April 25, 2005 TSTF-04-12

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Mr. Jesse L. Funches
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U.S. Nuclear Regulatory Commission
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SUBJECT: Submittal and Request for Fee Waiver for Review of TSTF-478, Revision 0, "BWR Technical Specification Changes that Implement the Revised Rule for Combustible Gas Control"

Dear Sir or Madam:

Enclosed for NRC review is TSTF-478, Revision 0, "BWR Technical Specification Changes that Implement the Revised Rule for Combustible Gas Control." TSTF-478 is a proposed change to the Standard Technical Specifications (NUREG-1433 and NUREG-1434) and a candidate for adoption by licensees under the Consolidated Line Item Improvement Process (CLIIP).

TSTF-478 proposes to delete the Containment Atmosphere Dilution system Specification and makes other changes to the BWR/4 and BWR/6 Standard Technical Specifications to reflect the changes to made to 10 CFR 50.44 in 2003. This Traveler is similar to TSTF-447, Revision 1, "Elimination of Hydrogen Recombiners and Change to Hydrogen and Oxygen Monitors," which was approved by the NRC on September 29, 2003. At the time TSTF-447 was being reviewed, the NRC agreed that the changes in TSTF-478 were also related to the rule change, but the NRC and the TSTF agreed to not pursue these changes that that time in order to not delay the issuance of the 10 CFR 50.44 rule change.

We request that NRC review of TSTF-478 be granted a fee waiver pursuant to the provisions of 10 CFR 170.11. The waiver of review fees for this Traveler would be consistent with the previous related fee waiver. In 2003, the NRC reviewed TSTF-447 under a fee waiver. This Traveler completes the changes to the Standard Technical Specifications begun by TSTF-447 that are necessary to reflect the revision to 10 CFR 50.44. This Traveler meets the exemption requirement in 10 CFR 170.11(a)(1)(iii), in that it is "a means of exchanging information between industry organizations and the NRC for the specific purpose of supporting the NRC's generic regulatory improvements or efforts." In this case, the generic regulatory effort is the NRC's revision to 10 CFR 50.44.

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The Owners Groups have not allocated funding for NRC review of this Traveler. If this change is not granted a fee waiver, please inform us so we may consider whether we wish to pursue or withdraw this change.

Should you have any questions, please do not hesitate to contact us.

Wesley Sparkman (WOG)

Michael Crowthers (BWROG)

Brian Woods (WOG)

Paul Infanger (BWOG)

Enclosure

cc: Thomas H. Boyce, Technical Specifications Section, NRC

Technical Specification Task Force
Improved Standard Technical Specifications Change Traveler

BWR Technical Specification Changes that Implement the Revised Rule for Combustible Gas Control

NUREGs Affected: ☐ 1430 ☐ 1431 ☐ 1432 ☑ 1433 ☑ 1434

Classification: 1) Technical Change   Recommended for CLIIP?: Yes

Correction or Improvement: Improvement   NRC Fee Status: Exempt

Benefit: Retires Equipment

Industry Contact: Mike Crowthers, (610) 774-7766, mhcrowthers@pplweb.com

See attached.

Revision History

OG Revision 0   Revision Status: Closed

Revision Proposed by: BWROG

Revision Description:
Original Issue

Owners Group Review Information

Date Originated by OG: 10-May-04

Owners Group Comments:
(No Comments)

Owners Group Resolution: Superceeded Date: 17-May-04

OG Revision 1   Revision Status: Closed

Revision Proposed by: BWROG

Revision Description:
Complete replacement of Revision 0. Revised title. In addition to the original change to eliminate CAD, added changes to Primary Containment Oxygen Concentration, Primary Containment and Drywell Hydrogen Ignitors, Drywell Cooling System Fans, and Drywell Purge System.

Owners Group Review Information

Date Originated by OG: 12-Aug-04

Owners Group Comments:
(No Comments)

Owners Group Resolution: Approved Date: 06-Oct-04

TSTF Review Information

TSTF Received Date: 06-Oct-04   Date Distributed for Review: 06-Oct-04

OG Review Completed: ☑ BWOG ☑ WOG ☑ CEOG ☑ BWROG

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OG Revision 1 Revision Status: Closed

TSTF Comments:

TSTF approved in principle at the August 25 TSTF meeting. BWROG chairman to provide additional editorial comments. To redistribute to BWROG TSICC for confirmation.

TSTF Resolution: Superceeded Date: 06-Feb-05

OG Revision 2 Revision Status: Active

Revision Proposed by: BWROG

Revision Description:
Various editorial improvements.

Owners Group Review Information

Date Originated by OG: 07-Feb-05

Owners Group Comments:
(No Comments)

Owners Group Resolution: Approved Date: 21-Mar-05

TSTF Review Information

TSTF Received Date: 21-Mar-05 Date Distributed for Review: 21-Mar-05

OG Review Completed: ☑ BWOG ☑ WOG ☑ CEOG ☑ BWROG

TSTF Comments:

(No Comments)

TSTF Resolution: Approved Date: 23-Apr-05

NRC Review Information

NRC Received Date: 25-Apr-05

Affected Technical Specifications

Bkgnd 3.6.3.1 Bases	Drywell Cooling System Fans	NUREG(s)- 1433 Only
S/A 3.6.3.1 Bases	Drywell Cooling System Fans	NUREG(s)- 1433 Only
Appl. 3.6.3.1 Bases	Drywell Cooling System Fans	NUREG(s)- 1433 Only
Ref. 3.6.3.1 Bases	Drywell Cooling System Fans	NUREG(s)- 1433 Only
Action 3.6.3.1.A Bases	Drywell Cooling System Fans	NUREG(s)- 1433 Only

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Action 3.6.3.1.B	Drywell Cooling System Fans	NUREG(s)- 1433 Only
Action 3.6.3.1.B Bases	Drywell Cooling System Fans	NUREG(s)- 1433 Only
Bkgnd 3.6.3.2 Bases	Primary Containment Oxygen Concentration	NUREG(s)- 1433 Only
S/A 3.6.3.2 Bases	Primary Containment Oxygen Concentration	NUREG(s)- 1433 Only
LCO 3.6.3.2 Bases	Primary Containment Oxygen Concentration	NUREG(s)- 1433 Only
Appl. 3.6.3.2	Primary Containment Oxygen Concentration	NUREG(s)- 1433 Only
Appl. 3.6.3.2 Bases	Primary Containment Oxygen Concentration	NUREG(s)- 1433 Only
Action 3.6.3.2	Primary Containment Oxygen Concentration	NUREG(s)- 1433 Only
Action 3.6.3.2 Bases	Primary Containment Oxygen Concentration	NUREG(s)- 1433 Only
Action 3.6.3.2.A	Primary Containment Oxygen Concentration	NUREG(s)- 1433 Only
Action 3.6.3.2.A Bases	Primary Containment Oxygen Concentration	NUREG(s)- 1433 Only
Action 3.6.3.2.B	Primary Containment Oxygen Concentration	NUREG(s)- 1433 Only
Action 3.6.3.2.B Bases	Primary Containment Oxygen Concentration	NUREG(s)- 1433 Only
3.6.3.3	CAD System Change Description: Deleted	NUREG(s)- 1433 Only
3.6.3.3 Bases	CAD System Change Description: Deleted	NUREG(s)- 1433 Only
S/A 3.6.3.1 Bases	Primary Containment and Drywell Hydrogen Ignitors	NUREG(s)- 1434 Only
Appl. 3.6.3.1 Bases	Primary Containment and Drywell Hydrogen Ignitors	NUREG(s)- 1434 Only
Action 3.6.3.1.B	Primary Containment and Drywell Hydrogen Ignitors	NUREG(s)- 1434 Only
Action 3.6.3.1.B Bases	Primary Containment and Drywell Hydrogen Ignitors	NUREG(s)- 1434 Only
Bkgnd 3.6.3.2 Bases	Drywell Purge System	NUREG(s)- 1434 Only
S/A 3.6.3.2 Bases	Drywell Purge System	NUREG(s)- 1434 Only
Appl. 3.6.3.2 Bases	Drywell Purge System	NUREG(s)- 1434 Only
Ref. 3.6.3.2 Bases	Drywell Purge System	NUREG(s)- 1434 Only
Action 3.6.3.2.A Bases	Drywell Purge System	NUREG(s)- 1434 Only
Action 3.6.3.2.B	Drywell Purge System	NUREG(s)- 1434 Only
Action 3.6.3.2.B Bases	Drywell Purge System	NUREG(s)- 1434 Only

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1.0 Description

The Nuclear Regulatory Commission (NRC) has revised 10 CFR 50.44 to amend its standards for combustible gas control in light-water-cooled power reactors. The Commission eliminated the design basis loss of coolant accident (LOCA) hydrogen release from 50.44 and consolidated the requirements for hydrogen and oxygen monitoring to 50.44, while relaxing safety classifications and licensee commitments to certain design and qualification criteria. TSTF-447, Elimination of Hydrogen Recombiners and Change to Hydrogen and Oxygen Monitors, implemented the majority of the Technical Specification (TS) changes resulting from this rule change. Specifically, TSTF-447 provided model changes to permit the NRC to efficiently process amendments to remove requirements for hydrogen recombiners, and hydrogen and oxygen monitors from TS. TSTF-447 was approved for adoption using the Consolidated Line Item Improvement Process (CLIIP) on September 25, 2003, and many Boiling Water Reactor (BWR) units have submitted TS changes to adopt the TSTF.

