5.6 NSSS Systems

GENE stated that analyses and/or evaluations of various affected NSSS systems will be performed as described in Section 3.0 to verify their continued operational capability to meet the existing design and safety requirements. Such analyses will be described in plant-specific applications. This section includes the discussion of the ECCS components. The ECCS systems provide protection in the event of a LOCA due to a rupture of the primary system piping. Although DBAs are not expected to occur during the lifetime of a plant, plants are designed and analyzed to ensure that the radiological dose from a DBA will not exceed the limits specified in 10 CFR Part 100. For a LOCA, Appendix K to 10 CFR Part 50 and 10 CFR 50.46 specify the design acceptance criteria for the PCT, local cladding oxidation, total hydrogen generation, coolable core geometry, and long-term cooling. The LOCA analysis considers a spectrum of break sizes and locations, including a rapid circumferential rupture of the largest recirculation system pipe. Assuming the most limiting concurrent single-failure, the LOCA analysis identifies the break sizes that most severely challenge the ECCS systems and the primary containment. The MAPLHGR operating limit is based on the most limiting

LOCA analysis, and licensees perform LOCA analyses for each new fuel type to demonstrate satisfaction of the acceptance criteria defined in 10 CFR 50.46 and Appendix K to 10 CFR Part 50.

5.6.1 Neutron Monitoring System

The TPO LTR states that the standard practice for BWR power uprates is that the average power radiation monitors (APRM) are re-calibrated to indicate the new 100 percent uprated power level. The APRM high flux scram and the upper limit of the rod block setpoints, expressed in units of percent of licensed power, will not be changed. The flow-biased APRM trips, expressed in units of absolute thermal power (i.e., MWt), will remain the same. Thus, because the operating limits and trip setpoints for potential transients under off-rated conditions do not change under TPO conditions, and the results of these transient analyses are not affected by the TPO, the staff has assurance that specified acceptable fuel design limits will not be exceeded. The generic approach for TPO uprates will follow this previously approved practice. Appendix F of the TPO LTR addresses the setpoint methodology to be applied to power uprate adjustments.

GENE states that no IRM-APRM adjustment is necessary to ensure that overlap with the setpoint range monitors (SRMs) and APRMs is adequate. The IRM channels will have sufficient margin to the upscale scram trip on the highest range when the APRM channels are reading near their downscale alarm trip because the change in APRM scaling is small for a TPO uprate. Plants that utilize a wide range neutron monitor (WRNM) will also require no adjustment.

The neutronic service life of the LPRM detectors and radiation level of the TIP will not be significantly affected due to the small increase in power level resulting from a TPO uprate. A TPO uprate will not change the number of cycles in the lifetime of any of the detectors. Based on this rationale, and the NRC's experience gained from the review of previous power uprate applications for BWR plants, the staff agrees with GENE's determination and concludes that a plant-specific evaluation of this matter in the TSAR for a specific facility is not necessary.

5.6.2 Recirculation System

The primary function of the recirculation system is to vary the core flow and power during normal operation. However, the recirculation system also forms part of the reactor coolant system (RCS) pressure boundary.

Operation at the TPO uprated power is accomplished along an extension of the current MELLLA rod line with no increase in the maximum core flow. There is also no increase in the dome pressure during normal operation. The TPO LTR states that the TPO uprate will not significantly reduce the maximum flow capability of the recirculation system, because the change in the core pressure drop will be small (approximated at less than 0.3 psid).

The staff agrees that the TPO uprate will not significantly affect the recirculation system capability; however, the recirculation system capability may be more limited for EPU plants that seek to implement a TPO uprate. Therefore, for plants that have not implemented an EPU, a plant-specific evaluation of the recirculation system capability need not be included in the TSAR. However, for plants that have implemented an EPU, the plant-specific TSAR will include an evaluation of the recirculation system capability. Section 5.6.2 and Appendix I of the TPO LTR discuss the recirculation system performance.

5.6.3 Control Rod Drive (CRD) and CRD Hydraulic Systems

The CRD and CRD hydraulic systems and supporting equipment will not be affected by a TPO uprate. Operating pressure and temperature conditions are not changed for this equipment. The CRD hydraulic system performance is independent of power level. Operation with no increase in the reactor vessel pressure will have no effect on the performance of the CRD system.

No further evaluation of CRD performance needs to be included in any plant-specific TPO uprate application, as indicated in Appendix J of the TPO LTR. The increased power level will have a consequential, small effect on control blade lifetime. This factor will continue to be tracked in accordance with current standard practice for each plant. Shutdown margin capability is included in each reload evaluation. The TPO uprate ($\leq$1.5%) is not expected to change the cycle lifetimes of any blades.

Therefore, the staff agrees with GENE's determination and concludes that a plant-specific evaluation in the TSAR is not necessary for the CRD system.

5.6.4 Residual Heat Removal System

The RHR system, which is designed to maintain the coolant inventory in the reactor vessel and to remove heat from the primary system and containment following reactor shutdown for both normal and post-accident conditions, operates in the low pressure coolant injection (LPCI) mode, shutdown cooling mode, suppression pool cooling mode, containment spray cooling mode, and fuel pool cooling assist mode, each of which is discussed below.

5.6.4.1 Low Pressure Coolant Injection

The LPCI mode of the RHR system is automatically initiated in the event of a LOCA. The primary purpose of the LPCI mode is to help maintain reactor vessel coolant inventory for a large break LOCA and for any small break, in conjunction with other ECCS systems, after the reactor vessel has depressurized.

Since the ECCS-LOCA performance analyses used to demonstrate the adequacy of the LPCI mode was performed at bounding power level (102 percent of the CLTP), the staff finds the generic disposition of the LPCI systems for the TPO uprate to be acceptable. The plant-specific TSAR will confirm the applicability of the generic disposition. Sections 5.6.4 and J.2.3.1 of Appendix J to the TPO LTR discuss the LPCI system performance at the TPO condition.

5.6.4.2 Shutdown Cooling Mode

The objective of normal shutdown is to reduce the bulk reactor temperature after scram to 125°F in approximately 20 hours using two SDC heat exchanger loops. RG 1.139, "Guidance for Residual Heat Removal," provides an alternative approach to demonstrate SDC capability:

the RHR system can reduce the reactor coolant temperature to 200°F within 36 hours. Section 5.6.4 of the TPO LTR discusses the shutdown cooling capability of the different BWR product lines. For the BWR/6 plants, the RHR heat exchangers are sized on the basis of post LOCA containment cooling requirements and are consequently oversized for the shutdown cooling mode requirements. In addition, since the BWR/6 RHR capability is based on 102 percent of the CRTP, the SDC mode performance at the TPO uprate operating condition is bounded by the initial RHR sizing analyses.

For some BWR/3 plants, and all BWR/4 and BWR/5 plants, the RHR heat exchangers are sized for the SDC mode. For the emergency cooling scenario, one train of the SDC mode provides heat removal and cooldown to the cold shutdown condition following rapid depressurization. Current analyses of the emergency SDC mode (for the BWR/3, BWR/4, and BWR/5 plants) are based on 102 percent of the CRTP level. Therefore, the TPO uprate will not change the analyzed power level for the current SDC analysis or the decay heat and the time to achieve emergency cooldown will not change as a result of a TPO uprate. Sections 5.6.4 and J.2.3.13 of Appendix J of the TPO LTR discuss the emergency SDC mode performance for a TPO uprate.

Based on the reasons given above, the staff finds that the generic disposition of the emergency SDC mode of the RHR acceptable. The TSAR for a particular plant will confirm the applicability of the generic disposition for that plant.

5.6.4.3 Suppression Pool Cooling Mode

In Section 5.6.4 of the TPO LTR, GENE states that the events necessary for the suppression pool cooling mode to function have already been analyzed at 102 percent of CLTP. Also, for BWR/2 and BWR/6 plants, initiation of the suppression pool cooling mode is a manual procedure based on high suppression temperature and is unaffected by the power increase. As such, no additional analyses in the plant-specific TSAR are needed.

Based on GENE's rationale and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees with GENE's determination and concludes that a plant-specific evaluation in the TSAR is not necessary. However, if the analyses of the suppression pool cooling mode was performed below 102 percent of CLTP, then a plant-specific justification must be provided.

5.6.4.4 Containment Spray Cooling Mode

In Section 5.6.4 of the TPO LTR, GENE states that the containment spray cooling mode is analyzed at 102 percent of CLTP and no further evaluation in the plant-specific TSAR is necessary.

Based on GENE's rationale and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees with GENE's determination and concludes that plant-specific evaluation in the TSAR is not necessary. However, if the analyses of the containment spray cooling mode was performed below 102 percent of CLTP, then a plant-specific justification must be provided.

5.6.4.5 Fuel Pool Cooling Assist Mode

In Section 5.6.4 of the TPO LTR, GENE states that a TPO power uprate will only have a small effect in the RHR fuel pool cooling assist mode. This is because RHR events are typically already analyzed at 102 percent of CLTP. However, GENE has determined that this system must be addressed on a plant-specific basis. The results will be included in the plant-specific TSAR.

Based on GENE's rationale and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees with GENE's determination and concludes that plant-specific evaluation in the TSAR is necessary. The staff will conduct the review on a plant-specific basis.

5.6.5 Standby Liquid Control System

As defined in Appendix A to 10 CFR Part 50, GDC 26 requires, in part, two independent reactivity control systems one of which is capable of maintaining the reactor core in a cold, subcritical condition, and one of which is capable of reliably controlling the rate of reactivity changes resulting from planned normal power changes, including xenon burnout, to assure that acceptable fuel design limits are not exceeded, assuming complete failure of the control rod system. The SLC system is designed to provide the redundant reactivity control capability by pumping neutron-absorbing sodium pentaborate solution into the reactor vessel to achieve the subcritical shutdown condition.

