DRAFT RULE LANGUAGE

as of October 26, 2001

The NRC staff has released the following draft rule language in response to guidance from the Commission dated August 2, 2001. The proposal would amend Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50.44, "Standards for combustible gas control system in light-water-cooled power reactors," and associated regulations based on experience gained from a fundamental reevaluation of the need for the regulation, the application of risk insights, and the incorporation of performance-based concepts, to the degree practicable. The proposed changes effectively "rebaselines" the existing regulation for current licensees and consolidates combustible gas control regulations for future applicants and licensees. The changes should reduce the regulatory burden for all applicants and licensees and improve the effectiveness of 10 CFR Part 50.44. The availability of the draft wording is intended to inform stakeholders of the current status of the NRC staffs activities to amend 10 CFR Part 50.44 and to provide stakeholders the opportunity to comment on the draft changes. The staff has also provided additional information within the body of the draft rule language which is bracketed ("[ ]") to facilitate understanding of the staffs intent and the development of guidance for the proposed rule.

This draft rule language was released to inform stakeholders of the current status of the 10 CFR Part 50.44 risk-informed rulemaking and to provide stakeholders with an opportunity to comment on the draft revisions. The draft rule language is preliminary and may be incomplete in one or more respects.

Two petitions for rulemaking have been submitted are related to this rulemaking. One from Mr. Bob Christie of Performance Technology, PRM-50-68, proposes to amend Part 50.44 to change regulations that the petitioner believes are detrimental and present a health risk to the public. The issues raised by Mr. Christie were discussed in SECY-00-0198. The second petition from the Nuclear Energy Institute, PRM-50-71, requests specific wording changes to improve regulatory efficiency by eliminating the need of licensees to obtain specific exemptions to use newer fuel cladding materials. These petitions are available for review on this rulemaking Web site. In SECY-01-0162, the NRC staff communicated to the Commission its recommended approach and discussed issues involving 10 CFR 50.44. The draft rule language reflects the staffs proposed resolution of the issues relating to hydrogen control which are raised in the two petitions for rulemaking.

The staff notes that, as proposed, this revision of 10 CFR 50.44 will be retitled and completely revised. As a result of the draft wording changes, certain technical specifications in the standard technical specifications can be deleted or modified. The staff is also making the draft technical specification changes, ADAMS accession no. ML012990311, associated with the draft wording of 10 CFR 50.44 available for stakeholders comments. The draft changes to NUREGs 1430, 1431, 1432, 1433, and 1434 can be viewed from the preceding link.

§ 50.44 Combustible gas in containment.

(a) *Definitions.*

(1) *Mixed atmosphere* means that the concentration of combustible gases in any part of the containment is below a level that supports combustion or detonation that could cause loss of containment integrity.

(2) *Inerted atmosphere* means a containment atmosphere with less than 4 percent oxygen by volume.

(b) Subsubarticle NE-3220, Division 1, and Subsubarticle CC-3720, Division 2, of Section III of the ASME Boiler and Pressure Vessel Code, referenced in paragraphs (c)(3)(A), (c)(6)(E), and (d)(6)(B) of this section, have been approved for incorporation by reference by the Director of the Office of the Federal Register. A notice of any changes made to the material incorporated by reference will be published in the Federal Register. Copies of the ASME Boiler and Pressure Vessel Code may be purchased from the American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, NY. 10017. It is also available for inspection at the NRC Technical Reference Library, Two White Flint North, Room 2B9, 11545 Rockville Pike, Rockville, MD.

(c) *Requirements for currently-licensed reactors.* Each boiling or pressurized light-water nuclear power reactor with an operating license on [DATE OF RULE] must comply with the following requirements, as applicable:

(1) *Mixed atmosphere.* All containments must have a capability for ensuring a mixed atmosphere.

(2) *Combustible gas control.*

(A) All boiling water reactors with Mark I or Mark II type containments must have an inerted atmosphere.

