May 8, 2007

Technical Specification Task Force (TSTF)
11921 Rockville Pike, Suite 100
Rockville, MD 20852

SUBJECT: DENIAL OF TSTF-478, REVISION 1, "BWR TECHNICAL SPECIFICATION CHANGES THAT IMPLEMENT THE REVISED RULE FOR COMBUSTIBLE GAS CONTROL"

Dear Members of the TSTF,

By letter dated February 21, 2007, the Boiling Water Reactors Owners Group (BWROG) submitted TSTF-478, Revision 1, "BWR Technical Specification Changes that Implement the Revised Rule for Combustible Gas Control." TSTF-478, Revision 0, "BWR Technical Specification Changes that Implement the Revised Rule for Combustible Gas Control" was originally submitted on April 25, 2005, and supplemented by an RAI Response letter dated February 7, 2007. After careful review, the Nuclear Regulatory Commission (NRC) staff has concluded that your request cannot be approved. The basis for this finding is documented in the enclosed Safety Evaluation. As a result of the completion of NRC review associated with TSTF-478, Revision 1, TAC# MC8336 has been formally closed out. Please contact me with any questions or concerns.

Sincerely,

/RA/

Timothy J. Kobetz, Chief
Technical Specifications Branch
Division of Inspections & Regional Support
Office of Nuclear Reactor Regulation

Enclosure:
Safety Evaluation

cc: See next page

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/RA/
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Enclosure:
Safety Evaluation

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SAFETY EVALUATION

U.S. NUCLEAR REGULATORY COMMISSION

OFFICE OF NUCLEAR REACTOR REGULATION

TECHNICAL SPECIFICATION TASK FORCE CHANGE TSTF-478, REVISION1,

"BWR TECHNICAL SPECIFICATION CHANGES THAT IMPLEMENT THE REVISED RULE

FOR COMBUSTIBLE GAS CONTROL"

1.0 INTRODUCTION

By letter dated February 21, 2007 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML070530490), the Boiling Water Reactors Owners Group (BWROG) submitted TSTF-478, Revision 1, "BWR Technical Specification Changes that Implement the Revised Rule for Combustible Gas Control." TSTF-478, Revision 0, "BWR Technical Specification Changes that Implement the Revised Rule for Combustible Gas Control" was originally submitted on April 25, 2005 (ADAMS Accession No. ML051170308). The Nuclear Regulatory Commission (NRC) staff issued a Request for Additional Information (RAI) letter on November 9, 2006 (ADAMS Accession No. ML062770089) and the TSTF provided an RAI Response letter dated February 7, 2007 (ADAMS Accession No. ML070380175).

The proposed changes would:

1. Delete Standard Technical Specification (STS) 3.6.3.3, "Containment Atmosphere Dilution (CAD) System," from NUREG-1433, "General Electric Plants, BWR/4 STS."

2. Revise STS 3.6.3.1, "Drywell Cooling System Fans" in NUREG-1433, "General Electric Plants, BWR/4 STS," to eliminate Required Action B.1. Required Action B.1 requires operators to verify by administrative means that a hydrogen control function is maintained in the primary containment when two required drywell cooling system fans are inoperable.

3. Revise the Bases of STS 3.6.3.2, "Drywell Purge System" in NUREG-1434, "General Electric Plants, BWR/6 STS," to eliminate references to Design Basis Accidents while adding references to Accidents.

4. Revise STS 3.6.3.2, "Primary Containment Oxygen Concentration," Applicability and Actions in NUREG-1433, "General Electric Plants, BWR/4 STS." Revised Actions include extending the Completion Time associated with restoring oxygen concentration to within limit in the primary containment.

5. Revise STS 3.6.3.1, “Primary Containment and Drywell Hydrogen Igniters” in NUREG-1434, “General Electric Plants, BWR/6 STS,” to eliminate Required Action B.1. Required Action B.1 requires operators to verify by administrative means that a hydrogen control function is maintained in the primary containment when two primary containment and drywell hydrogen ignitor divisions are inoperable.