Section 5.6.5 and Appendix L.3 of the TPO LTR, as supplemented by the RAI response dated August 7, 2002, discusses the SLC system's capability to provide its intended safety function (i.e., its shutdown and injection capability for ATWS and for providing the redundant reactivity control.) Since the neutron-absorption capability of the SLC system is dependent upon the fuel design and core loading, its capability is evaluated every reload to confirm the adequacy of the TS-specified sodium pentaborate solution concentration. For the core design changes associated with achieving the TPO uprate, no increase in the boron concentration is expected to be necessary. The SLC ATWS performance is addressed in Section 5.3.5 of this SE.

The SLC system is a manually operated system that is designed to inject a sodium pentaborate solution into the reactor at a maximum reactor pressure equal to the upper analytical setpoints for the lowest group of SRVs operating in the relief mode. For a TPO uprate, the SLC injection capability is a function of the RPV pressure. The key parameter affecting the RPV pressure during SLC system operation is the SRV setpoints, which will not change as result of a TPO uprate. Accordingly, the SLC system relief valve margin can be generically dispositioned as being adequate for TPO uprate, if the SLC system has confirmed a minimum relief valve margin of 70 psi (GE design value) before the uprate.

The SLC relief valve pressure margin is based on the difference between the pressure at the inlet of the SLC bypass relief valves and the minimum SLC bypass relief valves opening setpoint, accounting for the setpoint tolerance. A plant-specific evaluation of the SLC relief valve margin will be performed in those cases where the existing margin is less than 70 psi. In addition, if a plant-specific ATWS evaluation is performed for the TPO operation, the adequacy of the SLC system relief valve margin will be confirmed using the plant-specific results.

Confirmation of the adequacy of the SLC system injection capability, including the SLC relief valve margin, will be included in the TSAR.

The implementation of previous uprates (e.g., changes in the ATWS response attributable to an EPU or a stretch power uprate, in which the SRV setpoints changed to accommodate increases in the operating dome pressure) could affect the available SLC relief valve margin and the SLC system injection capability. Based on previous NRC power uprate experience, the staff believes that the proposed margin is high enough to provide an adequate basis to determine if the plant-specific evaluation is necessary; therefore, the proposed margin criteria will account for the combined effects of previous uprates and TPO on the SLC system injection capability. The staff concludes this approach is acceptable.

5.6.6 Reactor Water Cleanup (RWCU)

The function of the RWCU is to remove solids and dissolved impurities from the reactor coolant, thereby reducing the concentration of radioactive and corrosive species. The RWCU is a normally operating system with no safety-related functions other than containment isolation. The flow through the RWCU system is not significantly affected by the reactor power and recirculation flow conditions, therefore the increase of rated power due to a TPO uprate will not affect system capability. Operation at uprated power will cause a slight change in the quantity of fission and corrosion products and other soluble and insoluble impurities in the reactor water. However, GENE has determined that this change is insignificant and is well within the fuel warranty and TS limits on effluent conductivity and particulate concentration. The staff has concluded that the RWCU system will have sufficient capacity for reactor operation at the uprated power level, no modifications to the system are required, and, therefore, this approach is acceptable.

5.6.7 High-Pressure Coolant Injection and Reactor Core Isolation Cooling Systems

5.6.7.1 HPCI and High Pressure Core Spray (HPCS) Systems

The HPCS system, utilized in BWR/5 and 6 plants, is designed to spray water into the reactor vessel over a wide range of operating pressures. The HPCI system, utilized by BWR/3 and BWR/4 plants, is designed to pump water into the reactor vessel through the feedwater system over a wide range of operating pressures. Both the HPCI and HPCS systems (with other ECCS systems as backups) are designed to maintain reactor water level inventory during small-and intermediate-break LOCAs and isolation transients. The primary purpose of the HPCI and the HPCS systems is to maintain reactor vessel coolant inventory in the event of a small break LOCA that does not immediately depressurize the reactor vessel. The HPCS system also provides spray cooling for long-term core cooling after a LOCA. The HPCI and the HPCS systems serve as a backup to the RCIC system to provide makeup water in the event of an LOFW transient.

The TPO LTR generically dispositioned the HPCI and HPCS systems performance evaluations, stating that the TPO uprate will not result in any change in the operating pressure or the pressure setpoints of the SRVs. The capability of the turbine-driven HPCI system to successfully develop the horsepower and speed required by the pumps is unchanged for the TPO uprate. The improved turbine startup logic modifications installed in most HPCI plants are expected to provide acceptable startup capability for all TPO uprate operating conditions. Similarly, the TPO uprate does not change the power required by the HPCS pump or the HPCS diesel generator unit. In addition, both HPCS and HPCI systems will continue to provide core cooling and inventory during a LOCA, because the ECCS-LOCA analysis is performed at 102 percent CLTP. Section 5.6.7 and Appendix E to the TPO LTR discuss the HPCI system performance and the corresponding ECCS-LOCA performance evaluations.

Since the ECCS-LOCA performance analyses used to demonstrate the adequacy of the HPCS and the HPCI systems were performed at a bounding power level (102 percent of the CLTP), the staff finds the generic disposition of the high pressure ECCS systems at the TPO uprate acceptable. The plant-specific TSAR will confirm the applicability of the generic disposition.

5.6.7.2 RCIC System/Isolation Condenser (IC)

The RCIC system provides core cooling in the event of a transient in which the RPV is isolated from the main condenser concurrent with LOFW and with the RPV pressure greater than the maximum allowable for the initiation of a low-pressure core cooling system. The RCIC system is evaluated for its ability to provide core cooling and maintain the water level above the top of the active fuel (TAF).

The TPO LTR generically dispositioned the RCIC system’s capability to perform its design function, stating that there is no change in the operating pressure or the pressure setpoints of the SRVs for a TPO uprate. The topical report states that the capability of the turbine-driven system to successfully develop the horsepower and speed required by the pumps is unchanged for the TPO uprate. Appendix E to the TPO LTR states that the LOFW transient analysis is performed at 102 percent of the CLTP. Therefore, the LOFW analysis-of-record for the plant-specific applications bounds the TPO uprate operating condition. In addition, the TPO LTR states that the LOFW transient analysis uses decay heat value ≥ the 1979 American Nuclear Society (ANS) Standard 5.1 (published in 1979) + 10 percent, which is the same decay heat calculation currently used in the safety analyses. Therefore, with the RCIC capacity and the decay heat calculations unchanged (based on 102 percent CLTP), the capability to maintain the water level above the TAF will also remain unchanged for the TPO operation.

The TPO LTR states that for BWR/4, 5 and 6 plants, the ability to avoid the Level 1, low-water level setpoint, (level outside the core shroud near the TAF) would be difficult for plants that have previously uprated. GENE considers Level 1 avoidance to be an operational issue, and stated that the TPO uprate changes will not significantly affect the ability of the plant to meet this operational goal. Section 5.6.7 and Appendix E of the TPO LTR discuss the RCIC system capability and performance.

In general, the staff agrees that the LOFW analysis-of-record does bound the TPO uprate conditions, and the TPO uprate changes will not significantly affect the Level 1 setpoint avoidance response in the event of an LOFW. However, the staff does not consider Level 1 setpoint avoidance to be an operational issue, because some EPU plants might not be able to avoid the water level (outside the shroud) reaching the Level 1 setpoint, where the ADS timer is initiated and the MSIVs close. Therefore, the LOFW sequence events for these plants would include MSIVC and the RCIC system evaluations based on a LOFW event with isolation. Consequently, for EPU plants, the plant-specific submittal will confirm that the LOFW transient was analyzed at 102 percent of the CLTP. If the level 1 setpoint cannot be avoided, a plant-specific evaluation will be provided. In general, the TSAR will confirm the applicability of the generic disposition of the RCIC system capability. Based on the discussion presented above, the staff accepts the proposed approach for evaluating the RCIC system capability.

The IC system provides functions equivalent to the RCIC system. When the reactor vessel is isolated from the normal heat sink and the high pressure makeup systems, BWR/2 plants and some of the BWR/3 plants use the IC system to remove the decay heat from the reactor vessel, while maintaining the vessel liquid inventory. The IC system removes decay heat from the vessel by condensing the steam generated by the decay heat and returning the condensate to the vessel. Since the TPO LTR did not provide an evaluation to generically disposition the IC, a TPO uprate application will provide a plant-specific evaluation of the IC system. By letter dated March 21, 2003, GENE agreed to revise the accepted version of the TPO LTR to reflect this requirement. The staff finds this approach acceptable.

5.6.8 Nuclear System Pressure Relief and Automatic Depressurization System

5.6.8.1 Nuclear System Pressure Relief

The SRVs provide reactor overpressure protection for the NSSS to prevent failure of the nuclear system pressure boundary and uncontrolled release of fission products. The SRV setpoints are established to provide the reactor overpressure protection function, while ensuring that there is adequate margin between the reactor operating pressure and the SRV actuation setpoints to prevent unnecessary SRV actuations during normal plant maneuvers. A TPO uprate will not increase the SRV setpoints or change the number of SRVs-out-of-service (OOS) assumed in the ASME overpressure analysis. Since the ASME overpressure analyses are performed at 102 percent of the CLTP, the relief capacity of the SRVs will not be affected by a TPO uprate. Accordingly, the staff concludes that the SRVs can perform their safety functions at TPO uprate conditions.