(B) All boiling water reactors with Mark III type containments and all pressurized water reactors with ice condenser type containments must have the capability for controlling combustible gas generated from a metal-water reaction involving 75% of the fuel cladding surrounding the active fuel region (excluding the cladding surrounding the plenum volume) so that there is no loss of containment structural integrity.

[The requirement of a 75 percent metal-water reaction for the design and analysis of combustible gas control systems is appropriate for degraded core accident sequences where the reactor core remains in-vessel. The 75 percent value is greater than the in-vessel fuel cladding-water reaction estimated to have occurred at TMI-2 (46 FR 62281). The deliberate ignition systems provided to meet this existing hydrogen source term are capable of safely accommodating even greater amounts of hydrogen associated with even more severe core melt sequences

that fail the reactor vessel and involve molten core-concrete interaction. Deliberate ignition systems, if available, generally consume the hydrogen before it reaches concentrations that can be detrimental to containment integrity. The staff is investigating the cost effectiveness of improving the availability of these systems during station blackout sequences as part of GI-189.]

(3) *Post-accident inerting.*

[Note: Two options, the first more prescriptive and the second less prescriptive, are presented below. We invite public comment on the merits of each option and which is preferred.]

[Option 1]

(A) If the combustible gas system relies upon post accident inerting, the containment structure must be capable fo withstanding the increased pressure during the accident, as well as following inadvertent full inerting during normal plant operation These requirements can be met by documenting that, during an accident, Service Level C Limits or the Factored Load Category (as described in paragraph (c)(6)(E) of this section) are not exceeded; and following full inerting during normal operation the Service Level A Limits of Subarticle NE-3220 (for a steel containment) or the Service Load Category of Subarticle CC-3720 (for a concrete containment) are not exceeded. Modest deviations from the criteria in of this section will be considered by the Commission if good cause is shown.

[Option 2]

(A) If the combustible gas control system relies upon post-accident inerting, the containment structure must be capable of withstanding the increased pressure during the accident and following inadvertent full inerting during normal plant operations.

(B) Systems and components required to establish and maintain safe shutdown and containment integrity following inadvertent full inerting during normal plant operations must be designed and qualified for the environment caused by such inerting.

(C) Systems and components needed for safe operation of the plant must not be adversely affected by such inerting.

[This part is currently covered by 50.44(c)(3)(iv)(D). However, the staff is considering eliminating draft paragraph (c)(3)(A)-(C) which are applicable only to post-accident inerting. Post-accident inerting has never been implemented in existing plants. Unless there is a need to retain these requirements, the staff recommends that these requirements be eliminated.

If these requirements are retained, the associated regulatory guide would endorse, for Option 2, ASME Boiler and Pressure Vessel Code, Section III, Division 1, Subsubarticle NE-3220, Service Levels A and C Limits for steel containments, and the Service Load and Factored Load Categories of ASME Boiler and Pressure Vessel Code, Section III, Division 2, Subsubarticle CC-3720 for concrete containments, to demonstrate compliance.]

(4) *Equipment Survivability.* All boiling water reactors with Mark III containments and all pressurized water reactors with ice condenser type containments that do not rely upon an inerted atmosphere inside containment to control combustible gases must be able to establish and maintain safe shutdown and containment structural integrity with systems and components capable of performing their functions during and after exposure to the environmental conditions created by the burning of hydrogen. Environmental conditions caused by local detonations of hydrogen must also be included, unless such detonations can be shown unlikely to occur. The amount of hydrogen to be considered is equivalent to that generated from a metal-water reaction involving 75% of the fuel cladding surrounding the active fuel region (excluding the cladding surrounding the plenum volume).

(5) *Monitoring.*

(A) Equipment shall be provided for monitoring oxygen in containments that use an inerted atmosphere for combustible gas control. Equipment for monitoring oxygen must be functional and reliable for combustible gas control and accident management, including emergency planning.

(B) Equipment shall be provided for monitoring hydrogen in the containment. Equipment for monitoring hydrogen must be functional and reliable for accident management.

