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RIN 3150–AG76

Combustible Gas Control in Containment

AGENCY: Nuclear Regulatory Commission.

ACTION: Final rule.

SUMMARY: The Nuclear Regulatory Commission (NRC) is amending its regulations for combustible gas control in power reactors applicable to current licensees and is consolidating combustible gas control regulations for future reactor applicants and licensees. The final rule eliminates the requirements for hydrogen recombiners and hydrogen purge systems, and relaxes the requirements for hydrogen and oxygen monitoring equipment to make them commensurate with their risk significance. This action stems from the NRC's ongoing effort to risk-inform its regulations, and is intended to reduce the regulatory burden on present and future reactor licensees. Additionally, the final rule grants in part and denies in part a petition for rulemaking (PRM–50–68) submitted by Mr. Bob Christie. This notice constitutes final NRC action on PRM–50–68. The final rule also denies part of a petition for rulemaking (PRM–50–71) submitted by the Nuclear Energy Institute. The remaining issue in PRM–50–71 that is not addressed by this final rule will be evaluated in a separate NRC action. The NRC has updated a guidance document, ''Control of Combustible Gas Concentrations in Containment'' to address changes in the rule. A draft regulatory guide containing the revisions was published for comment with the proposed rule.

EFFECTIVE DATE: October 16, 2003.

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SUPPLEMENTARY INFORMATION:

I. Background

On October 27, 1978 (43 FR 50162), the NRC adopted a new rule, 10 CFR 50.44, specifying the standards for combustible gas control systems. The rule required the applicant or licensee to show that during the time period following a postulated loss-of-coolant accident (LOCA), but prior to effective operation of the combustible gas control system, either: (1) An uncontrolled hydrogen-oxygen recombination would not take place in the containment, or (2) the plant could withstand the consequences of an uncontrolled hydrogen-oxygen recombination without loss of safety function. If neither of these conditions could be shown, the rule required that the containment be provided with an inerted atmosphere to provide protection against hydrogen burning and explosion. The rule defined a release of hydrogen involving up to 5 percent oxidation of the fuel cladding as the amount of hydrogen to be assumed in determining compliance with the rule's provisions. This design-basis hydrogen release was based on the design-basis LOCA postulated by 10 CFR 50.46 and was multiplied by a factor of five for added conservatism to address possible further degradation of emergency core cooling.

The accident at Three Mile Island, Unit 2 involved oxidation of approximately 45 percent of the fuel cladding [NUREG/CR–6197, dated March 1994] with hydrogen generation well in excess of the amounts required to be considered for design purposes by § 50.44. Subsequently, the NRC reevaluated the adequacy of the regulations related to hydrogen control to provide greater protection in the event of accidents more severe than design-basis LOCAs. The NRC reassessed the vulnerability of various containment designs to hydrogen burning, which resulted in additional hydrogen control requirements adopted as amendments to § 50.44. The 1981 amendment, which added paragraphs (c)(3)(i), (c)(3)(ii), and (c)(3)(iii) to the rule, imposed the following requirements:

(1) An inerted atmosphere for boiling water reactor (BWR) Mark I and Mark II containments,

(2) installation of recombiners for light water reactors that rely on a purge or repressurization system as a primary means of controlling combustible gases following a LOCA, and

(3) installation of high point vents to relieve noncondensible gases from the reactor vessel (46 FR 58484; December 2, 1981).

On January 25, 1985 (50 FR 3498), the NRC published another amendment to § 50.44. This amendment, which added paragraph (c)(3)(iv), required a hydrogen control system justified by a suitable program of experiment and analysis for BWRs with Mark III containments and pressurized water reactors (PWRs) with ice condenser containments. In addition, plants with these containment designs must have systems and components to establish and maintain safe shutdown and containment integrity. These systems must be able to function in an environment after burning and detonation of hydrogen unless it is shown that these events are unlikely to occur. The control system must handle an amount of hydrogen equivalent to that generated from a metal-water reaction involving 75 percent of the fuel cladding surrounding the active fuel region.

When § 50.44 was amended in 1985, the NRC recognized that an improved understanding of the behavior of accidents involving severe core damage was needed. During the 1980s and 1990s, the NRC sponsored a severe accident research program to improve the understanding of core melt phenomena, combustible gas generation, transport and combustion, and to develop improved models to predict the progression of severe accidents. The results of this research have been incorporated into various studies (*e.g.*, NUREG–1150 and probabilistic risk assessments performed as part of the Individual Plant Examination (IPE) program) to quantify the risk posed by severe accidents for light water reactors.

The result of these studies has been an improved understanding of combustible gas behavior during severe accidents and confirmation that the hydrogen release postulated from a design-basis LOCA was not risk-significant because it was not large enough to lead to early containment failure, and that the risk associated with hydrogen combustion was from beyond design-basis (*e.g.*, severe) accidents. These studies also confirmed the assessment of vulnerabilities that went into the 1981 and 1985 amendments that required additional hydrogen control measures for some containment designs.