5.6.8.2 Reactor Overpressure Protection Analysis

The design pressure of the reactor vessel and RCPB remains at 1250 psig. The ASME Code peak pressure for the reactor vessel and RCPB is 1375 psig (110 percent of the design pressure of 1250 psig), which is the acceptance limit for pressurization events.

The TPO uprate will not involve any change in the operating pressure, the number of SRV-OOS assumed in the ASME overpressure analysis of the pre-TPO reload cycle, or the SRV setpoints. Since the ASME overpressure analyses are performed at 102 percent of the CLTP, the current ASME overpressure analysis will bound the TPO uprate. In addition, the first TPO uprate cycle reload analysis will include an ASME overpressure analysis based on the cycle-specific core configuration. Because the plant-specific applications will confirm that the pre-TPO uprate ASME overpressure analysis bounds the TPO uprate condition for all vendor reload methods, the staff concludes this approach is acceptable.

5.6.8.3 Automatic Depressurization System

The ADS uses relief or safety relief valves to reduce reactor pressure following a small-break LOCA, allowing the LPCI and the CS/LPCS system to provide core spray cooling and flooding.

After a specified delay, the ADS initiates on low water level (LL1/L3) and either one CS/LPCS system or both RHR pumps (LPCI mode) in one loop are running. The ability of the ADS to initiate on appropriate signals is not affected by the TPO power uprate. The initiation logic and the ADS valve control are not affected by the TPO uprate operating condition. The existing performance of the ADS valves will remain unchanged, because the small-break LOCA analyses was performed at 102 percent of the CLTP, and bounds the TPO uprate condition. Therefore, the staff concludes the generic disposition of the ADS valves performance is acceptable. The plant-specific TSAR will confirm the generic disposition. Section 5.6.8 of the TPO LTR discusses the ADS valve performance at the TPO uprate condition.

5.6.9 Containment Isolation System

In Section 5.6.9 of the TPO LTR, GENE states that the ability of the containment isolation valves and the operators to perform their required functions under TPO uprated flow rates and pressure differences will not be affected because the accident evaluations have already been evaluated at 102 percent of CLTP. The currently documented accident conditions remain bounding. No further evaluation in the plant-specific TSAR is necessary.

Based on GENE's rationale and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees that plant operations at the proposed power level will have an insignificant impact on the ability of the containment isolation system to meet its design objectives. Accordingly, the staff concludes that a plant-specific evaluation in the TSAR is not necessary.

5.6.10 Core Spray and Low Pressure Core Spray Systems

The CS/LPCS systems spray water into the reactor vessel after it is depressurized. The primary purpose of the CS/LPCS systems is to provide reactor vessel coolant inventory makeup for a large LOCA and for any small break LOCA after the reactor vessel has depressurized. They also provide spray cooling for long-term core cooling in the event of a LOCA.

Since the ECCS-LOCA performance analyses used to demonstrate the adequacy of the CS/LPCS systems were performed at bounding power level (102 percent of the CLTP), the staff concludes that the generic disposition of the CS/LPCS System for a TPO uprate is acceptable. The plant-specific TSAR will confirm the applicability of the generic disposition. Sections 5.6.10 and J.2.3.1 of Appendix J to the TPO LTR discuss the CS system's performance at the TPO uprate condition.

5.7 Reactor Core Design and Fuel

Fuel bundles are designed to ensure that the following criteria are met:

1. The fuel bundles are not damaged during normal steady-state operation including AOOs.

2. Any damage to fuel bundles will not be so severe as to prevent control rod insertion when required.

3. The number of fuel rod failures during accidents is not underestimated.

4. The coolability of the core is always maintained.

For each fuel vendor, the use of NRC-approved fuel design acceptance criteria and analysis methodologies ensures that the fuel bundles perform in a manner that is consistent with the objectives of Sections 4.2 and 4.3 of the NRC's SRP and GDC-10 of Appendix A to 10 CFR Part 50. The fuel vendors perform thermal-mechanical, thermal-hydraulic, neutronic, and material analyses to ensure that the fuel system design can meet the fuel design acceptance criteria during steady-state, AOO, or accident conditions.

The slightly higher core thermal power for TPO uprate operation may require an increase in the energy requirements for each cycle. The reactor core and fuel performance characteristics may change, depending on the core design changes used to achieve the additional energy requirement. The slight increase in the cycle energy requirements can be met by increasing the bundle enrichment, increasing the reload batch fraction and/or by changes in the fuel loading pattern. However, new fuel design changes are not necessary to achieve the TPO uprate, and the currently approved fuel design limits will not change.

The fuel introduction analyses and the standard reload analyses processes establish the bases for ensuring that the fuel and the core will be designed, loaded and operated in accordance with the NRC-approved fuel design acceptance criteria and meet all of the NRC's regulatory requirements. However, the TPO uprate core design changes are not expected to result in reactor core and fuel performance characteristics beyond the cycle-to-cycle core performance changes. Based on NRC's experience with power uprate reviews, the staff finds this assessment acceptable.

5.7.1 Shutdown Margin and Hot Excess Reactivity

All minimum shutdown margin requirements apply to cold shutdown ($\leq$212°F) conditions and will be maintained without change. Checks of cold shutdown margin based on SLC system boron injection capability and shutdown using control rods with the most reactive control rod stuck out are made for each reload submittal. A TPO uprate has no significant effect on these conditions, but they will continue to be confirmed and maintained during the reload core design process, as in all fuel cycles.

Reload fuel cycle analysis and core and fuel design for operation at the uprate power level will optimize the energy requirement and power distribution so that excess reactivity, hot and cold reactivity requirements, and the core and fuel performance characteristics can be met through fuel loading strategy and control rod patterns.

New fuel designs are not needed for a TPO uprate to ensure adequate safety. However, slightly higher batch fractions, for example, may be used to provide additional operating flexibility and to maintain fuel cycle length. All fuel and core design limits will continue to be met by control rod pattern adjustments. The staff agrees that plant operations at a TPO uprate power level will have an insignificant impact on the shutdown margin and hot excess reactivity TS requirements. As the reload analysis will assure these margins are maintained during any particular fuel cycle, the staff concludes that a plant-specific evaluation in the TSAR is not necessary.

5.7.2 Thermal Limits Assessment

As set forth in Appendix A to 10 CFR Part 50, GDC-10 requires that the reactor core and associated coolant, control and protection systems must be designed with appropriate margin to ensure that the SAFDLs are not exceeded during normal operation, including AOOs.

Operating limits are established to ensure that regulatory limits, including safety limits, are not exceeded for a range of postulated events (transients and accidents).

5.7.2.1 Minimum Critical Power Ratio Safety and Operating Limit

The safety limit minimum critical power ratio (SLMCPR) ensures that 99.9 percent of the fuel rods are protected from boiling transition during steady-state operation. The OLMCPR ensures that the SLMCPR will not be exceeded as a result of an AOO.

Cycle-specific core configurations will be evaluated for each reload to confirm the plant's capability to operate at the uprated conditions and to establish the cycle-specific operating limits. The transient analyses used to establish the OLMCPR are discussed in Section 5.3.3 of this safety evaluation. Based on **[ ]**, GENE predicts an OLMCPR change of **[ ]** for TPO uprate operation. This impact is within the range of variation seen for cycle-to-cycle analyses. The OLMCPR will be established based on the TPO uprate transient analysis before implementing the TPO uprate. Section 5.3.3 and Appendix E of the TPO LTR discuss the bases of GENE's transient analysis disposition, including the power level used in the transient analysis for different events.

Considering the predicted change in the OLMCPR for the TPO uprate, the use of NRC-approved analytical methods and codes and the fact that the core-specific OLMCPR will be established during the first TPO uprate cycle reload analyses, the staff accepts the proposed approach.

The TPO uprate would result in a slight decrease in the steady-state operating MCPR, with no changes in the rod pattern, fuel design, or core design. The TPO LTR states that the core and the fuel designs can be developed, such that there are adequate operating MCPR margins without restricting the core operation.

For the GENE methods, the plant-specific SLMCPR is confirmed during every reload using Monte Carlo analyses that assume the core is operating at the thermal limits. Such analyses assume core power distribution that maximizes the number of assemblies operating near these limits. The SLMCPR will be calculated for the first TPO uprate fuel cycle and confirmed for each subsequent cycle. Any changes to the TS-specified SLMCPR will also require staff review through an amendment request process. The SLMCPR calculation will be based on the actual core configuration for the cycle, including any resident fuel from vendors other than GE. This approach is also consistent for all fuel vendors' NRC-approved methods and approach.

The SLMCPR calculation is based on the nominal average power level and the uncertainty in its measurement. Historically, the GENE SLMCPR uncertainty allowance assumed a one sigma FW flow measurement uncertainty of 1.76 percent. The 1 sigma FW flow uncertainty value for the SLMCPR calculations was recently raised to 1.8 percent and the GENE SLMCPR calculations for TPO uprate operation will continue to use the current 1.8 percent uncertainty allowance. The TPO LTR gives each licensee the option of including the improved FW measurement uncertainty in the SLMCPR uncertainty factors to achieve a small SLMCPR benefit of **[ ]**. However, in the August 7, 2002, RAI response, GENE stated that the NRC approval of the current SLMCPR uncertainty methodology does not allow taking credit for specific improvements in the individual uncertainty values. The SLMCPR calculation uncertainties are considered as a "package," and any changes to the feedwater flow measurement uncertainty value would require NRC review of a new SLMCPR uncertainty methodology. Therefore, the plant-specific application of the proposed SLMCPR benefit option will require prior NRC approval of the uncertainty methodology. Sections 5.7.2.1 and E.2.5 of Appendix E of the TPO LTR discuss the SLMCPR performance.