The NRC staff has completed its review and finds that the TSTF did not demonstrate that the above proposed changes (4) and (5) would not result in an unacceptable increased risk to the public health and safety due to the higher probability of a possible primary containment failure during a reactor accident. Therefore, the NRC finds that TSTF-478, Revision 1, “BWR Technical Specification Changes that Implement the Revised Rule for Combustible Gas Control” is unacceptable for approval.

2.0 REGULATORY EVALUATION

Section 50.44, “Combustible Gas Control for Nuclear Power Reactors,” of Title 10 of the Code of Federal Regulations (10 CFR) provides standards for combustible gas control in light-water-cooled power reactors. 10 CFR 50.44 was revised on September 16, 2003 (68 FR 54123), as a result of studies that led to an improved understanding of combustible gas behavior during severe accidents. The studies confirmed that the hydrogen release postulated from a design-basis Loss of Coolant Accident (LOCA) was not risk significant because it was not large enough to lead to early containment failure, and that the risk associated with hydrogen combustion was from beyond design-basis (i.e., severe) accidents. As a result, requirements for maintaining hydrogen control equipment associated with a design-basis LOCA were eliminated from 10 CFR 50.44. Regulatory Guide (RG) 1.7, “Control of Combustible Gas Concentrations in Containment Following a Loss-of-Coolant Accident,” Revision 3, dated March 2007, provides detailed guidance that would be acceptable for implementing 10 CFR 50.44. Also, General Design Criterion (GDC) 41, “Containment Atmosphere Cleanup,” of Appendix A to 10 CFR 50 requires, in part, that systems to control hydrogen, oxygen, and other substances that may be released into the reactor containment shall be provided as necessary to reduce and control the concentration of hydrogen, oxygen, and other substances in the containment atmosphere following postulated accidents to assure that containment integrity is maintained.

10 CFR 50.36(c)(2) states that when a limiting condition for operation of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the technical specifications until the condition can be met. TSTF-478 contained changes to remedial actions permitted by the technical specifications and risk-informed decisionmaking was used by the NRC staff in evaluating many of the proposed changes.

General guidance for evaluating the technical basis of proposed risk-informed changes is provided in Chapter 19 of the NRC Standard Review Plan (SRP) (NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants”). More specific guidance related to risk-informed technical specification (TS) changes is provided in SRP Chapter 16.1, Risk-Informed Decisionmaking: Technical Specifications. SRP Chapter 19 states that a risk-informed application should be evaluated to ensure that the proposed change(s) meet five key safety principles:

1. the proposed change meets the current regulations unless it is explicitly related to a requested exemption or rule change

2. the proposed change is consistent with the defense-in-depth philosophy

3. the proposed change maintains sufficient safety margins

4. when the proposed change increase risks (i.e., core damage frequency (CDF) or large early release frequency (LERF)) the increases should be small and consistent with the intent of the Commission's Safety Goal Policy

5. the impact of the proposed change should be monitored using performance measurement strategies

The quality of the probabilistic risk assessment (PRA) supporting the change must be compatible with the safety implications of the TS change being requested. SRP Section 19.1 provides guidance for determining the technical adequacy of PRA results for risk-informed activities.

RG 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," and RG 1.177, "An Approach for Plant-Specific, Risk-Informed Decisionmaking: Technical Specifications," provide specific guidance and acceptance guidelines for assessing the impact of licensing basis changes, including proposed permanent TS changes. RG 1.177 provides additional acceptance guidelines for evaluating the risk associated with revised allowed outage times (AOTs).

The NRC staff also considered the guidance in NRR Office Instruction COM-111, "Managing the Interfaces Between Safety, Security, and Emergency Preparedness," since several of the proposed TS changes impact the hydrogen control function, for which plant improvements are currently under consideration as part of the resolution of Generic Safety Issue 189 (GSI-189), "Susceptibility of Ice Condenser and Mark III Containments to Early Failure from Hydrogen Combustion During a Severe Accident," and post-9/11 security assessments.