During the comment period for the 50.44 rule change, the Industry commented that BWRs with Mark I Containment designs either use a Containment Atmospheric Dilution (CAD) System or Hydrogen Recombiners, and that both systems would no longer be required under the revised standards for combustible gas control. However, since the proposed rule change to 50.44 and the associated model safety evaluation did not specifically address elimination of the CAD System specification, the Industry agreed to request elimination of the CAD system separate from TSTF-447.

Subsequently, an additional inconsistency between the revised 50.44 rule and the BWR Improved Standard Technical Specifications (ISTS) was discovered. Namely, BWR/4 Specification 3.6.3.1, Drywell Cooling System Fans, and BWR/6 Specifications 3.6.3.1, Primary Containment and Drywell Hydrogen Igniters, and 3.6.3.2, Drywell Purge System, contain Required Actions to "Verify by administrative means that the hydrogen control function is maintained." The alternate hydrogen control functions (e.g., hydrogen recombiners or CAD systems) are intended to control a design basis LOCA hydrogen release. These functions are eliminated from the TS consistent with the 10 CFR 50.44 rule change that eliminated the design basis hydrogen release. The TS requirements for hydrogen recombiners were previously deleted by TSTF-447 and the CAD system requirements are proposed to be deleted by this Traveler. Therefore, this Traveler corrects the ISTS by eliminating the subject alternate hydrogen control function found acceptable in TSTF-447.

This proposed change also modifies BWR/4 Specification 3.6.3.2, Primary Containment Oxygen Concentration. According to the 50.44 rule change, primary containment oxygen concentration is no longer an initial condition assumed in the accident analysis, but is retained for severe accident mitigation. Therefore, a longer Completion Time, 72 hours vice 24 hours, to establish containment integrity is proposed reflecting the small likelihood of an accident occurring while in the Action.

2.0 Proposed Change

BWR/4 Specification 3.6.3.3, CAD system, and the associated Bases, are deleted from the BWR/4 ISTS. Note that the Specification is deleted and not relocated to licensee control. There are no subsequent specifications which must be renumbered. There are no reference changes required in other specifications due to this deletion.

BWR/4 Specification 3.6.3.1, Drywell Cooling System Fans, and BWR/6 Specifications 3.6.3.1, Primary Containment and Drywell Hydrogen Igniters, and 3.6.3.2, Drywell Purge System, are revised to eliminate Required Action B.1. Subsequent Required Actions are renumbered. The Bases are revised to reflect this change and other changes required by the 50.44 rule change.

BWR/4 Specification 3.6.3.2, Primary Containment Oxygen Concentration, is revised. The Applicability and Actions are revised. The Bases are revised to reflect the changes to the Specifications and other changes required by the 50.44 rule change.

3.0 Background

In the revised 10 CFR 50.44 rule, the Commission eliminated the requirements for hydrogen recombiners and hydrogen purge systems, and relaxed the requirements for hydrogen and oxygen monitoring equipment to make them commensurate with their risk significance. Installation of hydrogen recombiners and/or vent and purge systems originally required by 50.44 (b)(3) was intended to address the limited quantity and rate of hydrogen generation that was postulated from a design basis LOCA. In the basis for the rule change, the Commission found that this hydrogen release is not risk significant because the design basis LOCA hydrogen release does not contribute to the conditional probability of a large release up to 24 hours after the onset of core damage. In addition, the Commission found that these systems were ineffective at mitigating hydrogen releases from risk significant accident sequences that could threaten containment integrity.

The Commission noted that the regulatory analysis for the rulemaking found the cost of maintaining the recombiners exceeded the benefits of retaining them to prevent containment failure sequences that progress to the very late time frame. The Commission further noted that the "NRC believes that this conclusion would also be true for the backup hydrogen purge system even though the cost of the hydrogen purge system would be much lower because the system also is needed to inert the containment".

While the rule change was broad in its implications, the TS changes that were approved by the NRC (TSTF-447) in association with the rule change were relatively narrow and only addressed containment gas monitoring instrumentation requirements and the elimination of the hydrogen recombiner TS. Other justifiable TS changes were identified prior to and subsequent to the completion of the rule change. However, revision of the rule change package to address these other issues would have delayed the rule change, so the Industry and the NRC agreed to address the other ISTS changes related to the 50.44 rule change in a separate Traveler.

4.0 Technical Analysis

Elimination of the CAD System

As a result of the requirements originally imposed by 10 CFR 50.44, BWRs with Mark I containment designs either installed hydrogen recombiners or CAD systems to meet requirements for hydrogen control. To ensure that a combustible gas mixture does not occur, oxygen concentration is kept < 5.0 volume percent (v/o), or hydrogen concentration is kept < 4.0 v/o. Hydrogen recombiners work to reduce the combustible gas concentration in the primary containment by recombining hydrogen and oxygen to form water vapor. The CAD System functions to maintain combustible gas concentrations within the primary containment at or below the flammability limits following a postulated loss of coolant accident (LOCA) by diluting hydrogen and oxygen with nitrogen.

The following is an excerpt from the BWR/4 NUREG-1433 containing the TS BASES for BWRs with Mark I Containments who use hydrogen recombiners or CAD systems. By comparing these discussions side by side, it is evident that the two systems accomplish the same function, but accomplish the task via different systems

BWR-4 Hydrogen Recombiner BASES (B 3.6.3.1)	BWR-4 CAD BASES (B 3.6.3.3)
BACKGROUND The primary containment hydrogen recombiner eliminates the potential breach of primary containment due to a hydrogen oxygen reaction and is part of combustible gas control required by 10 CFR 50.44, "Standards for Combustible Gas Control Systems in Light-Water-Cooled Reactors" (Ref. 1), and GDC 41, "Containment Atmosphere Cleanup" (Ref. 2). The primary containment hydrogen recombiner is required to reduce the hydrogen concentration in the primary containment following a loss of coolant accident (LOCA). The primary containment hydrogen recombiner accomplishes this by recombining hydrogen and oxygen to form water vapor. The vapor remains in the primary containment, thus eliminating any discharge to the environment. The primary containment hydrogen recombiner is manually initiated since flammability limits would not be reached until several days after a Design Basis Accident (DBA). The primary containment hydrogen recombiner	BACKGROUND The CAD System functions to maintain combustible gas concentrations within the primary containment at or below the flammability limits following a postulated loss of coolant accident (LOCA) by diluting hydrogen and oxygen with nitrogen. To ensure that a combustible gas mixture does not occur, oxygen concentration is kept < [5.0] volume percent (v/o), or hydrogen concentration is kept < 4.0 v/o. The CAD System is manually initiated and consists of two independent, 100% capacity subsystems. Each subsystem includes a liquid nitrogen supply tank, ambient vaporizer, electric heater, and connected piping to supply the drywell and suppression chamber volumes. The nitrogen storage tanks each contain [4350] gal, which is adequate for [7] days of CAD subsystem operation. The CAD System operates in conjunction with emergency operating procedures that are used

functions to maintain the hydrogen gas concentration within the containment at or below the flammability limit of 4.0 volume percent (v/o) following a postulated LOCA. It is fully redundant and consists of two 100% capacity subsystems. Each primary containment hydrogen recombiner consists of an enclosed blower assembly, heater section, reaction chamber, direct contact water spray gas cooler, water separator, and associated piping, valves, and instruments. The primary containment hydrogen recombiner will be manually initiated from the main control room when the hydrogen gas concentration in the primary containment reaches [3.3] v/o. When the primary containment is inerted (oxygen concentration < 4.0 v/o), the primary containment hydrogen recombiner will only function until the oxygen is used up (2.0 v/o hydrogen combines with 1.0 v/o oxygen). Two recombiners are provided to meet the requirement for redundancy and independence. Each recombiner is powered from a separate Engineered Safety Feature bus and is provided with separate power panel and control panel. The process gas circulating through the heater, the reaction chamber, and the cooler is automatically regulated to [150] scfm by the use of an orifice plate installed in the cooler. The process gas is heated to [1200]_F. The hydrogen and oxygen gases are recombined into water vapor, which is then condensed in the water spray gas cooler by the associated residual heat removal subsystem and discharged with some of the effluent process gas to the suppression chamber. The majority of the cooled, effluent process gas is mixed with the incoming process gas to dilute the incoming gas prior to the mixture entering the heater section.	to reduce primary containment pressure periodically during CAD System operation. This combination results in a feed and bleed approach to maintaining hydrogen and oxygen concentrations below combustible levels.
SAFETY ANALYSIS The primary containment hydrogen recombiner provides the capability of controlling the bulk	SAFETY ANALYSES To evaluate the potential for hydrogen and oxygen accumulation in primary containment