[The associated RG would endorse the Category 2 design and qualification criteria of RG 1.97 for monitors designated for indicating system operating status (e.g., oxygen monitors in inerted atmosphere containments). The associated RG would endorse the Category 3 design and qualification criteria of RG 1.97 for monitors used as diagnostic or backup indicators (e.g., hydrogen monitors in Mark I and II, ice condenser and Mark III, and subatmospheric and large, dry containments). Oxygen monitors would remain in the Mark 1 and 2 standard technical specifications but hydrogen monitoring would be removed from all of the standard technical specifications.]

(6) *Analyses.*

Each holder of an operating license for a boiling water reactor with a Mark III type of containment or for a pressurized water reactor with an ice condenser type of containment, shall include in the FSAR an analysis that:

[Licensees are reminded that these analyses should have been included in the FSAR in accordance with the update requirements of 10 CFR 50.71(e)]

(A) provides an evaluation of the consequences of large amounts of hydrogen generated after the start of an accident (hydrogen resulting from the metal-water reaction of up to and including 75% of the fuel cladding surrounding the active fuel region, excluding the cladding surrounding the plenum volume) and include consideration of hydrogen control measures as appropriate;

(B) includes the period of recovery from the degraded condition;

(C) uses accident scenarios that are accepted by the NRC staff. These scenarios must be accompanied by sufficient supporting justification to show that they describe the behavior of the reactor system during and following an accident resulting in a degraded core.

(D) supports the design of the hydrogen control system selected to meet the requirements of this section; and,

(E) demonstrates, for those reactors that do not rely upon an inerted atmosphere to comply with paragraph (b)(2)(B) of this section, that:

[Note: Two options, the first more prescriptive and the second less prescriptive, are presented below. We invite public comment on the merits of each option and which is preferred.]

[Option 1]

(i) containment structural integrity is maintained. Containment structural integrity must be demonstrated by use of an analytical technique that is accepted by the NRC staff. This demonstration must include sufficient supporting justification to show that the technique describes the containment response to the structural loads involved. This method could include the use of actual material properties with suitable margins to account for uncertainties in modeling, in material properties, in construction tolerances, and so on. Another method could include a showing that the following specific criteria of the ASME Boiler and Pressure Vessel Code are met:

(1) That steel containments meet the requirements of the ASME Boiler and Pressure Vessel Code (Edition and Addenda as incorporated by reference in §50.55a(b)(1) of this part), specifically in Section III, Division 1, Subsubarticle NE - 3220, Service Level C Limits, considering pressure and dead load alone (evaluation of instability is not required); and

(2) That concrete containments meet the requirements of the ASME Boiler and Pressure vessel Code, Section III, Division 2, Subsubarticle CC - 3720, Factored Load Category, considering pressure and dead load alone; and

[Option 2]

(i) containment structural integrity is maintained. Containment structural integrity must be demonstrated by use of an analytical technique that is accepted by the NRC staff. This demonstration must include sufficient supporting justification to show that the technique describes the containment response to the structural loads involved. This method could include the use of actual material properties with suitable margins to account for uncertainties in modeling, in material properties, in construction tolerances, and so on; and

[For Option 2, the associated regulatory guide would continue to endorse ASME Boiler and Pressure Vessel Code, Section III, Division 1, Subsubarticle NE - 3220, Service Level C Limits, considering pressure and dead load alone (evaluation of instability is not required), for steel containments, and ASME Boiler and Pressure vessel Code, Section III, Division 2, Subsubarticle CC - 3720, Factored Load Category, considering pressure and dead load alone, for concrete containments.]

(ii) systems and components necessary to establish and maintain safe shutdown and to maintain containment integrity will be capable of performing their functions during and after exposure to the environmental conditions created by the burning of hydrogen, including local detonations, unless such detonations can be shown unlikely to occur.