II. Rulemaking Initiation

In a June 8, 1999, Staff Requirements Memorandum (SRM) on SECY–98–300, Options for Risk-informed Revisions to 10 CFR Part 50—''Domestic Licensing of Production and Utilization Facilities,'' the NRC approved proceeding with a study of risk-informing the technical requirements of 10 CFR Part 50. The NRC staff provided its plan and schedule for the study phase of its work to risk-inform the technical requirements of 10 CFR Part 50 in SECY–99–264, ''Proposed Staff Plan for Risk-Informing Technical Requirements in 10 CFR Part 50,'' dated November 8, 1999. The NRC approved proceeding with the plan for risk-informing the Part 50 technical requirements in a February 3, 2000, SRM. Section 50.44 was selected as a test case for piloting the process of risk-informing 10 CFR Part 50 in SECY–00–0086, ''Status Report on Risk-Informing the Technical Requirements of 10 CFR Part 50 (Option 3).''

Mr. Christie of Performance Technology, Inc. submitted letters, dated October 7 and November 9, 1999, that requested changes to the regulations in § 50.44. He requested that the regulations be amended to:

1. Retain the existing requirement in § 50.44(b)(2)(i) for inerting the atmosphere of existing Mark I and Mark II containments.
2. Retain the existing requirement in § 50.44(b)(2)(ii) for hydrogen control systems in existing Mark III and PWR ice condenser containments to be capable of handling hydrogen generated by a metal/water reaction involving 75 percent of the fuel cladding.
3. Require all future light water reactors to postulate a 75 percent metal/water reaction (instead of the 100 percent required by the current rule) for analyses undertaken pursuant to § 50.44(c).
4. Retain the existing requirements in § 50.44 for high point vents.
5. Eliminate the existing requirement in § 50.44(b)(2) to insure a mixed atmosphere in containment.
6. Eliminate the existing requirement for hydrogen releases during design basis accidents of an amount equal to that produced by a metal/water reaction of 5 percent of the cladding.
7. Eliminate the requirement for hydrogen recombiners or purge in LWR containments.
8. Eliminate the existing requirements for hydrogen and oxygen monitoring in LWR containments.
9. Revise GDC 41—Containment Atmosphere Cleanup—to require systems to control fission products and other substances that may be released into the reactor containment for accidents only where there is a high probability that fission products will be released to the reactor containment.

These letters have been treated by the NRC as a petition for rulemaking and assigned Docket No. PRM–50–68. The NRC published a document requesting comment on the petition in the **Federal Register** on January 12, 2000 (65 FR 1829). The issues associated with § 50.44 raised by the petitioner were discussed in SECY–00–0198, ''Status Report on Study of Risk-Informed Changes to the Technical Requirements of 10 CFR Part 50 (Option 3) and Recommendations on Risk-Informed Changes to 10 CFR 50.44 (Combustible Gas Control).'' The final rule and the petition are consistent in many areas, but differ regarding the functional requirements for hydrogen and oxygen monitoring, the requirement for ensuring a mixed atmosphere, the source term of hydrogen for water-cooled reactors to analyze in order to ensure containment integrity, and the need to revise GDC–41. The NRC's detailed basis for including these requirements in the rule is addressed in a subsequent section of this supplementary information.

The NRC also received a petition for rulemaking filed by the Nuclear Energy Institute. The petition was docketed on April 12, 2000, and has been assigned Docket No. PRM–50–71. The petitioner requests that the NRC amend its regulations to allow nuclear power plant licensees to use zirconium-based cladding materials other than zircaloy or ZIRLO, provided the cladding materials meet the requirements for fuel cladding performance and have received approval by the NRC staff. The petitioner believes the proposed amendment would improve the efficiency of the regulatory process by eliminating the need for individual licensees to obtain exemptions to use advanced cladding materials that have already been approved by the NRC. The change would remove the language in 10 CFR 50.44 regarding the use of zirconium-based cladding materials other than Zircaloy or ZIRLO. The NRC published a document requesting comment on the petition in the **Federal Register** on May 30, 2000 (65 FR 34599). The requested change is unrelated to the risk-informing of 10 CFR 50.44. The NRC addressed the NEI petition in this rulemaking for effective use of resources. Although the final rule does not contain the rule language changes requested by the petitioner, in its revision to 10 CFR 50.44, the NRC eliminated the old language referring to various types of fuel cladding. Thus, the final rule resolves the petitioner's concern regarding § 50.44. The NRC's detailed basis for this decision is addressed in a subsequent section of this supplementary information.

In SECY–00–0198, dated September 14, 2000, the NRC staff proposed a risk-informed voluntary alternative to the current § 50.44. Attachment 2 to that paper, hereafter referred to as the Feasibility Study, used the framework described in Attachment 1 to the paper and risk insights from NUREG–1150 and the IPE programs to evaluate the requirements in § 50.44. The Feasibility Study found that combustible gas generated from design-basis accidents was not risk-significant for any containment type, given intrinsic design capabilities or installed mitigative features. The Feasibility Study also concluded that combustible gas generated from severe accidents was not risk significant for: (1) Mark I and II containments, provided that the required inerted atmosphere was maintained; (2) Mark III and ice condenser containments, provided that the required igniter systems were maintained and operational, and (3) large, dry and sub-atmospheric containments because of the large volumes, high failure pressures, and likelihood of random ignition to help prevent the build-up of detonable hydrogen concentrations.

The Feasibility Study did conclude that the above requirements for combustible gas mitigative features were risk-significant and must be retained. Additionally, the Feasibility Study also indicated that some mitigative features may need to be enhanced beyond current requirements. This concern was identified as Generic Safety Issue-189 (GI–189). The resolution of GI–189 will assess the costs and benefits of improvements to safety which can be achieved by enhancing combustible gas control requirements for Mark III and ice condenser containment designs. The resolution of GI–189 is proceeding independently of this rulemaking. In an SRM dated January 19, 2001, the NRC directed the NRC staff to proceed expeditiously with rulemaking on the risk-informed alternative to § 50.44.