2.1 Containment Atmosphere Dilution System

The original purpose of the CAD system was to maintain combustible gas concentrations within the primary containment at or below the flammability limits following a postulated LOCA by diluting hydrogen and oxygen with nitrogen. The CAD system is considered ineffective at mitigating hydrogen releases from the more risk significant beyond design-basis accidents that could threaten primary containment integrity. The revised 10 CFR 50.44 rule requires systems and measures be in place to reduce the risks associated with hydrogen combustion from beyond design-basis accidents and eliminates requirements for maintaining hydrogen control equipment associated with a design-basis LOCA. As a result, the CAD system is no longer required to be maintained per the revised 10 CFR 50.44 rule. STS 3.6.3.3, "Containment Atmosphere Dilution (CAD) System," in NUREG-1433, "General Electric Plants, BWR/4 STS," can therefore be deleted, and the technical basis for allowing the deletion is found in Section 3.0, Technical Evaluation.

2.2 Drywell Cooling System Fans

10 CFR 50.44 requires that all primary containments must have a capability for ensuring a mixed atmosphere. The purpose of the Drywell Cooling System Fans is to ensure a uniformly mixed post accident primary containment atmosphere. STS 3.6.3.1, "Drywell Cooling System Fans" in NUREG-1433, "General Electric Plants, BWR/4 STS," implements the requirements of 10 CFR 50.44. The proposed change modifies the Required Actions that operators take when the Drywell Cooling System Fans are inoperable. 10 CFR 50.36(c)(2) states that when a limiting condition for operation of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the technical specifications until the condition can be met. Therefore, the Remedial Actions and associated allowed Completion Times when Drywell Cooling System Fans are inoperable may be revised as permitted by 10 CFR 50.36(c)(2). The technical basis for allowing the revision to the Required Actions in STS 3.6.3.1, "Drywell Cooling System Fans," is found in Section 3.0, Technical Evaluation.

2.3 Drywell Purge System

10 CFR 50.44 requires that all primary containments must have a capability for ensuring a mixed atmosphere. The purpose of the Drywell Purge System is to ensure a uniformly mixed post accident primary containment atmosphere. The proposed Bases change reflects the revised 10 CFR 50.44 rule by eliminating any references to Design Basis Accidents while adding references to Accidents. The technical basis for allowing the revision to the Bases section of STS 3.6.3.2, "Drywell Purge System," is found in Section 3.0, Technical Evaluation.

2.4 Primary Containment Oxygen Concentration

10 CFR 50.44 requires systems and measures be in place to reduce the risks associated with hydrogen combustion from beyond design-basis accidents. The purpose of maintaining an oxygen concentration less than 4.0 volume percent in Mark I and II primary containments is to render them inert to combustion during an accident. STS 3.6.3.2, "Primary Containment Oxygen Concentration," in NUREG-1433, "General Electric Plants, BWR/4 STS," implements the requirements of 10 CFR 50.44. Proposed changes include modifications to the Modes of Applicability, Required Actions, and Completion Times. One proposed change is to modify the Completion Time operators have to restore oxygen concentration to less than 4.0 volume percent if the primary containment oxygen concentration is not within limit. 10 CFR 50.36(c)(2) states that when a limiting condition for operation of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the technical specifications until the condition can be met. Therefore, the Remedial Actions and associated allowed Completion Times when Primary Containment Oxygen Concentration is not within limits may be revised as permitted by 10 CFR 50.36(c)(2). The technical basis for disapproving the revision to the Completion Time in STS 3.6.3.2, "Primary Containment Oxygen Concentration," is found in Section 3.0, Technical Evaluation.

2.5 Primary Containment and Drywell Hydrogen Igniters

10 CFR 50.44 requires systems and measures be in place to reduce the risks associated with hydrogen combustion from beyond design-basis accidents. The purpose of the Primary Containment and Drywell Hydrogen Igniters is to prevent the build up of higher hydrogen concentrations during an accident that could result in a violent reaction if ignited by a random

ignition source. STS 3.6.3.1, “Primary Containment and Drywell Hydrogen Igniters” in NUREG-1434, “General Electric Plants, BWR/6 STS,” implements the requirements of 10 CFR 50.44. The proposed change modifies the Required Actions that operators take when the Primary Containment and Drywell Hydrogen Igniters are inoperable. 10 CFR 50.36(c)(2) states that when a limiting condition for operation of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the technical specifications until the condition can be met. Therefore, the Remedial Actions and associated allowed Completion Times when Primary Containment and Drywell Hydrogen Igniters are inoperable may be revised as permitted by 10 CFR 50.36(c)(2). The technical basis for disapproving the revision to the Required Action in STS 3.6.3.1, “Primary Containment and Drywell Hydrogen Igniters,” is found in Section 3.0, Technical Evaluation.