hydrogen concentration in primary containment to less than the lower flammable concentration of 4.0 v/o following a DBA. This control would prevent a primary containment wide hydrogen burn, thus ensuring that pressure and temperature conditions assumed in the analysis are not exceeded. The limiting DBA relative to hydrogen generation is a LOCA. Hydrogen may accumulate in primary containment following a LOCA as a result of either: A metal steam reaction between the zirconium fuel rod cladding and the reactor coolant or Radiolytic decomposition of water in the Reactor Coolant System. To evaluate the potential for hydrogen accumulation in primary containment following a LOCA, the hydrogen generation is calculated as a function of time following the initiation of the accident. Assumptions recommended by Reference 3 are used to maximize the amount of hydrogen calculated. The calculation confirms that when the mitigating systems are actuated in accordance with emergency procedures, the peak hydrogen concentration in the primary containment is < 4.0 v/o (Ref. 4). The primary containment hydrogen recombiners satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii). 3. Regulatory Guide 1.7, Revision [1].	following a LOCA, hydrogen and oxygen generation is calculated (as a function of time following the initiation of the accident). The assumptions stated in Reference 1 are used to maximize the amount of hydrogen and oxygen generated. The calculation confirms that when the mitigating systems are actuated in accordance with emergency operating procedures, the peak oxygen concentration in primary containment is < [5.0] v/o (Ref. 2). Hydrogen and oxygen may accumulate within primary containment following a LOCA as a result of either: A metal water reaction between the zirconium fuel rod cladding and the reactor coolant or Radiolytic decomposition of water in the Reactor Coolant System. The CAD System satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii). 1. Regulatory Guide 1.7, Revision [2].

From the above, it is easily seen that the hydrogen recombiners and CAD system perform the exact same function for post-LOCA gas control. Considering that the 10 CFR 50.44 rule change allowed for elimination of hydrogen recombiners for post-LOCA gas control, it follows directly that the rule change basis would likewise allow for the elimination of CAD systems.

Hence, it is concluded that CAD systems no longer meet the criteria for retention in the TS and may be removed from the plant.

Certain statements in the amended rule may have influenced judgments on the disposition of the CAD system. Statements refer to the "backup purge system" which is not a system used in BWRs with Mark I Containments who have CAD systems. Some BWRs with Mark III Containment designs have a non-safety backup purge system. The backup purge system referred to in the amended rule is believed to be the CAD system; however, the CAD system is not used for purging or for inerting activities. The CAD system is only used for post-accident addition of nitrogen. A totally separate system is used in BWRs for the initial nitrogen inerting of the containment and BWRs who have CAD systems also have a separate system which may be used for purging/controlled venting as part of severe accident management strategies.

In addition, there appear to be judgments in the rule consideration that the cost to maintain the CAD system is not significant. In reality, the cost of maintaining the CAD system is significant at BWRs and exceeds the reported cost of maintaining the recombiners.

As part of the Commission's regulatory analysis for the proposed rulemaking cost and benefit calculations were performed for recombiners. The total benefits calculated are $21,300 which when compared with operating costs led to the conclusion that recombiners could be eliminated to reduce unnecessary regulatory burden. Concerning the "backup hydrogen purge system" (CAD), the regulatory analysis states:

> The issue of eliminating the requirement for safety grade purge/vent systems is not specifically analyzed in this regulatory analysis because the staff believes that the above conclusion would also be true for the backup hydrogen purge system. The cost is expected to exceed the estimated benefit of $21,320 as calculated in Appendix A of this document. In addition, the benefit would not be as great because the hydrogen purge system does not prevent a release.

The regulatory analysis referred to information provided by the BWR Owners' Group topical report NEDO-33033 titled "Regulatory Relaxation for the H2/O2 Monitors and Combustible Gas Control System," July 2001, for annual cost burden for recombiners and monitors. The BWR Owners' report also includes annual cost for maintaining the CAD system. The report notes that the typical yearly cost to maintain a BWR CAD system is approximately $200k. The major costs include:

- Vendor support $15k
- Maintenance, planning, and scheduling $25k
- System and design engineering $80k
- Component replacements and repairs $75k

The above yearly costs when compared to the maximum present worth benefits calculated in the Commission's regulatory analysis would support elimination of the CAD system to reduce unnecessary regulatory burden.

With respect to the potential benefits of maintaining CAD for severe accidents, the BWR Emergency Procedures conclude that use of CAD is of little benefit in responding to most events, due to its limited capacity. In fact, for the likely scenario of a degraded core that generates significant hydrogen, use of CAD can be detrimental to event mitigation as it overpressurizes the containment during containment flooding scenarios, forcing containment venting that would otherwise not be warranted.

From these discussions, it is clear that the change to 10 CFR 50.44 eliminated the basis for considering the CAD system to meet 10 CFR 50.36(c)(2)(ii). The Safety Evaluation reached the same conclusion for the hydrogen recombiner system and allowed that system to be deleted from the TS and allows the equipment to be eliminated from the plant. This Traveler deletes the CAD system from the TS and allows the equipment to be eliminated from the plant.

Elimination of the Required Actions to Verify the Hydrogen Control Function

Mark III containment plants were originally designed with only hydrogen recombiners to control the hydrogen from a DBA (5% cladding reaction). The igniters were added later as a backfit to control hydrogen from a severe accident (75 % cladding reaction). Although the igniters are primarily designed to control hydrogen generated from a severe accident, they can also control the smaller hydrogen buildup from a DBA.

BWR/6 TS 3.6.3.1, Required Action B.1, requires verification that the hydrogen control function is maintained if both igniter divisions are inoperable. The Bases only requires this verification for the DBA design function (i.e., one recombiner and one purge system). It does not require verification of alternate severe accident mitigation design features. Note that a recombiner is not sufficient to control hydrogen from a severe accident.

The 50.44 rule change eliminated the DBA hydrogen control requirements and the recombiner TS requirements. TSTF-447 eliminated the Required Action B.1 Bases statement describing which systems provide the alternate DBA hydrogen control capabilities, but the Action itself was unchanged. BWR/6 TS 3.6.3.1, Required Action B.1, needs to be deleted since the action was related to maintaining an alternate DBA function (i.e., the hydrogen recombiners) which has been eliminated. Alternate methods of managing a severe accident hydrogen release are addressed through the Severe Accident Management Guidelines.

Required Action B.1 of BWR/4 TS 3.6.3.1 and BWR/6 TS 3.6.3.2 requires verification that the hydrogen control function is maintained if both drywell cooling system fans (BWR/4 TS) or both drywell purge systems (BWR/6 TS) were inoperable. This Action may be deleted because, 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 mixing system unavailability.

The Drywell Cooling System fans (BWR/4 TS 3.6.3.1) and Drywell Purge Systems (BWR/6 TS 3.6.3.2) ensure a mixed atmosphere for combustible gas control as required by 10 CFR 50.44 (b)(1). A mixed atmosphere helps prevent localized accumulation of hydrogen following a Design Basis Accident (DBA) LOCA. Localized concentration in amounts exceeding the flammability limits could impact safety related structures or components relied upon to mitigate a DBA. More recent studies have shown, however, that the hydrogen release postulated from a DBA LOCA is not risk significant because it is not large enough to lead to early containment failure. The revised rule effective October 16, 2003, eliminated the design basis LOCA hydrogen release from 10 CFR 50.44, but retained the requirement for all containment types to have the capability for ensuring a mixed atmosphere. Since the DBA LOCA hydrogen release was eliminated from 10 CFR 50.44, the system is not needed to mitigate a design basis accident and therefore no longer satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii). However, the system requirements are retained in accordance with Criterion 4. The Applicable Safety Analysis section of the TS Bases for BWR/4 TS 3.6.3.1 and BWR/6 TS 3.6.3.2 are revised to state that the LCOs meet Criterion 4 instead of Criterion 3.

Changes to the Primary Containment Oxygen Concentration Specification

BWR/4 TS 3.6.3.2, Primary Containment Oxygen Concentration, Bases, Applicable Safety Analysis section, state that the LCO satisfies 10 CFR 50.36(c)(2)(ii) Criterion 2. Criterion 2 is "A process variable, design feature or operational restriction that is an initial condition of a design basis accident or transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier." As noted in the Final Rulemaking for 10 CFR 50.44 (68 FR 54123), a combustible gas mixture is no longer postulated to occur as a result of any design basis accident. Thus, the existing UFSAR accident analyses for evaluating combustible gas mixtures from a design basis LOCA, performed pursuant to Regulatory Guide 1.7, Rev. 2, (or earlier revision, per the individual plant's licensing basis) is no longer required and may be removed from the UFSAR, pursuant to 10 CFR 50.71(e). Therefore, LCO 3.6.3.2 no longer meets the definition of Criterion 2.