Based on the projected minor impact of the TPO uprate operating condition on the SLMCPR; the fact that the SLMCPR will be calculated before the implementation of a TPO uprate using NRC-approved analytical methods, process, and codes; and that any changes to TS-specified SLMCPR will require NRC staff review, the staff finds the proposed approach acceptable for a plant-specific TPO uprate application.

5.7.2.2 Maximum Average Planar Heat Generation Rate (MAPLHGR) and Maximum Linear Heat Generation Rate Operating Limits

The MAPLHGR and LHGR limits ensure that the plant does not exceed regulatory limits established in 10 CFR 50.46 or the fuel design limit. The MAPLHGR limit is determined by analyzing the limiting LOCA for the given plant. The maximum LHGR (MLHGR) limit is determined by the fuel rod thermal-mechanical design. The TPO LTR states that a TPO power uprate will result in only a small change to the steady-state operating MLHGR, if there are no compensating changes in the core and fuel design or rod pattern. However, the margin between the MLHGR for the fuel type and the operating MLHGR can be enhanced through an optimized rod pattern.

The licensing basis (Appendix K) ECCS-LOCA analyses have historically been performed at 102 percent of the CLTP; so the effect of the TPO uprate on the MAPLHGR operating limit is expected to be equivalent to the cycle-to-cycle impact. The reload analysis will confirm that the MAPLHGR and the MLHGR operating limits for each fuel bundle design will remain within the MAPLHGR limit established by the ECCS-LOCA analysis and the fuel-specific MLHGR limit. In addition, the adequacy of the applicable power and flow dependent MCPR and LHGR limits for the uprated operating range will also be confirmed during the TPO uprate reload cycle analysis. The TPO LTR proposes deferring the fuel and core performance and thermal limits assessments to the reload analyses that will be performed before the implementation of the TPO uprate. Since the reload analysis will ensure that there are acceptable margins between the licensing limits and the corresponding operating limits, and **[ ]**, the TPO uprate core design changes are not expected to result in reactor core and fuel performance characteristics beyond the cycle-to-cycle core performance changes. Accordingly, licensees will appropriately consider the potential effects of uprated power operation on the fuel design limits. Therefore, the staff finds deferring the thermal limits assessment to the standard reload process acceptable.

In the August 7, 2002, RAI response, GENE stated that the TPO uprate applies to plants for which a 20 percent power uprate has already been implemented, and whose licensees plan to gain additional operating power by installing more accurate feedwater measurement instrumentation. For licensees that choose to apply for a TPO uprate in combination with a larger power uprate, the NRC staff will review the fuel and core performance during the review of the larger power uprate, which may include an NRC staff audit. Some licensees that have already implemented an EPU may seek to gain additional operating power through a TPO uprate. A licensee seeking a TPO uprate that would result in CLTP in excess of 120 percent of the OLTP will provide plant-specific justifications for those evaluations not performed at 102 percent of the CLTP. Since the plant-specific application will provide the basis for assessing the impact of the additional power uprate, the staff finds this approach acceptable. Section 5.7 of the TPO LTR states that the evaluations of the core performance will be provided with the reload submittal that implements TPO uprate for a specific cycle. Similarly for plants already operating with an EPU, the licensee will submit to the NRC the TPO uprate cycle supplemental reload licensing report or applicable document prior to the implementation of the TPO power uprate.

As discussed in Section 4.3 of this SE, TPO applications involving a fuel supplier other than GE will provide additional supplemental justifications, evaluations or analyses to support the fuel-dependent areas of review. For the vendors other than GE, plant-specific applications will establish that the reload analyses are performed at bounding power levels, or provide the bases for assessing the impact of the TPO uprate on the thermal limits. The plant-specific applications will specify the resident fuel, identify the TPO uprate cycle vendor, and state the power levels and the power uncertainty factors used in the transient analyses that establish the thermal limits. For all fuel vendors, the standard reload analyses account for the characteristics and performance of all of the resident fuel. Therefore, mixed core effects are taken into account. Since the licensees will provide justifications or the supporting analyses that will allow the staff to assess the potential effects of a TPO uprate on the fuel design limits, the staff finds the proposed approach acceptable, for applications involving fuel suppliers other than GE.

5.8 Instrumentation and Control (I&C)

The generic evaluations in the TPO LTR of the impact of the proposed TPO power uprate on the suitability and functional capability of I&C systems and components concluded that the proposed uprate will not have any significant impact on the design functions of I&C systems. The TPO LTR confirms that the GENE methodology for calculating and calibrating instrument setpoints has been previously reviewed and approved by the staff. GENE's assessment of BWR generic-systems (included in the TPO LTR) concludes that most of the generic safety analyses bound the TPO uprate. However, there are some areas in plant analyses and system evaluations listed in Table B-3 of the TPO LTR that have not been generically evaluated and dispositioned. The plant-specific evaluations for these areas will be performed by the TSAR.

The generic guidance for license amendment submittals included in the TPO LTR is based on a generic BWR plant design for an uprate to 101.5% of CLTP. The staff reviewed the topics listed in Section 5.8 of the TPO LTR, "Control and Instrumentation"; Appendix F, "Specific Assumptions and Bases for Control, Instrumentation and Setpoint Evaluations"; applicable I&C portions of Appendix C, "Specific Assumptions and Bases for TPO Uprate Operating Conditions"; and applicable I&C portions of Appendix L, "Specific Assumptions and Bases for Evaluations of Other Aspects of TPO Uprate." The staff reviewed this material to verify that the TPO LTR properly addresses the impact of the proposed uprate on the suitability and functional capability of all associated I&C systems and components. The staff examined whether the TPO LTR considers all possible attributes including the methodology used for calculating setpoints and scaling instruments, to determine whether the generic guidelines provided by the TPO LTR for I&C portions of future license amendment submittals for power uprate are acceptable.

In accordance with GENE's TPO uprate program, the TPO LTR proposes to increase the power level up to 101.5 percent of the current licensed power level by applying reduced thermal power uncertainty (less than 2 percent) to the appropriate analyses and evaluations of a plant. The plant-specific amount of the power uprate will be determined by the actual accuracy claimed for the inservice FW flow measurement instrumentation. The inservice instrumentation could be either new and improved instrumentation or existing instrumentation. In any case, the actual thermal power increase that a plant can realize will depend on the magnitude of the reduction in uncertainty in the measurement of the thermal power that might be approved by the NRC staff in a plant-specific license amendment.

In its response to the staff's RAI, GENE stated that, while installation of an improved FW flow meter would be a plant modification, it is not the only way to reduce the reactor thermal power uncertainty. The magnitude of the plant-specific thermal power uncertainty reduction is dependent on several factors, including the design and accuracy of the FW flow measurement instrumentation. The most probable approach to a small power uprate using the TPO uprate process is through the installation of an improved FW flow meter. However, the TPO LTR is open to other approaches. The basis for the TPO uprate, including the performance characteristics of the plant-specific flow monitoring instrument, will be contained in the TSAR.

The proposed increase in power level maximum up to 101.5 percent of the current licensed current power level is based on reducing thermal power uncertainty to 0.5 percent of CLTP. The licensee must determine that actual uncertainties in the measurement of thermal core power justify a reduction in thermal power margin in safety and transient analyses, and that the plant has a program and procedures in place to monitor normal operation of the plant and demonstrate that the instrument uncertainty is no greater than the uncertainty used in the licensee's analyses to justify power uprate above its current licensed power level.

Therefore, the TSARs based on this TPO LTR should include the plant-specific power uncertainty calculations explicitly identifying all associated parameters (such as feedwater flow measurement, etc.), and their individual contributions to thermal power uncertainty. In addition, for TPO LTR related changes the TSAR should confirm that plant-specific procedures and a program are in place to:

a. monitor and maintain instrument calibration during normal plant operation to assure that the instrument uncertainty is not greater than the uncertainty used in the licensee's analyses to justify the TPO-based power uprate up to 101.5 percent of the licensed current power level;

b. control the software and hardware configuration of associated instrumentation;

c. perform corrective actions (where required) to maintain instrument uncertainty within limits;

d. report deficiencies of associated instruments to the manufacturer; and

e. receive and resolve the manufacturer's deficiency reports.

By letter dated March 21, 2003, GENE stated that the generation of a plant-specific TSAR is based on a generic production TSAR template. GENE will modify the production TSAR template to address the plant-specific programs and procedures to monitor normal operation of the plant as noted above. Since these programs and procedures do not involve generic GENE TPO evaluations, they are best addressed in the TSAR, rather than as a part of the TPO LTR.

5.8.1 I&C Systems Potentially Affected by the TPO Uprate

Operation at uprated power could alter many operating parameters and thereby affect the severity of design-basis accidents and transients. In the I&C area, the proposed TPO power uprate could change neutron flux, turbine inlet pressure, steam flow, and FW flow. Improved accuracy of the FW flow rate monitoring is the principal factor that allows the proposed TPO power uprate. To assess the impact of the power uprate, the TPO LTR evaluates the suitability of the I&C systems and components and of the signal ranges and setpoints of the instruments. The following systems and components are evaluated:

- Important control functions, including reactor pressure control, turbine bypass control, FW flow control, reactor water level control, recirculation flow control, and control instrumentation required for safe operation and shutdown of the plant.