In SECY–01–0162, ''Staff Plans for Proceeding with the Risk-Informed Alternative to the Standards for Combustible Gas Control Systems in Light-Water-Cooled Power Reactors in 10 CFR 50.44,'' dated August 23, 2001, the NRC staff recommended a revised approach to the rulemaking effort. This revised approach recognized that risk-informing Part 50, Option 3 was based on a realistic reevaluation of the basis of a regulation and the application of realistic risk analyses to determine the need for and relative value of regulations that address a design-basis issue. The result of this process necessitates a fundamental reevaluation or ''rebaselining'' of the existing regulation, rather than the development of a voluntary alternative approach to rulemaking. On November 14, 2001, in response to NRC direction in an SRM dated August 2, 2001, the NRC staff published draft rule language on the NRC Web site for stakeholder review and comment. In an SRM dated December 31, 2001, the NRC directed the staff to proceed with the revision to the existing § 50.44 regulations.

III. Final Action

The NRC is retaining existing requirements for ensuring a mixed atmosphere, inerting Mark I and II containments, and hydrogen control systems capable of accommodating an amount of hydrogen generated from a metal-water reaction involving 75 percent of the fuel cladding surrounding the active fuel region in Mark III and ice condenser containments. The NRC is eliminating the design-basis LOCA hydrogen release from § 50.44 and consolidating the requirements for hydrogen and oxygen monitoring into § 50.44 while relaxing safety classifications and licensee commitments to certain design and qualification criteria. The NRC is also relocating and rewording without materially changing the hydrogen control requirements in § 50.34(f) to § 50.44. The high point vent requirements are being relocated from § 50.44 to a new § 50.46a with a change that eliminates a requirement prohibiting venting the reactor coolant system if it could ''aggravate'' the challenge to containment.

Substantive issues are addressed in the following sections.

A. Retention of Inerting, BWR Mark III and PWR Ice Condenser Hydrogen Control Systems, Mixed Atmosphere Requirements, and Associated Analysis Requirements

The final rule retains the existing requirement in § 50.44(c)(3)(i) to inert Mark I and II type containments. 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. Retaining the requirement maintains the current level of public protection, as discussed in Section 4.3.2 of the Feasibility Study.

The final rule retains the existing requirements in § 50.44(c)(3)(iv), (v), and (vi) that BWRs with Mark III containments and PWRs with ice condenser containments provide a hydrogen control system justified by a suitable program of experiment and analysis. The amount of hydrogen to be considered is that generated from a metal-water reaction involving 75 percent of the fuel cladding surrounding the active fuel region (excluding the cladding surrounding the plenum volume). The analyses must demonstrate that the structures, systems and components necessary for safe shutdown and maintaining containment integrity will perform their functions during and after exposure to the conditions created by the burning hydrogen. Environmental conditions caused by local detonations of hydrogen must be included, unless such detonations can be shown unlikely to occur. A significant beyond design-basis accident generating significant amounts of hydrogen (on the order of Three Mile Island, Unit 2, accident or a metal water reaction involving 75 percent of the fuel cladding surrounding the active fuel region) would pose a severe threat to the integrity of these containment types in the absence of the installed igniter systems. Section 4.3.3 of the Feasibility Study concluded that hydrogen combustion is not risk-significant, in terms of the framework document's quantitative guidelines, when igniter systems installed to meet § 50.44(c)(3)(iv), (v), and (vi) are available and operable. The NRC retains these requirements. Previously reviewed and approved licensee analyses to meet the existing regulations constitute compliance with this section. The results of these analyses must continue to be documented in the plant's Updated Final Safety Analysis Report in accordance with § 50.71(e).

The final rule also retains the § 50.44(b)(2) requirement that containments for all currently-licensed nuclear power plants ensure a mixed atmosphere. A mixed containment atmosphere prevents local accumulation of combustible or detonable gases that could threaten containment integrity or equipment operating in a local compartment.

B. Elimination of Design-Basis LOCA Hydrogen Release

The final rule removes the existing definition of a design-basis LOCA hydrogen release and eliminates requirements for hydrogen control systems to mitigate such a release at currently-licensed nuclear power plants. The installation of recombiners and/or vent and purge systems previously 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. The NRC finds that this hydrogen release is not risk-significant. This finding is based on the Feasibility Study which found that the design-basis LOCA hydrogen release did not contribute to the conditional probability of a large release up to approximately 24 hours after the onset of core damage. The requirements for combustible gas control that were developed after the Three Mile Island Unit 2 accident were intended to minimize potential additional challenges to containment due to long term residual or radiolytically-generated hydrogen. The NRC found that containment loadings associated with long term hydrogen concentrations are no worse than those considered in the first 24 hours and therefore, are not risk-significant. The NRC believes that accumulation of combustible gases beyond 24 hours can be managed by licensee implementation of the severe accident management guidelines (SAMGs) or other ad hoc actions because of the long period of time available to take such action. Therefore, the NRC eliminates the hydrogen release associated with a design-basis LOCA from § 50.44 and the associated requirements that necessitated the need for the hydrogen recombiners and the backup hydrogen vent and purge systems.