[This part is currently covered by 50.44(c)(3)(vi)(B). These analysis requirements are included for completeness and to ensure that previously reviewed and approved analyses remain a part of the plant's licensing basis. These requirements do not require any further analysis on the part of licensees.]

(d) The requirements in this paragraph apply to all applicants for and holders of a construction permit, operating license under Part 50 of this chapter or combined license under part 52 of this chapter, and to all applicants for a design approval or design certification under part 52, any of which are docketed after [DATE OF RULE].

[The applicable regulation section of Appendices A, B and C of Part 52 references the current version of 10 CFR 50.44. Applicants, who reference an existing certified design in Appendices A, B, or C of Part 52, may want to consider requesting exemption from the referenced version of 50.44 and adopting the requirements of this version of 50.44(c) when finalized.]

(1) *Mixed atmosphere*. All containments must have a capability for ensuring a mixed atmosphere.

(2) *Combustible gas control.*

All containments must have an inerted atmosphere or limit hydrogen concentrations in containment during and following an accident that releases an equivalent amount of hydrogen as would be generated from a 100% fuel-clad coolant reaction, uniformly distributed, to less than 10% and maintain containment structural integrity.

[This part is currently covered by 50.34(f)(2)(ix)(A).]

(3) *Post accident inerting.* If a post-accident inerted atmosphere is provided to comply with (c)(2) of this part, inadvertent actuation of the system can be safely accommodated during plant operation.

[This part is currently covered by 50.34(f)(2)(ix)(D). The staff is considering eliminating the requirements associated with post-accident inerting. This requirement has not been implemented to date for existing plants and existing design certifications and does not appear to be a realistic option for hydrogen control due to technical difficulties and added safety concerns.]

(4) *Equipment Survivability.* Equipment necessary for achieving and maintaining safe shutdown of the plant and maintaining containment structural integrity will perform its safety function during and after being exposed to the environmental conditions attendant with the release of hydrogen generated by the equivalent of a 100% fuel-clad coolant reaction including the environmental conditions created by activation of the combustible gas control system.

(5) *Monitoring.*

(A) Equipment shall be provided for monitoring oxygen in containments that use an inerted atmosphere for combustible gas control. Equipment for monitoring oxygen must be functional and reliable for combustible gas control and accident management, including emergency planning.

(B) Equipment shall be provided for monitoring hydrogen in the containment. Equipment for monitoring hydrogen must be functional and reliable for accident management.

[The associated RG would endorse the Category 2 design and qualification criteria of RG 1.97 for monitors designated for indicating system operating status. The associated RG would endorse the Category 3 design and qualification criteria of RG 1.97 for monitors used as diagnostic or backup indicators.]

(6) *Analyses.*

All applicants shall include in the safety analysis report an analysis that:

(A) demonstrates containment structural integrity. This demonstration must use an analytical technique that is accepted by the NRC staff and include sufficient supporting justification to show that the technique describes the containment response to the structural loads involved. The analysis must address an accident that releases hydrogen generated from 100% fuel clad coolant reaction accompanied by either hydrogen burning or the added pressure from post-accident inerting assuming carbon dioxide is the inerting agent. Systems necessary to ensure containment integrity shall also be demonstrated to perform their function under these conditions.

[Note: Two options, the first more prescriptive and the second less prescriptive, are presented below. We invite public comment on the merits of each option and which is preferred.]

[Option 1]

(B) demonstrates, by use of an analytical technique that is accepted by the NRC staff, that containment structural loadings produced by an inadvertent full actuation of a post-accident inerting hydrogen control system (assuming carbon dioxide), but not including seismic or design basis accident loadings, will not produce stresses in steel containments in excess of the limits set forth in the ASME Boiler and Pressure Vessel Code, Section III, Division 1, Subsubarticle NE-3220, Service Level A Limits, except that evaluation of instability is not required; for concrete containments the loadings specified above will not produce strains in the containment liner in excess of the limits set forth in the ASME Boiler and Pressure Vessel Code, Section III, Division 2, Subsubarticle CC-3720, Service Load Category. The containment must have the capability to safely withstand pressure tests at 1.10 and 1.15 times (for steel and concrete containments, respectively) the pressure calculated to result from carbon dioxide inerting.