- Setpoints for the following trip and alarm functions: flow-referenced APRM trip and alarm, fixed APRM trip and alarm, turbine first stage pressure, high reactor pressure scram, MSIV closure on high steam flow, cavitation protection for FW flow, low steam line pressure, MSIV closure on high steam line radiation and high steam tunnel temperature, rod worth minimizer low power, reactor vessel water level low/water level high, and power threshold above which fuel thermal margin monitoring is required.

The TPO LTR evaluation of the impact of the proposed TPO power uprate on I&C systems and components concludes that it will not change reactor pressure, temperature, water level, core and jet pump flow, or reactor and containment conditions requiring safety functions. The TPO uprate will not increase system capabilities needed for performance of safety functions. It will not change the peak transient or accident criteria for the monitored parameter(s) which is the design-basis of the instrument range(s). Therefore, the proposed TPO power uprate will not change the range and scaling of instruments that sense the flow, pressure, temperature, and pump head of the systems that provide safety functions for the reactor.

Safety systems and functions evaluated were: the RHR system, LPCI, HPCI, control rod drives, and high steam line flow isolation actuation. Instruments that sense abnormal reactor and/or containment conditions in order to initiate safety actions will remain at the current setpoints. The trip setpoints for the flow-referenced APRM trip and alarm will be lowered slightly because these setpoints are expressed in units of percent of licensed power in the technical specifications. However, in units of absolute thermal power (i.e., MWt), these setpoints remain unchanged. APRMs will be recalibrated to indicate the new 100 percent uprated power level. Setpoints for main steam line isolation on high steam flow high, radiation, and high steam tunnel temperature will be raised by the amount of the increase in the values of these parameters at the uprate conditions. This will maintain margin for avoiding inadvertent isolations. The GENE setpoint calculation methodology was used to evaluate the acceptability of actuation setpoints, calibrations, and uncertainties for the operating conditions of the TPO power uprate. The GENE setpoint calculation methodology was previously reviewed and approved by the staff and has been applied at many BWR plants.

In the generic approach, a proposed TPO power uprate will be accomplished with no increase in dome pressure above the current operating limits. This constraint minimizes the impact of uprating on reactor thermal duty, avoids changes to all instrument setpoints for system pressure and will not change the loading of safety/relief valves. Since the proposed power uprate will slightly increase steam flow to the turbine, there will be a small decrease in the pressure available at the turbine inlet for TPO-uprated power operation. During normal operation, reactor pressure is controlled by turbine pressure regulators controlling TCVs. TCVs have nonlinear characteristics and good control capability is difficult if the TCV’s normal operating point is too close to its wide-open position. To maintain the current dome pressure operating limits at the TPO-uprated power level, it is essential that the plant-specific design provide adequate margin between the TCV’s operating point and its steam flow capability at its maximum stroke (i.e.,valve wide open). In its TPO LTR, GENE states that operating experience has generally shown that sufficient margin exists for most BWR plants. Since GENE could not verify this statement for all operating BWR plants, the staff recommended that licensees' submittals for power uprate based on this TPO LTR should verify that the plant-specific design provides adequate flow margin between the uprated normal operating condition and the TCV’s steam flow capability at its maximum stroke. By letter dated March 21, 2003, GENE agreed to revise the accepted version of the TPO LTR to reflect this needed verification.

Licensee submittals that apply results of the generic evaluations of the LTR NEDC-32938P to support a plant-specific power uprate should confirm that the plant-specific I&C design and operating conditions are bounded by those used for the generic analyses and evaluations of the NEDC-32938P TPO uprate program. If the plant-specific design and/or the operating conditions of I&C systems and components are not bounded by those used for the generic analyses and evaluations of the NEDC-32938P TPO program, the plant-specific submittal should include a plant-specific analysis of the impact of the uprate on all applicable I&C systems and components. For those cases where the licensees used previously approved methods, the setpoint and/or instrument scaling calculations are acceptable. The licensee should confirm that either the GENE methodology or a plant-specific NRC staff-approved methodology has been used.

5.8.2 I&C Systems Conclusions

For the I&C area, the staff reviewed specific assumptions and bases for control, instrumentation, and setpoint evaluations (described in Appendix F of the TPO LTR) and I&C-related bases for operating conditions and testing requirements (described in Appendices C and L of the TPO LTR, respectively). In addition, the staff reviewed the licensing approach and criteria (described in Appendix B of the TPO LTR), the TPO uprating process, and the parts of the TPO LTR containing guidance for I&C portions of future licensee submittals seeking

NRC approval to implement a plant-specific TPO power uprate. As set forth above, these guidelines and licensing criteria for the plant-specific submittals are acceptable to the staff.

The TPO LTR stated that the following miscellaneous I&C items do not have a significant impact on the proposed power uprate: instrument loop response time and response time testing, plant computer system, simulator and training, safety parameter display system (SPDS) and technical support center, emergency operating procedures and normal plant operating procedures, and procedures associated with I&C efforts in surveillance, calibration and tracking of instrument drifts. If during the TSAR review, it should be determined that any of these items are affected by the TPO, the licensee’s submittal must include these miscellaneous I&C items in its plant-specific evaluation for impact of power uprate. The staff concludes that the approach described in the TPO LTR for power uprate impact evaluations is acceptable.

The staff notes that GENE’s evaluation of the impact of a TPO power uprate on functional capabilities of I&C systems important to safety in a generic BWR plant concludes that such a power uprate will have an insignificant impact on I&C systems’ capabilities to perform their intended design functions and that the design-basis acceptance criteria will continue to be met during operation at the proposed uprated power level. GENE’s setpoint calculation methodology, which was used for assessing the impact of uprated power operation on actuation trip setpoints and allowable values of safety-related instrumentation, has been previously approved by the staff. The staff finds that the generic guidance provided by the TPO LTR for plant-specific submittals is acceptable, provided the TPO LTR addresses the conditions stipulated in this safety evaluation.

5.9 Environmental Impact Evaluation

Pursuant to 10 CFR Part 51, each individual amendment request will address the environmental impact of the proposed action.

5.10 Balance-of-Plant Systems

System reviews will be performed to determine the capability of various BOP systems and components to ensure that they are capable of safely delivering the increased power output. Although no significant impact on plant safety associated with these systems is expected, the evaluations will be documented in the TSAR because these systems are frequently unique. The systems that receive the major review are described in the following sections.

5.10.1 Turbine Generator

In Section 5.10.1 of the TPO LTR, GENE states that the turbine-generator must be addressed on a plant-specific basis. The results will be included in the TSAR.

Based on GENE’s determination and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees that a plant-specific review is necessary and will conduct the review on a plant-specific basis.

5.10.2 Primary Containment System

In Sections 5.3.2, 5.4, and 5.10.2 and Appendices G and H of the TPO LTR, GENE discusses containment capability for a TPO uprate with no increase in reactor operating pressure. GENE states that the containment response (peak pressure, temperature, and loads) and radiological evaluation of a postulated LOCA event have been performed considering at least 2 percent power above the current licensed conditions and therefore no re-analysis is needed either generically or on a plant-specific basis.

Based on GENE's rationale and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees with GENE's determination and concludes that plant-specific evaluation in the TSAR is not necessary. However, if the containment system analysis is not bounded by the 102 percent allowance, then a plant-specific justification should be provided.

5.10.2.1 Containment System Performance

In Appendix A of the TPO LTR, GENE lists containment system performance associated with GL 89-10 and GL 96-06 as a matter that will be addressed on a plant-specific basis. The evaluations will be included in the TSAR.

Based on GENE's determination and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees that a plant-specific review of containment system performance is necessary and should be included in the plant-specific TSAR. The staff will conduct the review on a plant-specific basis.

5.10.3 Feedwater and Condensate Systems

In Section 5.10.3 of the TPO LTR, GENE states that the feedwater and condensate systems must be addressed on a plant-specific basis. The results will be included in the TSAR.

Based on GENE's determination and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees that a plant-specific review of the feedwater and condensate systems is necessary and should be included in the plant-specific TSAR. The staff will conduct the review on a plant-specific basis.

5.10.4 Condenser and Plant Cooling Water Systems

In Section 5.10.4 of the TPO LTR, GENE states that the performance of the condenser and steam jet air ejectors are expected to accommodate the slightly increased power conditions for most of the year. Slightly more degraded condenser vacuum conditions may limit the plant power level during hot weather. No changes will be made to the present plant heat sink maximum temperatures limits.

Based on GENE's determination and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff concludes that plant-specific confirmation or evaluation of condenser performance and steam jet air ejectors is necessary in the TSAR. The staff will conduct the review on a plant-specific basis.

5.10.5 Circulating Water Systems and/or Cooling Tower

In Section 5.10.5 of the TPO LTR, GENE states that the circulating water systems and/or cooling tower must be addressed with a plant-specific review to determine the expected performance under the TPO uprated thermal loads. Similar to the condenser, these systems may limit the power level during hot weather. However, no safety effect exists as long as the plant is operated within the applicable technical specifications. The results will be included in the TSAR.

Based on GENE's determination and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees that a plant-specific review of the circulating water system and any cooling tower is necessary and should be included in the plant-specific TSAR. The staff will conduct the review on a plant-specific basis.

5.10.5.1 Ultimate Heat Sink

In Appendix A of the TPO LTR, GENE lists that the ultimate heat sink will be addressed on a plant-specific basis. The evaluation will be included in the TSAR.

Based on GENE's determination and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees that a plant-specific review of the ultimate heat sink is necessary and should be included in the plant-specific TSAR. The staff will conduct the review on a plant-specific basis.