In plants with Mark I and II containments, the containment atmosphere is required to be maintained with a low concentration of oxygen, rendering it inert to combustion. Mark I and II containments can be challenged beyond 24 hours by the long-term generation of oxygen through radiolysis. The regulatory analysis for this proposed rulemaking found the cost of maintaining the recombiners exceeded the benefit of retaining them to prevent containment failure sequences that progress to the very late time frame. 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.

The NRC continues to view severe accident management guidelines as an important part of the severe accident closure process. Severe accident management guidelines are part of a voluntary industry initiative to address accidents beyond the design basis and emergency operating instructions. In November 1994, current nuclear power plant licensees committed to implement severe accident management at their plants by December 31, 1998, using the guidance contained in NEI 91–04, Revision 1, ''Severe Accident Issue Closure Guidelines.'' Generic severe accident management guidelines developed by each nuclear steam system supplier owners group includes either purging and venting or venting the containment to address combustible gas control. On the basis of the industry-wide commitment, the NRC is not requiring such capabilities, but continues to view purging and/or controlled venting of all containment types to be an important combustible gas control strategy that should be considered in a plant's severe accident management guidelines.

C. Oxygen Monitoring Requirements

The final rule amends § 50.44 to codify the existing regulatory practice of monitoring oxygen in currently-licensed nuclear power plant containments that use an inerted atmosphere for combustible gas control. Standard technical specifications and licensee technical specifications currently require oxygen monitoring to verify the inerted condition in containment. 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. If an inerted containment was to become de-inerted during a significant beyond design-basis accident, then other severe accident management strategies, such as purging and venting, would need to be considered. The oxygen monitoring is needed to implement these severe accident management strategies, in plant emergency operating procedures, and as an input in emergency response decision making.

The final rule reclassifies oxygen monitors as non safety-related components. Currently, as recommended by the NRC's Regulatory Guide (RG) 1.97, oxygen monitors are classified as Category 1. Category 1 is defined as applying to instrumentation designed for monitoring variables that most directly indicate the accomplishment of a safety function for design-basis events. By eliminating the design-basis LOCA hydrogen release, the oxygen monitors are no longer required to mitigate design-basis accidents. The NRC finds that Category 2, defined in RG 1.97, as applying to instrumentation designated for indicating system operating status, to be the more appropriate categorization for the oxygen monitors, because the monitors will still continue to be required to verify the status of the inerted containment. Further, the NRC believes that sufficient reliability of oxygen monitoring, commensurate with its risk-significance, will be achieved by the guidance associated with the Category 2 classification. Because of the various regulatory means, such as orders, that were used to implement post-TMI requirements, this relaxation may require a license amendment at some facilities. Licensees would also need to update their final safety analysis report to reflect the new classification and RG 1.97 categorization of the monitors in accordance with 10 CFR 50.71(e).

D. Hydrogen Monitoring Requirements

The final rule maintains the existing requirement in § 50.44(b)(1) for monitoring hydrogen in the containment atmosphere for all currently-licensed nuclear power plants. Section 50.44(b)(1), standard technical specifications and licensee technical specifications currently contain requirements for monitoring hydrogen, including operability and surveillance requirements for the monitoring systems. Licensees have made commitments to comply with design and qualification criteria for hydrogen monitors specified in NUREG–0737, Item II.F.1, Attachment 6 and in RG 1.97. The hydrogen monitors are required to assess the degree of core damage during a beyond design-basis accident and confirm that random or deliberate ignition has taken place. Hydrogen monitors are also used, in conjunction with oxygen monitors in inerted containments, to guide response to emergency operating procedures. Hydrogen monitors are also used in emergency operating procedures of BWR Mark III facilities. If an explosive mixture that could threaten containment integrity exists, then other severe accident management strategies, such as purging and/or venting, would need to be considered. The hydrogen monitors are needed to implement these severe accident management strategies.

The final rule reclassifies the hydrogen monitors as non safety-related components for currently-licensed nuclear power plants. With the elimination of the design-basis LOCA hydrogen release (see Item B. earlier), the hydrogen monitors are no longer required to support mitigation of design-basis accidents. Therefore, the hydrogen monitors do not meet the definition of a safety-related component as defined in § 50.2. This is consistent with the NRC's determination that oxygen monitors that are used for beyond-design basis accidents need not be safety grade.

Currently, RG 1.97 recommends classifying the hydrogen monitors in Category 1, defined as applying to instrumentation designed for monitoring key variables that most directly indicate the accomplishment of a safety function for design-basis accident events. Because the hydrogen monitors no longer meet the definition of Category 1 in RG 1.97, the NRC believes that licensees' current commitments are unnecessarily burdensome. The NRC believes that Category 3, as defined in RG 1.97, is an appropriate categorization for the hydrogen monitors because the monitors are required to diagnose the course of significant beyond design-basis accidents. Category 3 applies to high-quality, off-the-shelf backup and diagnostic instrumentation. As with the revision to oxygen monitoring, this relaxation may also require a license amendment at some facilities. Licensees will also need to update their final safety analysis report to reflect the new classification and RG 1.97 categorization of the monitors in accordance with 10 CFR 50.71(e).

E. Technical Specifications for Hydrogen and Oxygen Monitors

As discussed in III.C and III.D above, the amended rule requires equipment for monitoring hydrogen in all containments and for monitoring oxygen in containments that use an inerted atmosphere. The rule also requires that this equipment must be functional, reliable, and capable of continuously measuring the concentration of oxygen and/or hydrogen in containment atmosphere following a beyond design-basis accident for combustible gas control and severe accident management, including emergency planning. Because of the importance of these monitors for the management of severe accidents, the NRC staff evaluated whether operability and surveillance requirements for these monitors should be included in the technical specifications.