The regulatory analysis for the revised 50.44 rule change also concluded that combustible gases produced by severe (i.e., beyond design basis) accidents, involving both fuel-cladding oxidation and core-concrete interaction, would be risk significant for plants with Mark I and II containments if not for the inerted containment atmosphere. Thus, the final rule retains the existing requirement in 50.44(c)(3)(i) to inert Mark I and II type containments. However, given the change in status of being needed for severe accidents and not for DBAs, the Bases are revised to state that the LCO meets Criterion 4. Criterion 4 is "a structure, system, or component which operating experience or probabilistic risk assessment has shown to be significant to public health and safety."

The regulatory analysis performed for the Final Rule change to 10 CFR 50.44 (68 FR 54123), determined that the threat of a hydrogen explosion that threatened containment integrity was sufficiently improbable that it could be removed from the plant's design basis and re-categorized as a "severe accident." Given the low probability of a severe accident occurring while the primary containment oxygen is not within limit, the Traveler proposes to expand the current Completion Time of 24 hours to 72 hours, which is more in keeping with the severe accident determination.

The existing provision of the Applicability to allow the LCO to not be met within 24 hours of startup and shutdown, while originally intended to be a relaxation, often represents an operational hardship, and is not commensurate with the associated plant risk for a condition only associated with severe accidents. Changing the Applicability to remove the 24 hour allowance and instead invoking LCO 3.0.4.c, which allows entering the Mode of Applicability with the

LCO not met while relying on the actions, allows the use of the proposed 72 hour Completion Time instead of the Applicability exclusion. The generic risk evaluation performed for the rulemaking package justifies the LCO 3.0.4.c allowance, which need not be re-performed on a plant specific basis.

Inerting the primary containment is an operational problem because it prevents containment access without an appropriate breathing apparatus. Therefore, the primary containment is permitted to be de-inerted for a short period of time following plant startup to facilitate containment access to perform required inspections during startup. The use of the LCO 3.0.4.c provision will allow the containment to remain de-inerted for up to 72 hours after entry into MODE 1 to permit containment entries to perform inspections or any needed repairs just after startup. It also allows the process of inerting the containment to be performed after the plant has reached steady state conditions, rather than during the plant startup process, when many other activities and Surveillances are being performed. The current provision only allows a delay of up to 24 hours. This short allowance is sometimes not sufficient to prevent the plant from beginning the inerting process, only to have an equipment problem requiring containment entry, necessitating exiting the Mode of Applicability and de-inerting the containment. Such "starting and stopping" is an Operator distraction that is not warranted.

In addition, the Completion Time of 72 hours for Required Action A.1 will allow the containment to be de-inerted earlier in the routine plant shutdown process. This eliminates a complex task from the shutdown process, when many other activities are underway requiring Operator vigilance. The current provision of 24 hours prior to shutdown is a confusing allowance, requiring estimating when the shutdown will be completed, so that the Applicability time limit can be started appropriately. Any interruption in the shutdown process can cause the plant to stop the de-inerting process and re-inert the containment in order to comply with the LCO. Such "starting and stopping" is an Operator distraction that is not warranted.

5.0 Regulatory Analysis

5.1 No Significant Hazards Consideration

The TSTF has evaluated whether or not a significant hazards consideration is involved with the proposed generic change by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No.

   The Containment Atmosphere Dilution (CAD) system and primary containment oxygen concentration are not initiators to any accident previously evaluated. The Required Actions taken when a drywell cooling system fan, two drywell purge subsystems, or when two primary containment and drywell hydrogen igniter divisions are inoperable are not initiators to any accident previously evaluated. As a result, the probability of any accident previously evaluated is not significantly increased. The CAD system, drywell cooling system fans, drywell purge system, and primary containment and drywell hydrogen igniters are used to mitigate the consequences of an accident. However, the revised 10 CFR 50.44 no longer defines a design basis accident (DBA) hydrogen release and the Commission has subsequently found that the DBA loss of coolant accident (LOCA) hydrogen release is not risk significant. In addition, CAD has been determined to be ineffective at mitigating hydrogen releases from the more risk significant beyond design basis accidents that could threaten containment integrity. This is similar to the Staff's conclusion relative to hydrogen recombiners. Therefore, elimination of the CAD system will not significantly increase the consequences of any accident previously evaluated. The consequences of an accident while relying of the revised Required Actions for primary containment oxygen concentration, drywell cooling system fans, drywell purge systems, and primary containment and drywell hydrogen igniters are no different than the consequences of the same accidents under the current Required Actions. As a result, the consequences of any accident previously evaluated is not significantly increased.

Therefore, the proposed changes do not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No.

   No new or different accidents result from utilizing the proposed change. The changes do not involve a physical alteration of the plant (i.e., no new or different type of equipment will be installed) or a change in the methods governing normal plant operation, except for the elimination of the CAD system. The CAD system is not considered an accident precursor, nor does its existence or elimination have any adverse impact on the pre-accident state of the reactor core or post accident confinement of radionuclides within the containment building from any design basis event. In addition, the changes do not impose any new or different requirements. The changes to the Technical Specifications do not alter assumptions made in the safety analysis, but reflect changes to the safety analysis requirements allowed under the revised 10 CFR 50.44. The proposed changes are consistent with the revised safety analysis assumptions.

   Therefore, the proposed changes do not create the possibility of a new or different kind of accident from any previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

   Response: No.

   The Commission has determined that the DBA LOCA hydrogen release is not risk significant and is not required to be assumed in the plant's accident analyses. The proposed changes reflect this new position and, in light of the remaining plant equipment, instrumentation, procedures, and programs that provide effective mitigation of and recovery from reactor accidents, including postulated beyond design basis events, does not result in a significant reduction in a margin of safety.

Therefore, the proposed changes do not involve a significant reduction in a margin of safety.

Based on the above, the TSTF concludes that the proposed change presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

5.2 Applicable Regulatory Requirements/Criteria

The proposed changes revise the ISTS to reflect changes in the applicable regulatory requirements and criteria in 10 CFR 50.44.

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

6.0 Environmental Consideration

A review has determined that the proposed change would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed change does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed change meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed change.

7.0 References

1. Notice of Proposed Rulemaking, Federal Register: August 2, 2002 (Volume 67, Number 149), Proposed Rules, Page 50374-50383, Combustible Gas Control in Containment.

2. Final Rule, Federal Register: 68 FR 54141 (Volume 67, Number 149), September 16, 2003, Combustible Gas Control in Containment.

3. Letter from Thomas H. Boyce (NRC) to Technical Specification Task Force dated October 1, 2003, approving TSTF-447, Revision 1, "Elimination of Hydrogen Recombiners and Change to Hydrogen and Oxygen Monitors."

INSERT 1

The [Drywell Cooling System fans] ensure a mixed atmosphere for combustible gas control as required by 10 CFR 50.44 (b)(1). The [Drywell Cooling System fans] were originally designed to help mitigate the potential consequences of hydrogen generation following a Design Basis Accident (DBA) loss of coolant accident (LOCA). However, more recent studies have shown that the hydrogen release postulated from a DBA LOCA is not risk significant because it is not large enough to lead to early containment failure. The revised rule effective October 16, 2003, eliminated the design basis LOCA hydrogen release from 10 CFR 50.44 but retained the requirement for all containment types to have the capability for ensuring a mixed atmosphere in order to prevent local accumulation of detonable gases that could threaten containment integrity or equipment operating in a local compartment.

INSERT 2

With two primary containment and drywell igniter divisions inoperable, one igniter division must be restored to OPERABLE status within 7 days. In this condition, the ability to prevent an uncontrolled hydrogen ignition is reduced. However, severe accident management strategies employ other methods to control hydrogen concentrations and lower containment pressure to prevent overpressurization of the drywell and containment. In addition, the random ignition sources which could ignite the hydrogen after a buildup could also cause ignitions that help prevent the buildup of detonable hydrogen concentrations. The 7 day Completion Time is based on the low probability of the occurrence of a degraded core event that would generate hydrogen in amounts equivalent to a metal water reaction of 75% of the core cladding and the amount of time available after the event for operator action to prevent hydrogen accumulation or reduce containment pressure.

INSERT 3

The [Drywell Purge System] ensures a mixed atmosphere for combustible gas control as required by 10 CFR 50.44 (b)(1). The [Drywell Purge System] was originally designed to help mitigate the potential consequences of hydrogen generation following a Design Basis Accident (DBA) LOCA. However, more recent studies have shown that the hydrogen release postulated from a DBA LOCA is not risk significant because it is not large enough to lead to early containment failure. The revised rule effective October 16, 2003, eliminated the design basis LOCA hydrogen release from 10 CFR 50.44, but retained the requirement for all containment types to have the capability for ensuring a mixed atmosphere in order to prevent local accumulation of detonable gases that could threaten containment integrity or equipment operating in a local compartment.