5.10.6 Electrical Systems

GENE states that plant-specific evaluations are to be performed to demonstrate that electrical systems and components (including transformers) are capable of operating under increased electrical output and increased plant load conditions. It is expected that the small TPO increase in power will be within the capability of all electrical systems. Section 5.10.6 of the TPO LTR states that the results of the following plant-specific evaluations will be included in the TSAR :

1. Electrical grid stability: A grid stability analysis will be evaluated and revised if necessary. Any plant changes to control the reactive power will be identified in the TSAR.

2. Main generator: If the protective relaying for the main generator and main power transformer require modification, changes will be identified in the plant-specific TSAR.

3. The increased normal operating loads depend on the specific plant design and may include the recirculation pumps, condensate pumps, condensate booster pumps, motor driven feedwater pumps, and circulating water pumps. These additional loads may affect the ratings of the isophase bus, main power transformer, and startup/auxiliary transformers. Any changes will be identified in the plant-specific TSAR.

4. Balance of plant loads: A plant-specific evaluation of the AC power system will be performed to assure an adequate AC power supply to the safety systems. The TSAR will summarize the results of the plant-specific evaluation.

Based on GENE's determination and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees that a plant-specific review of the above items is necessary and should be included in the plant-specific TSAR. The staff will conduct the review on a plant-specific basis.

5.10.7 Emergency Diesels, M-G Sets and Batteries

5.10.7.1 Emergency Diesel Generators (EDG)

GENE stated that no load increase is expected, since the existing ratings and requirements for all safety-related systems and equipment are maintained. Plant-specific confirmation of this expectation will be included in the TSAR.

The staff has evaluated the applicant's submittal and concluded that the operation at the uprated level does not increase any loads beyond nameplate rating or revise any control logic. This system will be addressed on a plant-specific basis. The evaluation will be included in the TSAR.

5.10.7.2 M-G Sets and Batteries

GENE stated that no load increase is expected since the existing ratings and requirements for all safety-related systems and equipment are maintained. Plant-specific confirmation of this expectation will be included in the TSAR.

The staff has evaluated the applicant's submittal and concluded that the operation at the uprated level does not increase any loads beyond nameplate rating and, therefore, the design for DC power distribution system. This system will be addressed on a plant-specific basis. The evaluation will be included in the TSAR.

5.10.8 Spent Fuel Pool System

In Section 5.10.8 of the TPO LTR, GENE states that the function of the spent fuel pool system is to remove decay heat from spent fuel. A small increase to the spent fuel pool temperature due to the TPO uprate could occur. This system will be addressed on a plant-specific basis. The evaluation will be included in the TSAR.

Based on GENE's determination and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees that a plant-specific review of the spent fuel pool system is necessary and should be included in the plant-specific TSAR. The staff will conduct the review on a plant-specific basis.

5.10.9 Radwaste Systems

In Section 5.10.9 and Appendix J.2.3.11 of the TPO LTR, GENE states that a TPO uprate has no significant effect on the radwaste systems. This is because no significant increase in the total treated material is expected for an uprate of 1.5 percent of reactor power. No further evaluation is necessary in the plant-specific TSAR.

Based on the review of GENE's rationale and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff concludes that plant operations at the proposed uprated power level will have an insignificant impact on the ability of the radwaste systems to meet its design objectives. The staff concludes that plant-specific evaluation in the TSAR is not necessary.

5.10.10 BOP Piping

See Section 5.5.2 of this SE.

5.10.11 Offgas System

In Section 5.10.11 and Appendix J.2.3.12 of the TPO LTR, GENE discusses that core radiolysis (formation of H_2 and O_2) will increase linearly with power, thus increasing the heat load on the offgas recombiner and related components. GENE states that this small change is within the capability of the system and a plant-specific evaluation in the TSAR is not necessary.

Based on the review of GENE's rationale and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff concludes that plant operations at the proposed uprated power level will have an insignificant impact on the ability of the offgas system to meet its design objectives. The staff concludes that a plant-specific evaluation in the TSAR is not necessary.

5.11 Additional Aspects of TPO Uprate

5.11.1 10 CFR Part 50, Appendix R

In Section 5.11.1 of the TPO LTR, GENE states that some requirements for Appendix R were previously analyzed for 102 percent of current licensed rated power and the remaining requirements have been reviewed. Should any plant project a violation of the applicable criteria from the generic information, a plant-specific evaluation will be provided in the plant-specific TSAR. In Appendix L.4 of the TPO LTR, GENE states that the generic results for the limiting Appendix R events show that the impact of a TPO uprate is relatively small. If a licensee seeking a TPO uprate shows that its plant currently has sufficient margin for the projected change of the peak values of relevant parameters, no plant-specific Appendix R analysis need be included in the TSAR. If the previous Appendix R analysis does not show sufficient margin, Appendix R will be addressed in the TSAR.

Based on the review of GENE's rationale and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff concludes that a plant-specific

Appendix R confirmation or evaluation is necessary and will be included in the plant-specific TSAR. The staff will conduct the review on a plant-specific basis.

5.11.2 Environmental Qualification (EQ) of Electrical Equipment

Environmental qualification of electrical equipment important to safety will be reviewed to show that equipment can perform its required functions under the TPO uprated condition. Each application will show that the existing environmental envelopes remain valid. No significant change in normal operating conditions is expected for a TPO uprate. Expected changes include: operating temperature changes of <2°F in FW lines and <1°F in recirculation lines, operating pressure changes of <1 psi for feedwater and recirculation discharge lines, and operating radiological changes of ≤1.5 percent. Vessel dome pressure and other portions of primary coolant pressure boundary remain at current operating pressure. All harsh environmental design conditions are expected to have been defined for plant operation at ≥102 percent of current rated power, although plant-specific confirmation needs to be provided in the TSAR. All environmental design bases are expected to accommodate the small changes for TPO uprated operation, and this conclusion will be confirmed in the plant-specific TSAR. If any area is found to exceed the current EQ bases, the reevaluation will be provided in the TSAR. The review will show that the EQ of electrical equipment meets the requirements of 10 CFR 50.49. GENE states that the EQ of electrical equipment will meet the requirements of 10 CFR 50.49 or be reevaluated in the TSAR. The staff concludes that the use of the TSAR to reconfirm or reevaluate the environmental qualification is acceptable.

5.11.3 Emergency Operating Procedures

The BWR Emergency Procedure Guidelines (EPGs) have been reviewed to identify the effect (if any) on the plant EOPs due to operating at TPO uprated conditions. The EPG/EOP action steps are unchanged because they are symptom-based, independent of reactor power level. However, GENE has stated that certain threshold values for initiating mitigation actions (defined in the EPGs) are dependent upon power/decay heat levels. The EOP action thresholds are plant unique and will be addressed as needed by each individual applicant, using standard procedure updating processes as done in previous BWR uprates. The staff concludes that a TPO uprate of ≤1.5 percent CLTP will have a negligible impact on any of the operator action thresholds, and no detailed information is required in the TSAR.

5.11.4 Requirements for Shutdown and Refueling

The current shutdown and refueling TS requirements are sufficient to accommodate the TPO uprated configuration. Shutdown margin (Section 5.7.1) is confirmed for each reload fuel cycle and will not be included in the TSAR. Spent fuel pool cooling will be addressed on a plant-specific basis as discussed in Section 5.10.8 of the TPO LTR. GENE has stated they expect no impact on these matters as a result of the TPO uprate, other than possibly procedural changes associated with the new value of rated power. The shutdown margin and spent fuel pool cooling issues have been addressed and the staff agrees that current refueling requirements should be little changed as a result of the TPO uprate.

5.11.5 Operator Training

Operating training requirements will be reviewed by each utility. Additional training required to operate the plant in TPO uprated conditions is expected to be minimal (e.g., only small power/flow map and flow-referenced setpoint changes), because there is no change in system operating pressure or water level. Small differences in EOP action threshold values (Section 5.11.3) may also be introduced. Based on GENE's determination and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff concludes that plant operations at the proposed uprated power level will have a minimal impact on operator training. Accordingly, the staff concludes that a plant-specific evaluation in the TSAR is not needed.

5.11.6 Plant Life

The plant nuclear steam supply system (reactor pressure vessel, reactor internals, piping, and primary coolant pressure boundary) are evaluated and monitored against criteria regarding the effect of the TPO power uprate on age-related degradation (e.g., Section 5.5.1.5 of the TPO LTR for the reactor vessel). Equipment that is routinely replaced such as the fuel and the control rod drive mechanisms is not included in this evaluation.

GENE concluded that the longevity of most equipment will not be affected by the TPO power uprate because there is no significant change in the operating conditions for a constant-pressure TPO uprate. The staff agrees that the TPO uprate will not affect the longevity of most equipment. For plants operating pursuant to a renewed license, those few components which might be affected already have effective plant programs in place to detect and mitigate age-related degradation. No additional maintenance, inspection, testing or surveillance procedures are necessary for the small change being introduced by TPO uprate. Current practices will be sufficient, even for equipment like the main transformer, which will operate under slightly higher loads at TPO uprated conditions.

5.11.7 Station Blackout

GENE stated that the SBO requirements, which are not previously analyzed for 102 percent of current licensed rated power, have been reviewed to ensure that these requirements continue to be met at the TPO uprated power level. Should any plant project a violation of the applicable criteria from the information provided in Section L.5 of Appendix L of the TPO LTR, a plant-specific evaluation will be provided in the plant specific TSAR.