In order to be retained in the technical specifications, the monitors must meet one of the four criteria set forth by 10 CFR 50.36. These criteria are as follows:

1. Installed instrumentation that is used to detect, and indicate in the control room, a significant abnormal degradation of the reactor coolant pressure boundary.

2. A process variable, design feature, or operating 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.

3. A structure, system, or component that is part of the primary success path and that functions or actuates to mitigate a design basis accident or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.

4. A structure, system or component that operating experience or probabilistic risk assessment has shown to be significant to public health and safety.

As stated in the **Federal Register** notice (60 FR 36953) for the final rule for technical specifications, these criteria were established to address a ''trend toward including in technical specifications not only those requirements derived from the analyses and evaluations included in the safety analysis report but also essentially all other Commission requirements governing the operation of nuclear power plants. This extensive use of technical specifications is due in part to a lack of well-defined criteria (in either the body of the rule or in some other regulatory document) for what should be included in technical specifications.'' As such, the NRC has decided, and established by rule, not to duplicate regulatory requirements in the technical specifications.

Hydrogen and oxygen monitors do not meet criteria 1, 2, or 3 of 10 CFR 50.36 described above. In addition, the Feasibility Study performed by the NRC, and documented in section 4 of Attachment 2 of SECY–00–0198, concluded that the requirement to provide a system to measure the hydrogen concentration in containment does not contribute to the risk estimates for core melt accidents for large dry containments; is not risk significant during the early stages of core melt accidents for Mark I and Mark II containments; and is not risk significant in terms of dealing with the combustion threat of a core melt accident (except for those conditions when the igniters are not operable, *e.g.*, Station Blackout) for Mark III and ice condenser containments. These conclusions were based on the assumptions that Mark I and Mark II containments are inert and hydrogen igniters are operable for Mark III and ice condenser containments. It should be noted that the existing technical specification requirements for hydrogen igniters and for maintaining primary containment oxygen concentration below 4 percent by volume (*i.e.*, inerted), are not being removed; therefore, the conclusions in the Feasibility Study on the risk significance of the hydrogen monitors remain valid. On this basis, the NRC has concluded that hydrogen monitors do not meet criterion 4 of 10 CFR 50.36.

Oxygen monitoring is not the primary means of indicating a significant abnormal degradation of the reactor coolant pressure boundary. Oxygen monitors are used to determine the primary containment oxygen concentration in boiling water reactors. As stated above, the limit for primary containment oxygen concentration for Mark I and II containments will remain in technical specifications; therefore, a technical specification requirement for oxygen monitors would be redundant. In addition, technical specifications for hydrogen igniters for Mark III containments will remain. The oxygen monitors have been shown by probabilistic risk assessment to not be risk-significant. On this basis, the NRC has concluded that oxygen monitors do not meet criterion 4 of 10 CFR 50.36.

The NRC has several precedents regarding not duplicating regulatory requirements for severe accidents in the technical specifications. The Anticipated Transients Without Scram (ATWS) rule, (10 CFR 50.62) requires each pressurized water reactor to have equipment from sensor output to final actuation device, diverse from the reactor trip system, to automatically initiate the auxiliary (or emergency) feedwater system and initiate a turbine trip under conditions indicative of an ATWS. This equipment is required to be designed to perform its function in a reliable manner and has no associated requirements incorporated in the technical specifications. The Station Blackout (SBO) rule, (10 CFR 50.63) requires that each light water reactor must be able to withstand and/or recover from a station blackout event. Section 50.63 also states that an alternate ac power source will constitute acceptable capability to withstand station blackout provided an analysis is performed that demonstrates that the plant has this capability from onset of the station blackout until the alternate ac source and required shutdown equipment are started and lined up to operate. Again, no requirements for the alternate ac source are required to be in technical specifications.

NRC experience with implementation of the above regulations for non safety-related equipment has shown that reliability commensurate with severe accident assumptions is assured without including such equipment in technical specifications. According to the ''Final Report—Regulatory Effectiveness of the Station Blackout Rule'' (ADAMS ACCESSION NUMBER: ML003741781), the reliability of the alternate ac power source has improved after implementation of the SBO rule. It states:

''Before the SBO rule was issued, only 11 of 78 plants surveyed had a formal EDG reliability program, 11 of 78 plants had a unit average EDG reliability less that 0.95, and 2 of 78 had a unit average EDG reliability of less that 0.90. Since the SBO rule was issued, all plants have established an EDG reliability program that has improved EDG reliability. A report shows that only 3 of 102 operating plants have a unit average EDG reliability less than 0.95 and above 0.90 considering actual performance on demand, and maintenance (and testing) out of service (MOOS) with the reactor at power.''

Therefore, the NRC staff has concluded that requirements for hydrogen and oxygen monitors can be removed from technical specifications. The basis for this conclusion is:

1. These monitors do not meet the criteria of 10 CFR 50.36,
2. The amended 10 CFR 50.44 requires hydrogen and oxygen monitors to be maintained reliable and functional, and
3. The regulatory precedents set by the treatment of other equipment for severe accidents required by 10 CFR 50.62 and 50.63.