3.0 TECHNICAL EVALUATION

3.1 Containment Atmosphere Dilution System

BWRs with Mark I containment designs originally either installed hydrogen recombiners or CAD systems to meet requirements for hydrogen control following a design-basis LOCA. The hydrogen recombiners and the CAD system performed similar functions for post-LOCA gas control by decreasing the hydrogen concentration. Hydrogen recombiners functioned to reduce the combustible gas concentration in the primary containment by recombining hydrogen and oxygen to form water vapor. The CAD system’s intended function was to maintain combustible gas concentrations within the primary containment at or below the flammability limits following a postulated LOCA by diluting hydrogen and oxygen with nitrogen.

Studies performed for supporting the 10 CFR 50.44 rule change confirmed that the hydrogen release postulated from a design-basis LOCA was not risk significant because it was not large enough to lead to early containment failure, and that the risk associated with hydrogen combustion was from beyond design-basis (i.e., severe) accidents. As a result, the revised 10 CFR 50.44 rule eliminates requirements for maintaining hydrogen control equipment associated with a design-basis LOCA and requires systems and measures be in place to reduce the risks associated with hydrogen combustion from beyond design-basis accidents.

In addition, in a core degradation scenario that generates significant hydrogen, use of the CAD system can be detrimental to event mitigation as it may overpressurize the containment, forcing containment venting that would otherwise not be warranted.

Since the CAD system’s original intended function was to maintain combustible gas concentrations within the primary containment at or below the flammability limits following a LOCA, and is considered ineffective at mitigating hydrogen releases from the more risk significant beyond design-basis accidents that could threaten primary containment integrity, the staff finds that the deletion of STS 3.6.3.3, “Containment Atmosphere Dilution (CAD) System,” from NUREG-1433, “General Electric Plants, BWR/4 STS is acceptable.

3.2 Drywell Cooling System Fans

The purpose of the Drywell Cooling System Fans is to ensure a uniformly mixed post accident primary containment atmosphere. TSTF-478, Revision 1, proposes to eliminate Required Action B.1 in STS 3.6.3.1, “Drywell Cooling System Fans” in NUREG-1433, “General Electric

Plants, BWR/4 STS." Required Action B.1 requires operators to verify by administrative means that a hydrogen control function is maintained in the primary containment when two required Drywell Cooling System Fans are inoperable. The Completion Time for Required Action B.1 was within 1 hour and once per 12 hours thereafter. As a result of the proposed revision, the only actions operators would be required to take when two required Drywell Cooling System Fans are inoperable is to restore one required Drywell Cooling System Fan to operable status within 7 days.

Neither NUREG-1150, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants," nor the technical analyses in support of the risk-informed changes to 10 CFR 50.44, credit the drywell fans in a beyond design-basis (i.e., severe) accident because they are deemed ineffective in preventing a challenge to containment due to combustible gas accumulation in a deinerted containment. Because of the inerted nature of Mark I and II containments, the risk significance of keeping the atmosphere mixed to prevent hydrogen combustion is low. The drywell cooling fans isolate on a high drywell pressure signal, and within the BWROG Emergency Procedure and Severe Accident Guidelines their use is limited to dealing with high drywell temperatures. As a result, the NRC staff finds that the proposed revision to STS 3.6.3.1, "Drywell Cooling System Fans," is acceptable, since the impact of having two required Drywell Cooling System Fans inoperable for 7 days will only have a negligible impact on risk.