3.6 CONTAINMENT SYSTEMS

3.6.3.1 [Drywell Cooling System Fans]

LCO 3.6.3.1 Two [drywell cooling system fans] shall be OPERABLE.

APPLICABILITY: MODES 1 and 2.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One [required] [drywell cooling system fan] inoperable.	A.1 Restore [required] [drywell cooling system fan] to OPERABLE status.	30 days
B. Two [required] [drywell cooling system fans] inoperable.	B.1 Verify by administrative means that the hydrogen control function is maintained. AND	1 hour AND Once per 12 hours thereafter
	B.2 Restore one [required] [drywell cooling system fan] to OPERABLE status.	7 days
C. Required Action and associated Completion Time not met.	C.1 Be in MODE 3.	12 hours

B 3.6 CONTAINMENT SYSTEMS

B 3.6.3.1 [Drywell Cooling System Fans]

BASES

BACKGROUND

The [Drywell Cooling System fans] ensure a uniformly mixed post accident primary containment atmosphere, thereby minimizing the potential for local hydrogen burns due to a pocket of hydrogen above the flammable concentration.

The [Drywell Cooling System fans] are an Engineered Safety Feature and are designed to withstand a loss of coolant accident (LOCA) in post accident environments without loss of function. The system has two independent subsystems consisting of fans, fan coil units, motors, controls, and ducting. Each subsystem is sized to circulate [500] scfm. The [Drywell Cooling System fans] employ both forced circulation and natural circulation to ensure the proper mixing of hydrogen in primary containment. The recirculation fans provide the forced circulation to mix hydrogen while the fan coils provide the natural circulation by increasing the density through the cooling of the hot gases at the top of the drywell causing the cooled gases to gravitate to the bottom of the drywell. The two subsystems are initiated manually since flammability limits would not be reached until several days after a LOCA. Each subsystem is powered from a separate emergency power supply. Since each subsystem can provide 100% of the mixing requirements, the system will provide its design function with a worst case single active failure.

an accident

The [Drywell Cooling System fans] use the Drywell Cooling System recirculating fans to mix the drywell atmosphere. The fan coil units and recirculation fans are automatically disengaged during a LOCA but may be restored to service manually by the operator. In the event of a loss of offsite power, all fan coil units, recirculating fans, and primary containment water chillers are transferred to the emergency diesels. The fan coil units and recirculating fans are started automatically from diesel power upon loss of offsite power.

APPLICABLE SAFETY ANALYSES

Insert 1

The [Drywell Cooling System fans] provide the capability for reducing the local hydrogen concentration to approximately the bulk average concentration following a Design Basis Accident (DBA). The limiting DBA relative to hydrogen generation is a LOCA.

an accident.

Hydrogen may accumulate in primary containment following a LOCA as a result of:

a. A metal steam reaction between the zirconium fuel rod cladding and the reactor coolant or

BASES

APPLICABLE SAFETY ANALYSIS (continued)

b. Radiolytic decomposition of water in the Reactor Coolant System.

To evaluate the potential for hydrogen accumulation in primary containment following a LOCA, the hydrogen generation as a function of time following the initiation of the accident is calculated. Conservative assumptions recommended by Reference 1 are used to maximize the amount of hydrogen calculated.

The Reference 2 calculations show that hydrogen assumed to be released to the drywell within 2 minutes following a DBA LOCA raises drywell hydrogen concentration to over 2.5 volume percent (v/o). Natural circulation phenomena result in a gradient concentration difference of less then 0.5 v/o in the drywell and less than 0.1 v/o in the suppression chamber. Even though this gradient is acceptably small and no credit for mechanical mixing was assumed in the analysis, two [Drywell Cooling System fans] are [required] to be OPERABLE (typically four to six fans are required to keep the drywell cool during operation in MODE 1 or 2) by this LCO.

The [Drywell Cooling System fans] satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).

LCO

Two [Drywell Cooling System fans] must be OPERABLE to ensure operation of at least one fan in the event of a worst case single active failure. Each of these fans must be powered from an independent safety related bus.

Operation with at least one fan provides the capability of controlling the bulk hydrogen concentration in primary containment without exceeding the flammability limit.

APPLICABILITY

In MODES 1 and 2, the two [Drywell Cooling System fans] ensure the capability to prevent localized hydrogen concentrations above the flammability limit of 4.0 v/o in drywell, assuming a worst case single active failure.

In MODE 3, both the hydrogen production rate and the total hydrogen produced after a LOCA would be less than that calculated for the DBA LOCA. Also, because of the limited time in this MODE, the probability of an accident requiring the [Drywell Cooling System fans] is low. Therefore, the [Drywell Cooling System fans] are not required in MODE 3.

BASES

APPLICABILITY (continued)

In MODES 4 and 5, the probability and consequences of a LOCA are reduced due to the pressure and temperature limitations in these MODES. Therefore, the [Drywell Cooling System fans] are not required in these MODES.

ACTIONS

A.1

With one [required] [Drywell Cooling System fan] inoperable, the inoperable fan must be restored to OPERABLE status within 30 days. In this Condition, the remaining OPERABLE fan is adequate to perform the hydrogen mixing function. However, the overall reliability is reduced because a single failure in the OPERABLE fan could result in reduced hydrogen mixing capability. The 30 day Completion Time is based on the availability of the second fan, the low probability of the occurrence of a LOCA that would generate hydrogen in amounts capable of exceeding the flammability limit, the amount of time available after the event for operator action to prevent exceeding this limit, and the availability of the Containment Atmosphere Dilution System.

B.1 and B.2

-----------------------------------REVIEWER'S NOTE-----------------------------------
This Condition is only allowed for units with an alternate hydrogen control system acceptable to the technical staff.

With two [Drywell Cooling System fans] inoperable, the ability to perform the hydrogen control function via alternate capabilities must be verified by administrative means within 1 hour. The alternate hydrogen control capabilities are provided by the [Primary Containment Inerting System or one subsystem of the Containment Atmosphere Dilution System]. The 1 hour Completion Time allows a reasonable period of time to verify that a loss of hydrogen control function does not exist.

-----------------------------------REVIEWER'S NOTE-----------------------------------
The following is to be used if a non-Technical Specification alternate hydrogen control function is used to justify this Condition: In addition, the alternate hydrogen control system capability must be verified once per 12 hours thereafter to ensure its continued availability.

BASES

ACTIONS (continued)

[Both] the [initial] verification [and all subsequent verifications] may be performed as an administrative check by examining logs or other information to determine the availability of the alternate hydrogen control system. It does not mean to perform the Surveillances needed to demonstrate OPERABILITY of the alternate hydrogen control system. If the ability to perform the hydrogen control function is maintained, continued operation is permitted with two [Drywell Cooling System fans] inoperable for up to 7 days. Seven days is a reasonable time to allow two [Drywell Cooling System fans] to be inoperable because the hydrogen control function is maintained and because of the low probability of the occurrence of a LOCA that would generate hydrogen in amounts capable of exceeding the flammability limit.

an accident

and due to post-accident natural circulation forces that promote mixing.

C.1

If any Required Action and associated Completion Time cannot be met, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 12 hours. The allowed Completion Time of 12 hours is reasonable, based on operating experience, to reach MODE 3 from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.6.3.1.1

Operating each [required] [Drywell Cooling System fan] for ≥ 15 minutes ensures that each subsystem is OPERABLE and that all associated controls are functioning properly. It also ensures that blockage, fan or motor failure, or excessive vibration can be detected for corrective action. The 92 day Frequency is consistent with the Inservice Testing Program Frequencies, operating experience, the known reliability of the fan motors and controls, and the two redundant fans available.

BASES

SURVEILLANCE REQUIREMENTS (continued)

[SR 3.6.3.1.2

Verifying that each [required] [Drywell Cooling System fan] flow rate is ≥ [500] scfm ensures that each fan is capable of maintaining localized hydrogen concentrations below the flammability limit. The [18] month Frequency is based on the need to perform this Surveillance under the conditions that apply during a plant outage and the potential for an unplanned transient if the Surveillance were performed with the reactor at power. Operating experience has shown these components usually pass the Surveillance when performed at the [18] month Frequency. Therefore, the Frequency was concluded to be acceptable from a reliability standpoint.]

REFERENCES

1. Regulatory Guide 1.7, Revision [0]. 3
2. FSAR, Section [6.2.5].

-----NOTE-----
LCO 3.0.4.c is applicable.

3.6 CONTAINMENT SYSTEMS

3.6.3.2 Primary Containment Oxygen Concentration

LCO 3.6.3.2 The primary containment oxygen concentration shall be < 4.0 volume percent.