Sections 5.11.7 and L.5 of Appendix L to the TPO LTR discuss the process for demonstrating continued compliance with the SBO requirements for the TPO uprate. The staff has reviewed Section L.5 of Appendix L, which documents **[** **]** consistent with the guidelines of NUMARC 87-00 and RG 1.155, "Station Blackout." It is shown that a TPO uprate of $\leq$1.5 percent will have a small impact on SBO, including the adequacy of the condensate storage inventory, the plant's ability to maintain containment integrity, and the capability of the plant's systems (RCIC and HPCI) to maintain core cooling and coverage. Table L-3 of the TPO LTR provided some data **[** **]** for use in estimating the impact of a TPO uprate on a plant's capability to cope with an

SBO. The TPO LTR, as supplemented, proposed that the SBO coping capability for the TPO uprate would be dispositioned as follows:

1. If the previous SBO analyses were performed at ≥102 percent of CLTP, the existing SBO analyses bound the TPO uprate conditions.

2. If the previous SBO analyses were performed at CLTP, **[**

   ], a plant-specific SBO analysis is not required. **[**

   .**]**

3. If the previous SBO analyses do not meet the proposed **[** **]** criteria, a plant-specific evaluation will be performed for the TPO operation.

The TSAR will state the category to which a plant's SBO evaluation is dispositioned, and will state whether the plant can meet the 10 CFR 50.63 requirements for operation at the uprated conditions. Specifically, the TSAR will confirm whether the plant has sufficient condensate inventory for TPO uprate operation and whether the RCIC or HPCI systems can provide core cooling and coverage during the SBO coping period. Based on the discussions in the TPO LTR, the staff has concluded that if the results of the plant specific evaluations are consistent with the guidelines of NUMARC 87-00 and RG 1.155, the design for SBO would meet the requirements of 10 CFR 50.63 and is acceptable. Individual applicants should include appropriate confirmation or SBO analysis in the TSAR.

5.11.8 <u>High Energy Line Break</u> (HELB)

In Section 5.11.8 of the TPO LTR, GENE states that there is no significant change to the HELB analysis due to the TPO uprate changes. The system operating temperatures and pressures change only slightly: less than 2°F and less than 5 psi for the FW lines and less than 1°F and 1 psi in the recirculation lines due to slightly higher pressure drops at the TPO flow rate and core pressure drop with current core flow. Vessel dome pressure and other portions of the primary coolant pressure boundary remain at current operating pressure or lower. GENE concludes that the consequences of any postulated HELB will not significantly change. In the June 6, 2001, submittal, GENE states that if the plant specific harsh environmental evaluations did not consider the input power to be 102 percent, then the HELB analysis would be included and provided as part of the TSAR in the re-evaluation.

Based on GENE's rationale and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees with GENE's determination. The staff concludes that a plant-specific confirmation or re-evaluation with respect to HELB events in the TSAR is necessary.

5.11.8.1 Moderate Energy Line Break

In Section 5.11.12 of the TPO LTR, GENE states that the moderate energy line break anaylsis is not impacted because the operating pressure is unchanged at the uprated power level.

Based on GENE's rationale and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees with GENE's determination. The staff concludes that a plant-specific evaluation in the TSAR is not necessary.

5.11.9 Probabilistic Safety Assessment (PSA)

As set forth below, the impact of a TPO power uprate on plant risk is concluded to be insignificant. Each licensee has completed an Individual Plant Examination (IPE) with respect to each of its plants in response to GL 88-20, "Individual Plant Examination for Severe Accident Vulnerability." Most licensees completed their IPEs by performing a PSA. A Level 1 PSA models the events that lead to core damage and calculates the core damage frequency. A Level 2 PSA models core melt progression and containment failure and calculates the frequency and magnitude of radioactive release.

A TPO uprate ($\leq$1.5 percent power increase) is not a significant change in the PSA or the IPE for any BWR. Most of the controlling scenarios (e.g., LOCA, limiting overpressure transients, loss of feedwater flow transients) have already been analyzed for 102 percent of current licensed power. Appendix L, Section L.3 of the TPO LTR shows that ATWS results are not significantly affected by a TPO uprate because the maximum operating rod line boundary is not being raised. No new initiating events are introduced by a TPO uprate. No changes are required in the PSA/IPE success criteria (e.g., no change in the number of pumps required for core cooling, containment heat removal, and SRVs needed for reactor depressurization). The slight change in the time available for operator actions (due to higher decay heat) does not have a significant impact on the PSA results. Therefore, the staff agrees with GENE's conclusion that PSA/IPE need not be addressed in a plant-specific TSAR.

5.12 Other Systems

5.12.1 MSIVs and Steamline Flow Restrictors

In Appendix J.2.3.7 of the TPO LTR, GENE states that the performance requirements for the MSIVs and main steamline flow restrictors are negligibly impacted by a TPO uprate. At normal operation, the flow restrictors are required to pass a higher flowrate, which will result in an increased pressure drop. For the faulted condition with a postulated steam line break outside containment, the fluid flow in the broken steam line increases until it is limited by the main steam line flow restrictor. Because the maximum operating dome pressure does not change, the resulting break flow rate is unchanged from the current analysis and the operational stresses are not affected. Therefore, the main steamline flow restrictors are not affected by a TPO uprate.

Because the flow restrictors were designed and analyzed for the choke flow condition with the maximum pressure difference, which is bounding for the TPO uprate condition, the TPO LTR concludes that the structural integrity of flow restrictors will not be affected by a TPO uprate. There will be no change in operating temperature and a slight decrease in pressure along the steamline due to the higher flow rate. There will be a less than 2 percent change in normal steam flow. GENE states that this small change will not affect any accident-related loads because the current loads continue to bound the analysis for TPO uprate operation. There is no increase in the steam flow calculated for a main steamline break accident. No change in the steamline break flow rate occurs because the flow restrictor and the operating pressure remains unchanged. GENE states that all safety and operational aspects of the MSIVs and the main steamline flow restrictor performance are within previous evaluations. GENE concludes that the TPO will have negligible impact on the current evaluation of the MSIVs and the main steamline flow restrictors and that a plant-specific evaluation in the TSAR is not necessary.

Based on GENE's rationale and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees that plant operations at the proposed uprated power level will have an insignificant impact on the ability of the MSIVs and main steamline flow restrictors to meet their design objectives. Accordingly, the staff concludes that a plant-specific evaluation in the TSAR is not necessary.

5.12.2 Main Control Room Atmosphere Control System

In Appendix J.2.3.8 of the TPO LTR, GENE states that the system had been evaluated for accident conditions from 102 percent power of current licensed power and therefore, the main control room atmosphere control system does not need to be addressed in the plant-specific TSAR.

Based on the review of GENE's rationale and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees that plant operations at the proposed uprated power level will have an insignificant impact on the ability of the main control room atmosphere control system to meet its design objectives. The staff concludes a plant-specific evaluation in the TSAR is not necessary. However, if the main control room atmosphere control system is not within the 102 percent allowance, then a plant-specific justification must be provided.

5.12.3 Standby Gas Treatment System

In Appendix J.2.3.9 of the TPO LTR, GENE discusses that the standby gas treatment system (SGTS) is designed to ensure controlled and filtered release of particulates and halogens from primary and secondary containment to the environment during abnormal and accident situations in order to maintain off-site thyroid doses within the 10 CFR Part 100 limits. The SGTS is sized to maintain the secondary containment at a slight negative pressure. Maintaining this negative pressure serves to prevent unfiltered release of radioactive material from the secondary containment to the environment. GENE states that the capability of the SGTS to maintain this negative pressure is not changed by the proposed power uprate.

GENE also states that the charcoal filter beds are currently evaluated to accommodate potential accident conditions from 102 percent of current rated power. As such, the system remains capable of performing its function adequately for a TPO uprate and the SGTS system need not be addressed in the plant-specific TSAR.

Based on GENE's rationale and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff concludes that the uprated power level operation will have an insignificant impact on the ability of the SGTS to meet its design objectives. The staff concludes a plant-specific evaluation in the TSAR is not necessary. However, if the current SGTS analysis was performed considering operation at less than 102 percent of CLTP, then a plant-specific justification must be provided.

5.12.4 Post-LOCA Combustible Gas Control

In Appendix J.2.3.10 of the TPO LTR, GENE states that no significant increase in the hydrogen-generation consequences of an accident are postulated because the metal available for the reaction is unchanged. Further, the increase in hydrogen production due to radiolytic decomposition is unchanged because the system has been previously evaluated for accident conditions at 102 percent of current licensed power. GENE concludes that with the TPO uprate, there is not a significant effect on the post accident hydrogen control system, and no further evaluation is necessary for the plant-specific TSAR.

Based on GENE's rationale and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees that the uprated power level operation will have an insignificant impact on the ability of the post-LOCA combustible gas control system to meet its design objectives. Accordingly, the staff concludes that a plant-specific evaluation in the TSAR is not necessary.

5.12.5 Main Steam Isolation Valve Leakage Control System

In Table J-2 of Appendix J of the TPO LTR, GENE states that the uprate will have no significant impact for plants with this system. This is because operating pressure is unchanged and valve leakage is unaffected.

Based on GENE's rationale and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees that plant operations at the proposed uprated power level will not significantly impact the ability of the main steam isolation valve leakage control system to meet its design objectives. Accordingly, the staff concludes that plant-specific confirmation or evaluation in the TSAR is necessary.

5.12.6 Auxiliary Steam System

In Table J-1 of Appendix J of the TPO LTR, GENE states that the auxiliary steam system is not impacted because it is not directly associated with normal power operation. GENE concludes that no evaluation of auxiliary steam system in the plant-specific TSAR is necessary.