3.3 Drywell Purge System

The purpose of the Drywell Purge System is to ensure a uniformly mixed post accident primary containment atmosphere by reducing the hydrogen concentration in the drywell. TSTF-478, Revision 1, modifies the Bases of STS 3.6.3.2, "Drywell Purge System" in NUREG-1434, "General Electric Plants, BWR/6 STS," to eliminate references to Design Basis Accidents while adding references to Accidents. The proposed change is editorial in nature in that it revises the Bases of STS 3.6.3.2 to reflect the revised 10 CFR 50.44 rule. As a result, the NRC staff finds that the proposed revision to STS 3.6.3.2, "Drywell Purge System," is acceptable.

3.4 Primary Containment Oxygen Concentration Specification

The purpose of maintaining an oxygen concentration less than 4.0 volume percent in Mark I and II primary containments is to render them inert to combustion during an accident. The current Mode of Applicability of STS 3.6.3.2, "Primary Containment Oxygen Concentration," in NUREG-1433, "General Electric Plants, BWR/4 STS," requires that the primary oxygen concentration shall be less than 4.0 volume percent in Mark I and II containments in Mode 1 during the time period from 24 hours after Thermal Power is greater than 15% Rated Thermal Power (RTP) following startup to 24 hours prior to reducing Thermal Power to less than 15% RTP prior to the next scheduled reactor shutdown. The Mode of Applicability is revised in TSTF-478, Revision 1, to state that the LCO is applicable in Mode 1, and is therefore more restrictive than the current Applicability statement. Since the revision to the STS 3.6.3.2 Mode of Applicability is more restrictive (i.e., more conservative) than what is currently allowed, the Mode of Applicability change is considered acceptable by the NRC staff.

Current STS 3.6.3.2, Required Action B.1 states to reduce Thermal Power to less than (or equal to) 15% RTP within 8 hours if Required Action A.1 (restore oxygen concentration to within limits) cannot be completed within the stated Completion Time. Required Action B.1 is revised

in TSTF-478, Revision 1 to require operators to be in Mode 2 within 8 hours if Required Action A.1 (restore oxygen concentration to within limits) cannot be completed within the stated Completion Time. The revision to Required Action B.1 is also more restrictive than the current Required Action. Since the revision to STS 3.6.3.2, Required Action B.1 is more restrictive (i.e., more conservative) than what is currently allowed, the revision to Required Action B.1 is considered acceptable by the NRC staff.

Current STS 3.6.2, Action A, requires operators to restore the oxygen concentration to less than 4.0 volume percent within 24 hours if the primary containment oxygen concentration is not within limits. TSTF-478, Revision 1, extends the current Completion Time of 24 hours to a proposed 72 hours. Based on a scoping assessment performed by the NRC staff, the ΔLERF for the proposed extension would exceed the 1E-7 per year value associated with a "very small change" in RG 1.174. Therefore, the NRC staff issued an RAI requesting that the TSTF provide an assessment of the approximate level of the risk increase associated with extending the completion time from 24 hours to 72 hours. The NRC staff noted that this assessment should address: the likelihood of either an internally-initiated or an externally-initiated core damage event occurring during the additional 96 hour period (i.e., 48 additional hours during startup and 48 additional hours during shutdown), the potentially higher CDF associated with transition risk during startup and shutdown, when the containment might be deinerted, and the increase in the conditional containment failure probability (CCFP) for a deinerted containment (essentially 1.0) versus an inerted containment.