APPLICABILITY: MODE 1 ~~during the time period:~~

~~a. From [24] hours after THERMAL POWER is > [15]% RTP following startup, to~~

~~b. [24] hours prior to reducing THERMAL POWER to < [15]% RTP prior to the next scheduled reactor shutdown.~~

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Primary containment oxygen concentration not within limit.	A.1 Restore oxygen concentration to within limit.	~~24~~ 72 hours
B. Required Action and associated Completion Time not met.	B.1 ~~Reduce THERMAL POWER to ≤ [15]% RTP.~~ Be in MODE 2.	8 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.6.3.2.1	Verify primary containment oxygen concentration is within limits.	7 days

B 3.6 CONTAINMENT SYSTEMS

B 3.6.3.2 Primary Containment Oxygen Concentration

BASES

BACKGROUND

~~All nuclear reactors must be designed to withstand events that generate hydrogen either due to the zirconium metal water reaction in the core or due to radiolysis. The primary method to control hydrogen is to inert the primary containment. With the primary containment inert, that is, oxygen concentration < 4.0 volume percent (v/o), a combustible mixture cannot be present in the primary containment for any hydrogen concentration. An event that rapidly generates hydrogen from zirconium metal water reaction will result in excessive hydrogen in primary containment, but oxygen concentration will remain < 4.0 v/o and no combustion can occur. This LCO ensures that oxygen concentration does not exceed 4.0 v/o during operation in the applicable conditions.~~The Reference 1 Final Rule removed the definition of a design-basis LOCA hydrogen release and eliminated requirements for hydrogen control systems to mitigate such a release at currently-licensed nuclear power plants. However, the supporting analysis for this rulemaking concluded that combustible gases produced by beyond design-basis accidents, involving both fuel-cladding oxidation and core-concrete interaction, would be risk significant for plants with Mark I and II containments if not for the inerted containment atmosphere. Given the relatively small volume and large zirconium inventory, these containments, without inerting, would have a high likelihood of failure from hydrogen combustion due to the potentially large concentration of hydrogen that a severe accident could cause. With the primary containment inert, that is, oxygen concentration < 4.0 volume percent (v/o), a combustible mixture cannot be present in the primary containment for any hydrogen concentration. Thus, the Final Rule required plants with Mark I and II containments to maintain the containment atmosphere with a low concentration of oxygen (i.e., < 4.0 v/o), rendering it inert to combustion.

APPLICABLE SAFETY ANALYSES

The Reference 1 ~~calculations~~ evaluation assumes that the primary containment is inerted when an event with significant core damage occurs. Thus, the hydrogen assumed to be released to the primary containment as a result of degraded core conditions is not likely to produce combustible gas mixtures in the primary containment. ~~inerted when a Design Basis Accident loss of coolant accident occurs. Thus, the hydrogen assumed to be released to the primary containment as a result of degraded core conditions metal water reaction in the reactor core will~~ is ~~not~~ likely to ~~produce combustible gas mixtures in the primary containment.~~

Primary containment oxygen concentration satisfies Criterion ~~2~~ 4 of 10 CFR 50.36(c)(2)(ii), as it provides defense in depth for beyond design basis events that could result in combustible gas mixtures that could threaten containment integrity and lead to offsite radiological releases.

LCO

The primary containment oxygen concentration is maintained < 4.0 v/o to ensure that an a beyond-design basis event that can produces any significant amounts of hydrogen does not result in a combustible mixture inside primary containment.

APPLICABILITY

The primary containment oxygen concentration must be within the specified limit when primary containment is inerted, except as allowed by the relaxations during startup and shutdown NOTE addressed below. The primary containment must be inert in MODE 1, since this is the condition with the highest probability of an event that could produce hydrogen.

~~Inerting the primary containment is an operational problem because it prevents containment access without an appropriate breathing apparatus. Therefore, the primary containment is inerted as late as possible in the plant startup and de-inerted as soon as possible in the plant shutdown. As long as reactor power is < 15% RTP, the potential for an event that generates significant hydrogen is low and the primary containment need not be inert. Furthermore, the probability of an event that generates hydrogen occurring within the first [24] hours of a startup, or within the last [24] hours before a shutdown, is low enough that these "windows," when the primary containment is not inerted, are also justified. The [24] hour time period is a reasonable amount of time to allow plant personnel to perform inerting or de-inerting.~~

BASES

ACTIONS

A Note to the Actions permits the use of the provisions of LCO 3.0.4.c. This allowance permits entry into the Mode of Applicability while relying on the ACTIONS.

A.1

If oxygen concentration is ≥ 4.0 v/o at any time while operating in MODE 1, ~~with the exception of the relaxations allowed during startup and shutdown,~~ oxygen concentration must be restored to < 4.0 v/o within ~~24~~ 72 hours. Intentional entry into the Condition and Required Actions is permitted during the reactor startup and shutdown process. The ~~24~~ 72 hour Completion Time is allowed when oxygen concentration is ≥ 4.0 v/o because of the low probability and long duration of an event that would generate significant amounts of hydrogen occurring during this period.

B.1

If oxygen concentration cannot be restored to within limits within the required Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, power must be reduced MODE 2 ~~to ≤ [15]% RTP~~ within 8 hours. The 8 hour Completion Time is reasonable, based on operating experience, to reduce reactor power from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.6.3.2.1

The primary containment must be determined to be inert by verifying that oxygen concentration is < 4.0 v/o. The 7 day Frequency is based on the slow rate at which oxygen concentration can change and on other indications of abnormal conditions (which would lead to more frequent checking by operators in accordance with plant procedures). Also, this Frequency has been shown to be acceptable through operating experience.

REFERENCES

1. ~~FSAR, Section [6.2.5].~~ Federal Register Notice 68 FR 54123, Combustible Gas Control in Containment, Final Rule, dated September 16, 2003.

3.6 CONTAINMENT SYSTEMS

3.6.3.3 Containment Atmosphere Dilution (CAD) System

LCO 3.6.3.3 Two CAD subsystems shall be OPERABLE.

APPLICABILITY: MODES 1 and 2.

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. One CAD subsystem inoperable.	A.1	Restore CAD subsystem to OPERABLE status.	30 days
B. [Two CAD subsystems inoperable.	B.1	Verify by administrative means that the hydrogen control function is maintained.	1 hour AND Once per 12 hours thereafter
	AND		
	B.2	Restore one CAD subsystem to OPERABLE status.	7 days]
C. Required Action and associated Completion Time not met.	C.1	Be in MODE 3.	12 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.6.3.3.1	Verify ≥ [4350] gal of liquid nitrogen are contained in the CAD System.	31 days
SR 3.6.3.3.2	Verify each CAD subsystem manual, power operated, and automatic valve in the flow path that is not locked, sealed, or otherwise secured in position is in the correct position or can be aligned to the correct position.	31 days

B 3.6 CONTAINMENT SYSTEMS

B 3.6.3.3 Containment Atmosphere Dilution (CAD) System

BASES

BACKGROUND

The CAD System functions to maintain combustible gas concentrations within the primary containment at or below the flammability limits following a postulated loss of coolant accident (LOCA) by diluting hydrogen and oxygen with nitrogen. To ensure that a combustible gas mixture does not occur, oxygen concentration is kept < [5.0] volume percent (v/o), or hydrogen concentration is kept < 4.0 v/o.

The CAD System is manually initiated and consists of two independent, 100% capacity subsystems. Each subsystem includes a liquid nitrogen supply tank, ambient vaporizer, electric heater, and connected piping to supply the drywell and suppression chamber volumes. The nitrogen storage tanks each contain ≥ [4350] gal, which is adequate for [7] days of CAD subsystem operation.

The CAD System operates in conjunction with emergency operating procedures that are used to reduce primary containment pressure periodically during CAD System operation. This combination results in a feed and bleed approach to maintaining hydrogen and oxygen concentrations below combustible levels.

APPLICABLE SAFETY ANALYSES

To evaluate the potential for hydrogen and oxygen accumulation in primary containment following a LOCA, hydrogen and oxygen generation is calculated (as a function of time following the initiation of the accident). The assumptions stated in Reference 1 are used to maximize the amount of hydrogen and oxygen generated. The calculation confirms that when the mitigating systems are actuated in accordance with emergency operating procedures, the peak oxygen concentration in primary containment is < [5.0] v/o (Ref. 2).

Hydrogen and oxygen may accumulate within primary containment following a LOCA as a result of:

a. A metal water reaction between the zirconium fuel rod cladding and the reactor coolant or

b. Radiolytic decomposition of water in the Reactor Coolant System.

The CAD System satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii).