F. Combustible Gas Control Requirements for Future Applicants

Section 50.44(c) of the final rule sets forth combustible gas control requirements for all future water-cooled nuclear power reactor designs with characteristics (*e.g.* type and quantity of cladding materials) such that the potential for production of combustible gases is comparable to currently-licensed light-water reactor designs. The NRC's requirements for future reactors previously specified in § 50.34(f)(2)(ix) have been reworded for conciseness but without material change and relocated to § 50.44(c)(2) to consolidate the combustible gas control requirements in § 50.44 for easier reference. This sub-paragraph requires a system for hydrogen control that can safely accommodate hydrogen generated by the equivalent of a 100 percent fuel clad metal-water reaction and must be capable of precluding uniformly distributed concentrations of hydrogen from exceeding 10 percent (by volume). If these conditions cannot be satisfied, an inerted atmosphere must be provided within the containment. The requirements specified in amended § 50.44(c)(2) are applicable to future water-cooled reactors with the same potential for the production of combustible gas as currently-licensed light-water reactor designs and are consistent with the criteria currently contained in § 50.34(f)(2)(ix) to preclude local concentrations of hydrogen collecting in areas where unintended combustion or detonation could cause loss of containment integrity or loss of appropriate accident mitigating features. Additional advantages of providing hydrogen control mitigation features (rather than reliance on random ignition of richer mixtures) include the lessening of pressure and temperature loadings on the containment and essential equipment. These requirements reflect the Commission's expectation that future designs will achieve a higher standard of severe accident performance (50 FR 32138; August 8, 1985).

Section 50.44(d) applies to non-water-cooled reactors and water-cooled reactors that have different characteristics regarding the production of combustible gases from current light-water reactors. Because the specific details of the designs and construction materials used in such future reactors cannot now be known, paragraph (d) specifies a general performance-based requirement that future applicants submit information to the NRC indicating how the safety impacts of combustible gases generated during design-basis and significant beyond design-basis accidents are addressed to ensure adequate protection of public health and safety and common defense and security. This information must be based in part upon a design-specific probabilistic risk assessment. The Commission has endorsed the use of PRAs as a tool in regulatory decisionmaking, see *Use of Probabilistic Risk Assessment Methods in Nuclear Activities: Final Policy Statement* (60 FR 42622, August 16, 1995), and is currently using PRAs as one element in evaluating proposed changes to licensing bases for currently licensed nuclear power plants, see Regulatory Guide 1.174, *An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisionmaking: General Guidance* (July 1998) and Standard Review Plan, Chapter 19, ''Use of Probabilistic Risk Assessment in Plant-Specific, Risk Informed Decisionmaking: General Guidance,'' NUREG–0800 (July 1998). The use of PRA methodologies in determining whether severe accidents involving combustible gas must be addressed by future non-water-cooled reactor designs (and water-cooled designs which have different combustible gas generation characteristics as compared with the current fleet of light-water-cooled reactors) is a logical extension of the NRC's efforts to expand the use of PRAs in regulatory decisionmaking.

At this time, the NRC is not able to set forth a detailed description of, or specific criteria for defining a ''significant'' beyond design-basis accident for these future reactor designs, because the fuel and vessel design, cladding material, coolant type, and containment strategy for these reactor designs are unknown at the time of this final rulemaking. Based in part upon the design-specific PRA, the NRC will determine: (i) What type of accident is considered ''significant'' for each future reactor design, (ii) whether combustible gas control measures are necessary, and if so, (iii) whether the combustible gas control measures proposed for each design provide adequate protection to public health and safety and common defense and security. Although it is impossible at this time to provide a detailed description or criteria for determining what constitutes a ''significant'' beyond design-basis accident for the future reactors that are subject to this provision, the NRC nonetheless believes that the concept of ''significant'' with respect to severe accidents has regulatory precedent which will guide the NRC staff's evaluation of the PRA information for future plants. Section 50.34(f)(2)(ix) of the NRC's current regulations already defines what is in essence the significant beyond design-basis accident which future reactor designs comparable to current light-water reactor designs must be capable of addressing, viz., an accident comparable to a degraded core accident at a current light-water reactor in which a metal-water reaction occurs involving 100 percent of the fuel cladding surrounding the active fuel region (excluding the cladding surrounding the plenum volume). With respect to other ''beyond design-basis'' accidents, the Commission has addressed anticipated transients without scram (ATWS), and station blackout, which are currently regarded as ''beyond design-basis accidents.'' The nuclear power industry, at the behest of the NRC, has developed severe accident management guidelines to provide for a systematized approach for responding to severe accidents during operations. Finally, the Commission has required all nuclear power plant licensees to implement emergency preparedness planning to address the potential for offsite releases of radiation in excess of 10 CFR Part 100 limits. A careful review of these regulatory efforts discloses a common thread: regulatory actions addressing ''beyond design-basis'' accidents have generally been determined based upon a consideration of probability of the accident, together with consideration of the potential scope and seriousness of the health and property value impacts to the general public. Thus, it is possible to set forth a high-level conceptual description of a ''significant'' beyond design-basis accident involving combustible gas for which the

Commission intends for future non-water-cooled reactor designers to address. First, such an accident would have relatively low probability of occurrence, based upon the PRA, but would not be so small that the accident would be deemed incredible. Second, a ''significant'' beyond design-basis accident involving combustible gas would have serious offsite consequences for the public, involving the potential for death or significant acute or chronic health effects to the general public and/or significant radioactive contamination of offsite property which could result in permanent or long-term commitment of property to nuclear use. Such accidents would typically call for activation of offsite emergency preparedness measures in order to mitigate the adverse effects on public health and safety.