The RAI response indicated an approximate ΔLERF of 2.2E-7 per year based on consideration of internal and external events, and a more refined ΔLERF estimate of 7.8E-8 per year based on removing from consideration sequences that either have sufficiently long warning times that evacuation would be completed prior to release, or already lead to a large early release. However, the risk assessment appears to have underestimated the risk increase in two regards. First, the TSTF assumed that the current TS results in 90 hours of deinerted operation per year compared to 144 hours of deinerted operation per year for the proposed time limit (i.e., an additional 54 hours of deinerted operation with the proposed limit). The 90 hours represents operational history when plants had more frequent startup and shutdowns due to shorter operational cycles (12 or 18 months versus 24 months) and more forced shutdowns. The 90 hours equates roughly to one refueling outage shutdown and startup, and one or two forced outage shutdowns and startups per year. When the current and proposed time limits are compared on an equivalent basis, representing anticipated future operations, the additional hours of deinerted operation with the proposed limit is substantially greater than represented in the RAI response. In the NRC staff's view the proposed limit could result in an increase in the time of deinerted operation of approximately 108 hours per year (assuming one refueling outage every 2 years and one forced outage per year.) Based on NRC staff estimates, this would result in a ΔLERF of 1.6E-7 per year, rather than 7.8E-8 per year reported in the RAI response. The corresponding Incremental Conditional Large Early Release Probability (ICLERP), based on scoping estimates of CDF and CCFP, would be about 2.1E-7, which exceeds the acceptance guideline of 5E-8 provided in RG 1.177 for a single TS AOT change.

Second, in refining their risk estimate, the TSTF removed from consideration those sequences that either have sufficiently long warning times that evacuation would be completed prior to release (i.e., loss of decay heat removal sequences and long term station blackout sequences) or already lead to a large early release. Based on the former assumption, 66 percent of internal event CDF and 65 percent of the fire CDF was eliminated from consideration. Based on the

latter assumption, 63 percent of the seismic CDF was eliminated from consideration. The NRC staff notes that removal of sequences that already lead to a large early release is a legitimate adjustment, but removing events on the basis of a long warning time is not justified without a more detailed consideration of event timing, including specific consideration of the time to reach a General Emergency, the delay in initiating and completing an evacuation, and the time to fission product release. Moreover, removing events on the basis of a long warning time ignores the impact that a combustion event might have on late containment failure. In assessing the impact of a proposed change on defense-in-depth, the impact on both early failure and late failure of the containment barrier should be considered. If sequences with long warning times are not eliminated, the NRC staff estimates that the proposed change would result in a ΔLERF of about 4E-7 per year in contrast to the previously cited NRC staff values, and an ICLERP of about 5E-7 based on scoping estimates of CDF and CCFP. Although exceeding the acceptance guidelines in RG 1.177, the risk increase is not so large as to call into question the presumption of adequate protection of public health and safety.

Several additional issues concerning the TSTF calculations are important to note:

- The aforementioned TSTF (and NRC) estimates of CDF, LERF, and ICLERP are based on mean values for a sample of BWR plants, rather than on the most limiting plant within the population of affected plants. For example, in determining the LERF for internal events, the sample used by the TSTF included 5 of the 23 domestic operating BWRs with Mark I containments, and 2 of the 5 domestic operating BWRs with Mark II containments. In determining the external event CDF (and LERF), an average of the BWR plant values reported in NUREG-1742 was used. Thus, while the aforementioned risk results may be representative of a typical plant, they would underestimate the risk impact at some plants and overestimate the impacts at other plants within the plant population. The risk impacts for the most limiting plants within the population could be substantially underestimated due to the large variation of internal and external event CDF and containment performance modeling assumptions within the population of plants.

- The plant-specific PRAs used by the TSTF to establish the representative internal events CDF and LERF estimates were not specified and information regarding the technical quality of these PRAs for this application was not provided. Such information would include peer review findings in areas related to the requested changes, the resolution of these findings, and the impact of unresolved peer review findings. Thus, the NRC staff is unable to reach a conclusion regarding the technical quality and defensibility of the TSTF risk estimates.

- Mark I and II containments are particularly vulnerable to hydrogen combustion events given their small volumes and large zirconium inventory. As such, a core damage event that occurs while the containment is deinerted would likely lead to a failure of multiple barriers (i.e., the core and the containment). An extension of the period of time that the plant could operate with the containment deinerted essentially translates into an increased time window in which the containment barrier would be unavailable in a core damage event. This is an important consideration when assessing the impact of the requested changes on

defense-in-depth, which is one of the five key safety principles in SRP Chapter 19 and RG 1.174. The previous risk estimates account for internal and external events, as typically reflected in PRA, but do not account for the contribution to CDF and LERF from security events. From a quantitative perspective, inclusion of security events within the assessment, if feasible, would increase the estimated risk impacts. However, the magnitude of this contribution would be highly speculative given the large uncertainties related to security events and the general inability to treat these types of threats quantitatively in a PRA. From a qualitative perspective, the time that a plant is permitted to operate with the containment barrier essentially compromised should be minimized, and permitted to increase only if a compelling safety case is made. In the NRC staff's view, the rationale provided by the TSTF for extending the period of deinerted operation is not compelling and is based more on operational convenience than on safety considerations.