BASES

LCO	Two CAD subsystems must be OPERABLE. This ensures operation of at least one CAD subsystem in the event of a worst case single active failure. Operation of at least one CAD subsystem is designed to maintain primary containment post-LOCA oxygen concentration < 5.0 v/o for 7 days.
APPLICABILITY	In MODES 1 and 2, the CAD System is required to maintain the oxygen concentration within primary containment below the flammability limit of 5.0 v/o following a LOCA. This ensures that the relative leak tightness of primary containment is adequate and prevents damage to safety related equipment and instruments located within primary containment. In MODE 3, both the hydrogen and oxygen production rates and the total amounts produced after a LOCA would be less than those calculated for the Design Basis Accident LOCA. Thus, if the analysis were to be performed starting with a LOCA in MODE 3, the time to reach a flammable concentration would be extended beyond the time conservatively calculated for MODES 1 and 2. The extended time would allow hydrogen removal from the primary containment atmosphere by other means and also allow repair of an inoperable CAD subsystem, if CAD were not available. Therefore, the CAD System is not required to be OPERABLE in MODE 3. In MODES 4 and 5, the probability and consequences of a LOCA are reduced due to the pressure and temperature limitations of these MODES. Therefore, the CAD System is not required to be OPERABLE in MODES 4 and 5.
ACTIONS	<u>A.1</u> If one CAD subsystem is inoperable, it must be restored to OPERABLE status within 30 days. In this Condition, the remaining OPERABLE CAD subsystem is adequate to perform the oxygen control function. However, the overall reliability is reduced because a single failure in the OPERABLE subsystem could result in reduced oxygen control capability. The 30 day Completion Time is based on the low probability of the occurrence of a LOCA that would generate hydrogen and oxygen in amounts capable of exceeding the flammability limit, the amount of time available after the event for operator action to prevent exceeding this limit, and the availability of the OPERABLE CAD subsystem and other hydrogen mitigating systems.

BASES

ACTIONS (continued)

B.1 and B.2

-----REVIEWER'S NOTE-----
This Condition is only allowed for plants with an alternate hydrogen control system acceptable to the technical staff.

With two CAD subsystems inoperable, the ability to perform the hydrogen control function via alternate capabilities must be verified by administrative means within 1 hour. The alternate hydrogen control capabilities are provided by the [Primary Containment Inerting System or one hydrogen recombiner and one Drywell Cooling System fan]. The 1 hour Completion Time allows a reasonable period of time to verify that a loss of hydrogen control function does not exist.

-----REVIEWER'S NOTE-----
The following is to be used if a non-Technical Specification alternate hydrogen control function is used to justify this Condition: In addition, the alternate hydrogen control system capability must be verified once per 12 hours thereafter to ensure its continued availability.

[Both] the [initial] verification [and all subsequent verifications] may be performed as an administrative check by examining logs or other information to determine the availability of the alternate hydrogen control system. It does not mean to perform the Surveillances needed to demonstrate OPERABILITY of the alternate hydrogen control system. If the ability to perform the hydrogen control function is maintained, continued operation is permitted with two CAD subsystems inoperable for up to 7 days. Seven days is a reasonable time to allow two CAD subsystems to be inoperable because the hydrogen control function is maintained and because of the low probability of the occurrence of a LOCA that would generate hydrogen in amounts capable of exceeding the flammability limit.

With two CAD subsystems inoperable, one CAD subsystem must be restored to OPERABLE status within 7 days. The 7 day Completion Time is based on the low probability of the occurrence of a LOCA that would generate hydrogen in the amounts capable of exceeding the flammability limit, the amount of time available after the event for operator action to prevent exceeding this limit, and the availability of other hydrogen mitigating systems.

BASES

ACTIONS (continued)

C.1

If any Required Action cannot be met within the associated Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 12 hours. The allowed Completion Time of 12 hours is reasonable, based on operating experience, to reach MODE 3 from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.6.3.3.1

Verifying that there is ≥ [4350] gal of liquid nitrogen supply in the CAD System will ensure at least [7] days of post-LOCA CAD operation. This minimum volume of liquid nitrogen allows sufficient time after an accident to replenish the nitrogen supply for long term inerting. This is verified every 31 days to ensure that the system is capable of performing its intended function when required. The 31 day Frequency is based on operating experience, which has shown 31 days to be an acceptable period to verify the liquid nitrogen supply and on the availability of other hydrogen mitigating systems.

SR 3.6.3.3.2

Verifying the correct alignment for manual, power operated, and automatic valves in each of the CAD subsystem flow paths provides assurance that the proper flow paths exist for system operation. This SR does not apply to valves that are locked, sealed, or otherwise secured in position, since these valves were verified to be in the correct position prior to locking, sealing, or securing.

A valve is also allowed to be in the nonaccident position provided it can be aligned to the accident position within the time assumed in the accident analysis. This is acceptable because the CAD System is manually initiated. This SR does not apply to valves that cannot be inadvertently misaligned, such as check valves. This SR does not require any testing or valve manipulation; rather, it involves verification that those valves capable of being mispositioned are in the correct position.

BASES

SURVEILLANCE REQUIREMENTS (continued)

The 31 day Frequency is appropriate because the valves are operated under procedural control, improper valve position would only affect a single subsystem, the probability of an event requiring initiation of the system is low, and the system is a manually initiated system.

REFERENCES

1. Regulatory Guide 1.7, Revision [2].

2. FSAR, Section [ ].

3.6 CONTAINMENT SYSTEMS

3.6.3.1 Primary Containment and Drywell Hydrogen Ignitors

LCO 3.6.3.1 Two divisions of primary containment and drywell hydrogen ignitors shall be OPERABLE, each with > 90% of the associated ignitor assemblies OPERABLE.

APPLICABILITY: MODES 1 and 2.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One primary containment and drywell hydrogen ignitor division inoperable.	A.1 Restore primary containment and drywell hydrogen ignitor division to OPERABLE status.	30 days
B. Two primary containment and drywell hydrogen ignitor divisions inoperable.	B.1 Verify by administrative means that the hydrogen control function is maintained. AND	1 hour AND Once per 12 hours thereafter
	B.2 (1) Restore one primary containment and drywell hydrogen ignitor division to OPERABLE status.	7 days
C. Required Action and associated Completion Time not met.	C.1 Be in MODE 3.	12 hours

BASES

APPLICABLE SAFETY ANALYSES	The hydrogen ignitors cause hydrogen in containment to burn in a controlled manner as it accumulates following a degraded core accident (Ref. 3). Burning occurs at the lower flammability concentration, where the resulting temperatures and pressures are relatively benign. Without the system, hydrogen could build up to higher concentrations that could result in a violent reaction if ignited by a random ignition source after such a buildup. The hydrogen ignitors are not included for mitigation of a Design Basis Accident (DBA) because an amount of hydrogen equivalent to that generated from the reaction of 75% of the fuel cladding with water is far in excess of the hydrogen calculated for the limiting DBA loss of coolant accident (LOCA) pursuant to 10 CFR 50.46. ~~The hydrogen concentration resulting from a DBA can be maintained less than the flammability limit using the hydrogen recombiners.~~ However, the hydrogen ignitors have been shown by probabilistic risk analysis to be a significant contributor to limiting the severity of accident sequences that are commonly found to dominate risk for units with Mark III containment. The hydrogen ignitors satisfy Criterion 4 of 10 CFR 50.36(c)(2)(ii).
LCO	Two divisions of primary containment and drywell hydrogen ignitors must be OPERABLE, each with more than 90% of the ignitors OPERABLE. This ensures operation of at least one ignitor division, with adequate coverage of the primary containment and drywell, in the event of a worst case single active failure. This will ensure that the hydrogen concentration remains near 4.0 v/o.
APPLICABILITY	In MODES 1 and 2, the hydrogen ignitor is required to control hydrogen concentration to near the flammability limit of 4.0 v/o following a degraded core event that would generate hydrogen in amounts equivalent to a metal water reaction of 75% of the core cladding. The control of hydrogen concentration prevents overpressurization of the primary containment. The event that could generate hydrogen in quantities sufficiently high enough to exceed the flammability limit is limited to MODES 1 and 2. In MODE 3, both the hydrogen production rate and the total hydrogen produced after a degraded core accident would be less than that calculated for ~~the DBA LOCA~~ an accident in MODE 1 or 2. Also, because of the limited time in this MODE, the probability of an accident requiring the hydrogen ignitor is low. Therefore, the hydrogen ignitor is not required in MODE 3. In MODES 4 and 5, the probability and consequences of a degraded core accident are reduced due to the pressure and temperature limitations. Therefore, the hydrogen ignitors are not required to be OPERABLE in MODES 4 and 5 to control hydrogen.

BASES

ACTIONS

A.1

With one hydrogen ignitor division inoperable, the inoperable division must be restored to OPERABLE status within 30 days. In this Condition, the remaining OPERABLE hydrogen ignitor division is adequate to perform the hydrogen burn function. However, the overall reliability is reduced because a single failure in the OPERABLE subsystem could result in reduced hydrogen control capability. The 30 day Completion Time is based on the low probability of the occurrence of a degraded core event that would generate hydrogen in amounts equivalent to a metal water reaction of 75% of the core cladding, the amount of time available after the event for operator action to prevent hydrogen accumulation from exceeding the flammability limit, and the low probability of failure of the OPERABLE hydrogen ignitor division.