Based on GENE's rationale and NRC experience gained from the review of previous power uprate applications for BWR plants, the staff agrees that plant operations at the proposed uprated power level will not impact the ability of the auxiliary steam system to meet its design objectives. Accordingly, the staff concludes that a plant-specific evaluation in the TSAR is not necessary.

5.12.7 New Fuel Handling and Storage

In Table J-1 of Appendix J of the TPO LTR, GENE states that new fuel handling and storage is not dependent upon reactor power level. GENE concludes that no evaluation of new fuel handling and storage in the plant-specific TSAR is necessary.

Based on GENE's rationale and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees that the uprated power level operation will not impact on the ability of the new fuel handling and storage to meet its design objectives. Accordingly, the staff concludes that a plant-specific evaluation in the TSAR is not necessary.

5.12.8 Instrument and Service Air Systems

In Tables J-1 and J-2 of Appendix J of the TPO LTR, GENE states that the power uprate will have negligible or no impact on the instrument and service air systems because their ability to perform at operational conditions is not dependent on reactor power level. No further evaluations in the plant-specific TSAR are necessary.

Based on GENE's rationale and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees that plant operations at the proposed uprated power level will not impact the ability of the instrument and service air systems to meet their design objectives. Accordingly, the staff concludes that plant-specific evaluations in the TSAR are not necessary.

5.12.9 Power-Dependent Heating, Ventilation and Air Conditioning Systems

GENE states that power-dependent heating, ventilation and air conditioning systems will be addressed on a plant-specific basis. The evaluations will be included in the TSAR.

Based on GENE's determination and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees that a plant-specific review is necessary and will be included in the plant-specific TSAR. Accordingly, the staff will conduct the review on a plant-specific basis.

5.12.10 Turbine Building Heating, Ventilation and Air Conditioning System

In Section 5.11.13 of the TPO LTR, GENE states that a TPO uprate is expected to have a negligible impact on the turbine building heating, ventilation and air conditioning system. This system will be addressed on a plant-specific basis. The evaluation will be included in the TSAR.

Based on GENE's determination and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees that a plant-specific review is necessary and will be included in the plant-specific TSAR. Accordingly, the staff will conduct the review on a plant-specific basis.

5.12.11 Fire Protection System

In Table J-1 of Appendix J of the TPO LTR, GENE states that the fire suppression or detection is not impacted because the ability to detect and suppress a fire is not dependent on reactor power level. No further evaluation in the plant-specific TSAR is necessary.

Based on GENE's rationale and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees that plant operations at the proposed uprated power level will not impact the ability of the fire protection system to meet its design objectives. Accordingly, the staff concludes a plant-specific evaluation in the TSAR is not necessary.

5.12.12 10 CFR Part 50, Appendix J Testing for Containment

In Section 5.11.13 of the TPO LTR, GENE states that the 10 CFR Part 50, Appendix J required testing for containment will not be affected because containment pressure test evaluations already consider 102 percent of current licensed power. No further plant-specific evaluation in the TSAR is needed.

Based on GENE's rationale and NRC experience gained from the review of power uprate applications for previous BWR plants, the staff agrees with GENE's determination. The staff concludes that a plant-specific evaluation in the TSAR is not necessary. However, if the 10 CFR Part 50, Appendix J testing for containment is not performed considering at least 102 percent of CLTP, then a plant-specific justification must be provided.

6.0 CLARIFICATION TO BE ADDED TO THE TPO LTR

The staff had requested that GENE add the following clarifications to Section 4.3, "Mixed Core Evaluations," Section 5.6.7.2, "RCIC System/Isolation Condenser (IC)," and Section 5.8, "Control and Instrumentation," of the TPO LTR. These clarifications will delineate the staff's expectations for the TSAR. By letter dated March 21, 2003, GENE agreed to revise the accepted version of the TPO LTR to reflect the following clarifications to assure that the implementation of this LTR will be consistent with the staff's safety evaluation.

1. The accepted version of the TPO LTR should state that in those cases where a fuel supplier other than GE is involved, the plant-specific submittal will identify the current fuel-dependent licensing basis analyses that were performed at bounding power levels and provide analyses or justifications to support fuel dependent licensing basis analyses performed at nominal conditions. [SE Section 4.3]

2. The accepted version of the TPO LTR should state that the plant-specific submittal should include an evaluation of the RCIC system capability if the level 1 setpoint cannot be avoided as result of the TPO uprate. [SE Section 5.6.7.2]

3. The accepted version of the TPO LTR should state that the plant-specific submittal should include an evaluation of the IC system (if applicable). [SE Section 5.6.7.2]

4. The accepted version of the TPO LTR should state that the plant-specific submittal should include the performance characteristics of the flow monitoring instrumentation. [SE Section 5.8]

5. The accepted version of the TPO LTR should state that the plant-specific submittal should confirm the design and operating conditions for applicable I&C systems and components are consistent with those used for generic TPO evaluations. [SE Section 5.8.1]

6. The accepted version of the TPO LTR should state that the plant-specific submittal will verify that the plant-specific design provides adequate flow margin between the uprated normal operating condition and the TCV's steam flow capability at its maximum stroke. [SE Section 5.8.1]

7.0 APPLICATION OF TPO LTR

Each section of the TPO LTR was in one of three disposition categories:

- Bounded by the CLTP analyses and evaluations
- Generic assessment
- Plant-specific evaluation

The generic assessments are those safety evaluations that can be dispositioned for a group or for all BWR plants by:

- A bounding analysis for the limiting conditions,
- Demonstrating that there is a negligible effect due to TPO, or
- Demonstrating that the required plant cycle-specific reload analyses are sufficient and appropriate for establishing the TPO licensing basis.

The staff reviewed each section of the TPO LTR to determine if the proposed resolution was acceptable. Each section of the SE identifies the conditions and limitations imposed on the use of the TPO LTR. To reference the TPO LTR, a plant must either perform a generic assessment or perform a plant-specific evaluation or determine that the existing evaluations or analyses were performed at 102 percent of CLTP as described in the staff's SE.

8.0 CONCLUSION

The staff's evaluation approves operation only as described and acceptably justified in Reference 1. The TPO LTR describes the generic guidelines, evaluations, criteria, process, and scope of work that would be needed to support increasing the licensed thermal power of a particular plant to account for improvements in the thermal power measurement. Thus, the staff concludes that if a licensee's application referencing the TPO LTR commits to the considerations and restrictions described in the staff's SE, the TPO LTR provides a methodology acceptable to the staff for justifying, in part, a power uprate for a particular facility based on improvements in the thermal power measurement.

9.0 REFERENCES

1. GE Nuclear Energy, "Generic Guidelines for General Electric Boiling Water Reactor Thermal Power Optimization," NEDC-32938P, Revision 1, November 2002 [known as the TPO LTR].

2. General Electric Services Information Letter (SIL) No. 636, Revision 1, "Additional Terms included in Reactor Decay Heat Calculations," June 1, 2001.

3. Letter from George Stramback (General Electric Nuclear Energy), to U.S. Nuclear Regulatory Commission, "Responses to Request for Additional Information-GE Nuclear

Energy Licensing Topical Report NEDC-32938P, RAI #’s 1-11, 20,21 and 26" June 6, 2001.

4. Letter from George Stramback (General Electric Nuclear Energy), to U.S. Nuclear Regulatory Commission, "Partial Response to Response to Request for Additional Information-GE Nuclear Energy Licensing Topical Report NEDC-32938P, RAI #’s 12-17 and 22-25," September 21, 2001.

5. Letter from J. F. Klapproth (General Electric Nuclear Energy), to U.S. Nuclear Regulatory Commission, "Final Responses to Request for Additional Information-GE Nuclear Energy Licensing Topical Report NEDC-32938P, RAI #’s 18 &19," October 5, 2001.

6. Letter from George Stramback (General Electric Nuclear Energy), to U.S. Nuclear Regulatory Commission, "Responses to Request for Additional Information (RAI) to Licensing Topical Report NEDC-32938P," August 7, 2002.

7. GE Nuclear Energy, "Generic Guidelines for General Electric Boiling Water Reactor Power Uprate," NEDO-31897, February 1992.

8. GE Nuclear Energy, "Generic Guidelines for General Electric Boiling Water Reactor Extended Power Uprate," NEDO-32424, April 1995.

9. General Electric Nuclear Energy, "Generic Guidelines for General Electric Boiling Water Reactor Extended Power Uprate," NEDC-32424P-A, February 1999 [Known as ELTR1].

10. GE Nuclear Energy, "Generic Evaluations of General Electric Boiling Water Reactor Extended Power Uprate," NEDC-32523P-A, February 2000, Supplement 1, Volume I, February 1999, and Supplement 1, Volume II, April, 1999 [Known as ELTR2].

11. GE Nuclear Energy, "BWR Owners Group Long-term Stability Solution Licensing Methodology," NEDO-31960-A and Supplement 1, April 1996.

12. GE Nuclear Energy, "Assessment of BWR Mitigation of ATWS," NEDO-24222, Volume II, December 1979.

13. Letter from C. O. Thomas (NRC) to J. F. Quirk (General Electric Nuclear Energy), "Acceptance for Referencing of LTR GESTR-LOCA and SAFER Models for Evaluation of LOCA," Section 5, Item 2, June 1, 1984.

Attachment: Proposed Table of Contents

Principle Contributors: Z. Abdullahi, S. V. Athvale, N. Trehan, C. F. Sheng, D. Jackson, C. Wu, S. LaVie, K. Parczewski

Date: April 1, 2003

GENE'S PROPOSED TABLE OF CONTENTS

EXECUTIVE SUMMARY

SE SECTION