The NRC is currently preparing a Draft Regulatory Guide DG–1122 for public comment, in which the terms, ''significant sequences'' and ''significant contributors'' are expected to be addressed. In addition, as part of the proposed rulemaking for risk-informing 10 CFR § 50.46 the Commission has instructed the NRC staff to develop suitable metrics for determining the appropriate risk cutoff for defining the maximum LOCA size. The metrics are to take into account the uncertainties inherent in development of PRAs. The NRC expects that these regulatory activities will ultimately result in more detailed examples of the ''significant beyond design-basis'' concept to assist a potential applicant in developing the design for a future non-water-cooled reactor (and water-cooled reactor designs which are significantly different in concept from current light-water-cooled reactors), and to guide the NRC's review of an application involving such a design.

G. Clarification and Relocation of High Point Vent Requirements From 10 CFR 50.44 to 10 CFR 50.46a

The final rule removes the current requirements for high point vents from § 50.44 and transfers them to a new § 50.46a. The NRC is relocating these requirements because high point vents are relevant to emergency core cooling system (ECCS) performance during severe accidents, and the final § 50.44 does not address ECCS performance. The requirement to install high point vents was adopted in the 1981 amendment to § 50.44. This requirement permitted venting of noncondensible gases that may interfere with the natural circulation pattern in the reactor coolant system. This process is regarded as an important safety feature in accident sequences that credit natural circulation of the reactor coolant system. In other sequences, the pockets of noncondensible gases may interfere with pump operation. The high point vents could be instrumental for terminating a core damage accident if ECCS operation is restored. Under these circumstances, venting noncondensible gases from the vessel allows emergency core cooling flow to reach the damaged reactor core and thus, prevents further accident progression.

The final rule amends the language in § 50.44(c)(3)(iii) by deleting the statement, ''the use of these vents during and following an accident must not aggravate the challenge to the containment or the course of the accident.'' For certain severe accident sequences, the use of reactor coolant system high point vents is intended to reduce the amount of core damage by providing an opportunity to restore reactor core cooling. Although the release of noncondensible and combustible gases from the reactor coolant system will, in the short term, ''aggravate'' the challenge to containment, the use of these vents will positively affect the overall course of the accident. The release of any combustible gases from the reactor coolant system has been considered in the containment design and mitigative features that are required for combustible gas control. Any reactor coolant system venting is highly unlikely to affect containment integrity; however, such venting will reduce the likelihood of further core damage. Because overall plant safety is increased by venting through high point vents, the final rule does not include this statement in § 50.46a.

H. Elimination of Post-Accident Inerting

The final rule no longer provides an option to use post-accident inerting as a means of combustible gas control. Although post-accident inerting systems were permitted as a possible alternative for mitigating combustible gas concerns after the accident at Three Mile Island, Unit 2, no licensee has implemented such a system to date. Concerns with a post-accident inerting system include increase in containment pressure with use, limitations on emergency response personnel access, and cost. Sections 50.44(c)(3)(iv)(D) and 50.34(f)(ix)(D) of the former rule were adopted to address these concerns. On November 14, 2001, draft rule language was made available to elicit comment from interested stakeholders. The draft rule language recommended eliminating the option to use post-accident inerting as a means of combustible gas control and asked stakeholders if there was a need to retain these requirements. Stakeholder feedback supported elimination of the post-accident inerting option and indicated that licensees do not intend to convert existing plants to use post-accident inerting. Because there is no need for the regulations to support an approach that is unlikely to be used, the NRC has decided to eliminate post-accident inerting requirements in the final rule.

IV. Comments and Resolution on Proposed Rule and Draft Regulatory Guide

The 60-day comment period for the proposed rule closed on October 16, 2002. The NRC received 14 letters, from 14 commenters, containing approximately 43 comments on the proposed rule and draft regulatory guide. Seven of the commenters were licensees, two were vendors, two were representatives of utility groups (the Nuclear Energy Institute and the Nuclear Utility Group on Equipment Qualification), two were private citizens, and one was a citizen group, Nuclear Information and Resource Service. All comments were considered in formulating the final rule. Copies of the letters are available for public inspection and copying for a fee at the Commission's Public Document Room, located at 11555 Rockville Pike, Room O–1 F23, Rockville, Maryland 20852.

Documents created or received at the NRC after October 16, 2002, are also available electronically at the NRC's Public Electronic Reading Room on the Internet at *http://www.nrc.gov/reading-rm.html*. From this site, the public can gain entry into the NRC's Agencywide Document Access and Management System (ADAMS), which provides text and image files of NRC's public documents. These same documents also may be viewed and downloaded electronically via the interactive rulemaking Web site established by NRC for this rulemaking at *http://ruleforum.llnl.gov*.

The following sections set forth the resolution of the public comments.

A. General Comments

Many commenters expressed strong support for the rule to improve the regulations in § 50.44 and ''commend[ed] the NRC for developing a rule based on risk-informed and performance-based insights that would eliminate unnecessary regulatory requirements.'' One industry commenter indicated that this rule will enhance public health and safety because it increases the reliability of the hydrogen and oxygen monitoring systems. The Advisory Committee on Reactor

Safeguards (ACRS) stated that the draft proposed rulemaking for risk-informed revisions to 10 CFR 50.44 will provide more effective and efficient regulation to deal with combustible gases in containments.