B.1 and B.2

Insert 2

With two primary containment and drywell ignitor divisions inoperable, the ability to perform the hydrogen control function via alternate capabilities must be verified by administrative means within 1 hour. The 1 hour Completion Time allows a reasonable period of time to verify that a loss of hydrogen control function does not exist. The verification may be performed as an administrative check by examining logs or other information to determine the availability of the alternate hydrogen control capabilities. It does not mean to perform the Surveillances needed to demonstrate OPERABILITY of the alternate hydrogen control capabilities. If the ability to perform the hydrogen control function is maintained, continued operation is permitted with two ignitor divisions inoperable for up to 7 days. Seven days is a reasonable time to allow two ignitor divisions to be inoperable because the hydrogen control function is maintained and because of the low probability of the occurrence of a LOCA that would generate hydrogen in the amounts capable of exceeding the flammability limit.

C.1

If any Required Action and required Completion Time cannot be met, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 12 hours. The allowed Completion Time of 12 hours is reasonable, based on operating experience, to reach MODE 3 from full power conditions in an orderly manner and without challenging plant systems.

3.6 CONTAINMENT SYSTEMS

3.6.3.2 [Drywell Purge System]

LCO 3.6.3.2 Two [drywell purge] subsystems shall be OPERABLE.

APPLICABILITY: MODES 1 and 2.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One [drywell purge] subsystem inoperable.	A.1 Restore [drywell purge] subsystem to OPERABLE status.	30 days
B. Two [drywell purge] subsystems inoperable.	B.1 Verify by administrative means that the hydrogen control function is maintained. AND	1 hour AND Once per 12 hours thereafter
	B.2 (1) Restore one [drywell purge] subsystem to OPERABLE status.	7 days
C. Required Action and associated Completion Time not met.	C.1 Be in MODE 3.	12 hours

B 3.6 CONTAINMENT SYSTEMS

B 3.6.3.2 [Drywell Purge System]

BASES

BACKGROUND

The [Drywell Purge System] ensures a uniformly mixed post accident containment atmosphere, thereby minimizing the potential for local hydrogen burns due to a pocket of hydrogen above the flammable concentration.

The [Drywell Purge System] is an Engineered Safety Feature and is designed to operate following a loss of coolant accident (LOCA) in post accident environments without loss of function. The system has two independent subsystems, each consisting of a compressor and associated valves, controls, and piping. Each subsystem is sized to pump [500] scfm. Each subsystem is powered from a separate emergency power supply. Since each subsystem can provide 100% of the mixing requirements, the system will provide its design function with a worst case single active failure.

Following a LOCA, the drywell is immediately pressurized due to the release of steam into the drywell environment. This pressure is relieved by the lowering of the water level within the weir wall, clearing the drywell vents and allowing the mixture of steam and noncondensibles to flow into the primary containment through the suppression pool, removing much of the heat from the steam. The remaining steam in the drywell begins to condense as steam flow from the reactor pressure vessel ceases, the drywell pressure falls rapidly. Both drywell purge compressors start automatically 30 seconds after a LOCA signal is received from the Emergency Core Cooling System instrumentation, but only when drywell pressure has decreased to within approximately [0.087] psi above primary containment pressure. This ensures the blowdown from the drywell to the primary containment is complete. The drywell purge compressors force air from the primary containment into the drywell. Drywell pressure increases until the water level between the weir wall and the drywell is forced down to the first row of suppression pool vents forcing drywell atmosphere back into containment and mixing with containment atmosphere to dilute the hydrogen.

BASES

APPLICABLE SAFETY ANALYSES

The [Drywell Purge System] provides the capability for reducing the drywell hydrogen concentration to approximately the bulk average primary containment concentration following a Design Basis Accident (DBA). The limiting DBA relative to hydrogen generation is a LOCA.

Hydrogen may accumulate in primary containment following a LOCA as a result of:

a. A metal steam reaction between the zirconium fuel rod cladding and the reactor coolant and

b. Radiolytic decomposition of water in the Reactor Coolant System and drywell sump.

To evaluate the potential for hydrogen accumulation in primary containment following a LOCA, the hydrogen generation as a function of time following the initiation of the accident is calculated. Conservative assumptions recommended by Reference 1 are used to maximize the amount of hydrogen calculated.

[Based on a conservative assumption used to calculate the hydrogen concentration versus time after a LOCA, the hydrogen concentration in the primary containment would reach [3.5 v/o about 6 days] after the LOCA and [4.0 v/o about 2 days] later if no hydrogen mixing and recombiner were functioning (Ref. 2).]

The [Drywell Purge System] satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii).

LCO

Two [drywell purge] subsystems must be OPERABLE to ensure operation of at least one primary containment [drywell purge] subsystem in the event of a worst case single active failure. Operation with at least one OPERABLE [drywell purge] subsystem provides the capability of controlling the hydrogen concentration in the drywell without exceeding the flammability limit.

APPLICABILITY

In MODES 1 and 2, the two [drywell purge] subsystems ensure the capability to prevent localized hydrogen concentrations above the flammability limit of 4.0 v/o in the drywell, assuming a worst case single active failure.

In MODE 3, both the hydrogen production rate and the total hydrogen produced after a LOCA would be less than that calculated for the DBA LOCA. Also, because of the limited time in this MODE, the probability of an accident requiring the [Drywell Purge System] is low. Therefore, the [Drywell Purge System] is not required in MODE 3.

BASES

APPLICABILITY (continued)

an accident

In MODES 4 and 5, the probability and consequences of a LOCA are reduced due to the pressure and temperature limitations in these MODES. Therefore, the [Drywell Purge System] is not required in these MODES.

ACTIONS

A.1

With one [drywell purge] subsystem inoperable, the inoperable subsystem must be restored to OPERABLE status within 30 days. In this Condition, the remaining OPERABLE subsystem is adequate to perform the drywell purge function. However, the overall reliability is reduced because a single failure in the OPERABLE subsystem could result in reduced drywell purge capability. The 30 day Completion Time is based on the availability of the second subsystem, the low probability of a LOCA that would generate hydrogen in amounts capable of exceeding the flammability limit, and the amount of time available after the event for operator action to prevent hydrogen accumulation from exceeding this limit.

an accident

B.1 and B.2

-----REVIEWER'S NOTE-----
This Condition is only allowed for units with an alternate hydrogen control system acceptable to the technical staff.

With two [drywell purge] subsystems inoperable, the ability to perform the hydrogen control function via alternate capabilities must be verified by administrative means within 1 hour. The alternate hydrogen control capabilities are provided by [one division of the hydrogen ignitors]. The 1 hour Completion Time allows a reasonable period of time to verify that a loss of hydrogen control function does not exist.

-----REVIEWER'S NOTE-----
The following is to be used if a non-Technical Specification alternate hydrogen control function is used to justify this Condition: In addition, the alternate hydrogen control system capability must be verified once per 12 hours thereafter to ensure its continued availability.

BASES

ACTIONS (continued)

[Both] the [initial] verification may [and all subsequent verifications] may be performed as an administrative check by examining logs or other information to determine the availability of the alternate hydrogen control system. It does not mean to perform the surveillances needed to demonstrate OPERABILITY of the alternate hydrogen control system. If the ability to perform the hydrogen control function is maintained, continued operation is permitted with two [drywell purge] subsystems inoperable for up to 7 days. Seven days is a reasonable time to allow two [drywell purge] subsystems to be inoperable because the hydrogen control function is maintained and because of the low probability of the occurrence of a LOCA that would generate hydrogen in amounts capable of exceeding the flammability limit.

an accident

and due to post-accident natural circulation forces that promote mixing

C.1

If any Required Action and the required Completion Time cannot be met, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 12 hours. The allowed Completion Time of 12 hours is reasonable, based on operating experience, to reach MODE 3 from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.6.3.2.1

Operating each [drywell purge] subsystem for ≥ 15 minutes ensures that each subsystem is OPERABLE and that all associated controls are functioning properly. It also ensures that blockage, compressor failure, or excessive vibration can be detected for corrective action. The 92 day Frequency is consistent with Inservice Testing Program Frequencies, operating experience, the known reliability of the compressor and controls, and the two redundant subsystems available.

[SR 3.6.3.2.2

Verifying that each [drywell purge] subsystem flow rate is ≥ [500] scfm ensures that each subsystem is capable of maintaining drywell hydrogen concentrations below the flammability limit. The 18 month Frequency is based on the need to perform this Surveillance under the conditions that apply during a plant outage and the potential for an unplanned transient if the Surveillance were performed with the reactor at power. Operating experience has shown that these components usually pass the Surveillance when performed at the [18] month Frequency. Therefore, the Frequency was concluded to be acceptable from a reliability standpoint.]

BASES

REFERENCES	1. Regulatory Guide 1.7, Revision [0]. 3
	2. FSAR, Section [6.2.5].