[Option 2]

(B) demonstrates, by use of an analytical technique that is accepted by the NRC staff, that containment structural loadings produced by an inadvertent full actuation of a post-accident inerting hydrogen control system (assuming carbon dioxide), but not including seismic or design basis accident loadings, will not produce excessive stresses in the containment. The containment must have the capability to safely withstand pressure tests at 1.10 and 1.15 times (for steel and concrete containments, respectively) the pressure calculated to result from carbon dioxide inerting.

[This part is currently covered by 50.34(f)(3)(v). The associated regulatory guide would endorse the July 1, 1980 ASME Boiler and Pressure Vessel Code, Section III, Division 1, Subsubarticle NE - 3220, Service Level C Limits for steel containments and the Factored Load Category of ASME Boiler and Pressure Vessel Code, Section III, Division 2, Subsubarticle CC-3720 for concrete containments to meet the requirements in (A). To meet the requirements in (B), Option 2, the associated regulatory guide would endorse ASME Boiler and Pressure Vessel Code, Section III, Division 1, Subsubarticle NE-3220, Service Level A Limits, except that evaluation of instability is not required, for steel containments; and the Service Load Category of ASME Boiler and Pressure Vessel Code, Section III, Division 2, Subsubarticle CC-3720 for concrete containments.]

ADDITIONAL SUBSTANTIVE AND CONFORMING CHANGES:

§ 50.34 Contents of Applications; technical information.

(a) *Preliminary safety analysis report.*

* * *

(4) A preliminary analysis and evaluation of the design and performance of structures, systems, and components of the facility with the objective of assessing the risk to public health and safety resulting from operation of the facility and including determination of (i) the margins of safety during normal operations and transient conditions anticipated during the life of the facility, and (ii) the adequacy of structures, systems, and components provided for the prevention of accidents and the mitigation of the consequences of accidents. Analysis and evaluation of ECCS cooling performance and the need for high point vents following postulated loss-of-coolant accidents shall be performed in accordance with the requirements of § 50.46 of this part for facilities for which construction permits may be issued after December 28, 1974.

* * *

(b) *Final safety analysis report.*

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(f)

Paragraph (g) is redesignated as (h) and a new paragraph (g) is added to read as follows:

(g) *Combustible gas control.*

All applicants for and holders of a construction permit, operating license under Part 50 of this chapter or combined license under part 52 of this chapter, and to all applicants for a design approval or design certification under part 52 of this chapter, whose application was submitted after [EFFECTIVE DATE OF RULE], must contain the analyses required by 50.44.

§ 50.46 High point vents.

(e) Each light-water nuclear power reactor shall be provided with high point vents for the reactor coolant system, for the reactor vessel head, and for other systems required to maintain adequate core cooling if the accumulation of noncondensible gases would cause the loss of function of these systems.

(1) High point vents are not required for the tubes in U-tube steam generators.

(2) The high point vents must be remotely operated from the control room.

(3) The design of the vents and associated controls, instruments and power sources must conform to the requirements of Appendix A and Appendix B of this part.

(4) The vent system shall be designed to ensure a low probability that (A) the vents will not perform their safety functions and (B) there would be inadvertent or irreversible actuation of a vent.

(5) The use of these vents during and following an accident must not aggravate the challenge to the containment or the course of the accident.

PART 52-EARLY SITE PERMITS; STANDARD DESIGN CERTIFICATIONS; AND COMBINED LICENSES FOR NUCLEAR POWER PLANTS

§ 52.47 Contents of applications

(a)(ii) Demonstration of compliance with any technically relevant portions of the Three Mile Island requirements set forth in 10 CFR 50.34 (f) except paragraphs (f)(1)(xii), (f)(2)(ix) and (f)(3)(v);