Based on the information contained in the TSTF-478, Revision 1, submittal and the RAI response, the NRC staff concludes that the TSTF has provided insufficient rationale and justification for extending the allowable time for deinerted operations to 72 hours and that alternatives that can achieve the TSTF's objectives with smaller risk impacts should be considered.

3.5 Primary Containment and Drywell Hydrogen Igniters

The purpose of the Primary Containment and Drywell Hydrogen Igniters is to prevent the build up of higher hydrogen concentrations during a beyond design-basis (i.e., severe) accident that could result in a violent reaction if ignited by a random ignition source. TSTF-478, Revision 1, proposes to eliminate Required Action B.1 in STS 3.6.3.1, "Primary Containment and Drywell Hydrogen Igniters" in NUREG-1434, "General Electric Plants, BWR/6 STS." Required Action B.1 requires operators to verify by administrative means that a hydrogen control function is maintained in the primary containment when two primary containment and drywell hydrogen igniter divisions are inoperable. The Completion Time for Required Action B.1 was within 1 hour and once per 12 hours thereafter. As a result of the proposed revision, the only actions operators would be required to take when two primary containment and drywell hydrogen igniter divisions are inoperable is to restore one primary containment and drywell hydrogen igniter division to operable status within 7 days.

Prior to the revised 10 CFR 50.44 rule change, given a failure of a primary containment and drywell hydrogen ignitors division (in Mark III containments), the alternate hydrogen control capabilities were considered to be the hydrogen recombiners and possibly the actions taken in response to the plant-specific Severe Accident Management Guidelines. The TSTF rationale for deleting Required Action B.1 is that (1) the TS Bases only require the verification for the Design Basis Accident (DBA) function, and do not require verification of an alternate severe accident mitigation design features and (2) consistent with the basis for the changes to 10 CFR 50.44, the probability of the occurrence of an accident that would generate hydrogen in the amounts capable of exceeding the flammability limit is low during the 7-day period of system unavailability.

TSTF-478, Revision 1, did not include an evaluation of the risk impacts associated with the requested changes. Accordingly, the NRC staff requested additional information to assess the risk implications of the requested changes. This information requested included:

- An assessment of the approximate level of the risk increase associated with extending the completion time for restoring a primary containment and drywell hydrogen ignitor division to 7 days, when all divisions are inoperable, including consideration of both internally and externally-initiated events.

- A more detailed description of the severe accident management strategies for controlling hydrogen concentrations and lowering containment pressure and the associated equipment/systems on which these actions would rely.

The TSTF provided an assessment of effectively extending, from 12 hours to 7 days, the time that the hydrogen control function in Mark III containments (i.e., both divisions of hydrogen ignitors) can be inoperable before requiring a shutdown. The response to the RAI indicated an ICLERP of 8.36E-9 considering all internal events, and an ICLERP of 3.8E-8 considering internal and external events that do not involve loss of decay heat removal or long-term station blackout.

In the NRC staff's view, the risk assessment appears to have underestimated the risk increase associated with this change by eliminating all loss of decay heat removal and long-term station blackout sequences from consideration, and by assigning an optimistic CCFP for the remaining sequences. The NRC staff notes that while elimination of some loss of decay heat removal and long-term station blackout sequences may be justified, elimination of all such sequences is not justified without a more detailed consideration of event timing, including specific consideration of the time to reach a General Emergency, the delay in initiating and completing an evacuation, and the time to fission product release. However, even if all sequences involving loss of decay heat removal or long-term station blackout are eliminated, use of a CCFP of 1.0 for core damage events in which ignitors are inoperable (as suggested in the regulatory analysis for Mark III containments performed in support of GSI-189), together with scoping values for CDF and baseline LERF would result in an ICLERP of about 2E-7. This exceeds the acceptance guideline of 5E-8 provided in RG 1.177 for a single TS AOT change. Although exceeding the acceptance guidelines in RG 1.177, the risk increase is not so large as to call into question the presumption of adequate protection of public health and safety.

Several additional issues concerning the TSTF calculations are important to note:

- The aforementioned TSTF (and NRC) estimates of CDF, LERF, and ICLERP are based on mean values for a sample of BWR plants, rather than on the most limiting plant within the population of affected plants. Thus, while the aforementioned risk results may be representative of a typical plant, they would underestimate the risk impact at some plants and overestimate the impacts at other plants within the plant population. The risk impacts for the most limiting plants within the population could be substantially underestimated due to the large variation of internal and external event CDF and containment performance modeling assumptions within the population of plants.

- The plant-specific PRA(s) used by the TSTF to establish the representative internal events CDF and LERF estimates were not specified and information regarding the technical quality of these PRAs for this application was not provided. Such information would include peer review findings in areas related to the requested changes, the resolution of these findings, and the impact of unresolved peer review findings. Thus, the NRC staff is unable to reach a conclusion regarding the technical quality and defensibility of the TSTF risk estimates.

- Similar to Mark I and II containments, Mark III containments are particularly vulnerable to hydrogen combustion events. As such, a core damage event that occurs while the hydrogen ignitors are not available would likely lead to a failure of multiple barriers (i.e., the core and the containment). An extension of the period of time that the plant could operate with both divisions of ignitors inoperable essentially translates into an increased time window in which the containment barrier would be unavailable in a core damage event. This is an important consideration when assessing the impact of the requested changes on defense-in-depth, which is one of the five key safety principles in SRP Chapter 19 and RG 1.174. The previous risk estimates account for internal and external events, as typically reflected in a PRA, but do not account for the contribution to CDF and LERF from security events. From a quantitative perspective, inclusion of security events within the assessment, if feasible, would increase the estimated risk impacts. However, the magnitude of this contribution would be highly speculative given the large uncertainties related to security events and the general inability to treat these types of threats quantitatively in a PRA. From a qualitative perspective, the time that a plant is permitted to operate with the containment barrier essentially compromised should be minimized and permitted to increase only if a compelling safety case is made. Additionally, extending the time that ignitors could be inoperable would undercut improvements to ignitor power supplies planned for implementation at Mark III plants as a result of recent security assessments and would compromise the mitigating strategy for security event response.

Based on the information contained in the TSTF-478 submittal and the RAI response, the NRC staff concludes that the TSTF has provided insufficient rationale and justification for extending the allowable time for operation with ignitors inoperable to 7 days and that alternatives that can achieve the TSTF's objectives with smaller risk impacts should be considered.

4.0 CONCLUSION

The NRC staff has completed its review and finds that the following proposed changes requested in TSTF-478, Revision 1, "BWR Technical Specification Changes that Implement the Revised Rule for Combustible Gas Control," would result in an unacceptable increased risk to the public health and safety due to the higher probability of a possible primary containment failure during a reactor accident:

- Revision of STS 3.6.3.2, "Primary Containment Oxygen Concentration," Actions in NUREG-1433, "General Electric Plants, BWR/4 STS," to include extending the

Completion Time associated with restoring oxygen concentration to within limits from 24 hours to 72 hours in Mark I and II primary containments.

- Revision of STS 3.6.3.1, “Primary Containment and Drywell Hydrogen Igniters” in NUREG-1434, “General Electric Plants, BWR/6 STS,” to eliminate Required Action B.1 requiring operators to verify by administrative means that a hydrogen control function is maintained in the primary containment when two primary containment and drywell hydrogen ignitor divisions are inoperable.

Therefore, the NRC finds that TSTF-478, Revision 1, “BWR Technical Specification Changes that Implement the Revised Rule for Combustible Gas Control” is unacceptable for approval.

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