The NRC also received feedback on several issues for which comments were specifically requested in the draft rule language. The existing rule provides detailed, prescriptive instructions using American Society of Mechanical Engineers (ASME) references for analyzing the performance of boiling water reactor (BWR) Mark III and pressurized water reactor (PWR) ice condenser containments. In the final rule, the NRC has provided an option for a more performance-based approach, which received positive public comment. Based upon stakeholder input, the final rule eliminates the existing references to ASME standards and other prescriptive requirements. The regulatory guide attached to this paper includes the ASME approach as one in which the intent of the regulations could be satisfied.

One private citizen questioned why the NRC was considering relaxing requirements that provide protection against some of the uncertainties and hazards of nuclear power. A citizen group opposed the changes by contending that eliminating the design-basis accident release, relaxing safety classifications, and relaxing licensee commitments to certain design and qualification criteria only benefits the money interests of the licensees. This group also stated its belief that the NRC's reliance on limited Three Mile Island (TMI) data points was insufficient to relax requirements solely to accommodate industry cost cutting strategies.

The NRC is moving to risk-informed, performance-based regulation that takes into account the benefits and consequences of actions by licensees and the NRC. One of the benefits of risk-informed regulation is that it concentrates resources on areas that are more important and minimizes resource allocation on areas that are shown to be less significant. As part of the basis for deciding the level of importance of various areas, during the 1980s and 1990s, the NRC sponsored a severe accident research program to improve the understanding of core melt phenomena, combustible gas generation, transport, and combustion, and to develop improved models to predict the progression of severe accidents. The results of this research have been incorporated into various studies (*e.g.*, NUREG–1150 and probabilistic risk assessments performed as part of the Individual Plant Examination (IPE) program) to quantify the risk posed by severe accidents for light water reactors. The result of these studies has been an improved understanding of combustible gas behavior during severe accidents and confirmation that the combustible gas release postulated from a design-basis LOCA was not risk-significant because it would not lead to early containment failure, and that the risk associated with gas combustion was from beyond-design-basis (*e.g.*, severe) accidents.

In making its regulatory decisions, the NRC first considers public safety, then other issues such as public confidence and reducing unnecessary regulatory burden. Based upon the results of significant research into design-basis and beyond design-basis accidents, the NRC has determined that a design-basis combustible gas release is not risk-significant and certain beyond design-basis combustible gas releases are risk-significant. Therefore, the NRC is removing the requirements for combustible gas control systems that mitigate consequences of non-risk-significant design-basis accidents which are also not effective in reducing the risk from combustible gas releases in beyond-design-basis accidents.

The citizen group also contended that because GSI–191, ''Assessment of Debris Accumulation on PWR Sump Pump Performance'', is not resolved, removing the hydrogen recombiner requirements and relaxing the hydrogen and oxygen monitoring requirements are premature and constitute a dangerous trend towards risk ''misinformed'' regulation.

The NRC disagrees with the commenter's contention. The NRC's philosophy on all GSIs is to first determine whether the existing situation provides adequate protection of public health and safety, and if there is sufficient margin to allow continued safe operation of the affected plants while seeking a final resolution of the GSI. For GSI–191, the NRC concluded that even though uncertainties remained regarding the debris accumulation issue, adequate protection of public health and safety was maintained. Accordingly, the fact that GSI–191 has not reached final resolution does not present an impediment to the revision to § 50.44.

An industry group requested that the terms ''safety-significant'' and ''industrial'' instead of high and low safety/risk significance be used in this rule and regulatory guide. The NRC disagrees. The terms ''high and low safety/risk significance'' were not included in the proposed rule and are not in the final rule. The term ''safety-significant'', when used in supporting documentation, is used to identify systems, structures, and components (SSCs) that contribute to safety. The term does not confer the level of significance on the SSC. Additionally, the term ''risk significant'' is used to identify those conditions that contribute to risk. Again, no level of significance is assigned by the use of this term. Additionally, the change in terminology requested by the commenter would be inconsistent with the supporting NRC documents and reports. Changing terminology could cause unnecessary confusion on the part of licensees and the public.

B. General Clarifications

One commenter questioned if the draft regulatory guide would become Regulatory Guide 1.7, Revision 3. When the NRC resolves the comments on DG–1117, the guidance will be published as Regulatory Guide 1.7, Revision 3.

A licensee requested that the first sentence of Item 3 of the fourth paragraph of section B of the draft regulatory guide be revised to read: ''The following requirements apply to all construction permits or operating licenses under 10 CFR Part 50, and to all design approvals, design certifications, or combined licenses under 10 CFR Part 52, any of which are issued after the effective date of the rule.'' The NRC agrees that the commenter's request represents a clearer way of expressing the NRC's intent. In addition, the term ''manufacturing licenses'' has been added to make clear that the revised requirements apply to applicants for manufacturing licensees, which was inadvertently omitted from the proposed rule. These changes have been included in both the regulatory guide and in the final rule.

The licensee also requested that the NRC reword the statement in section 5 of the draft regulatory guide to read: ''For future applicants and licensees as defined in Part 50.44(c), the analysis must address an accident that releases hydrogen generated from 100 percent fuel clad-coolant reaction accompanied by hydrogen burning.'' Another licensee requested that section C.5, ''Containment Integrity'', should state that it does not apply to currently licensed plants. The NRC disagrees with these requests. Section 5 of DG–1117 was intended to apply to current and future plants. However, the wording was not clear and inadvertently caused some confusion on the applicability of the section. To clarify that section 5 applies to current and future plants, its wording has been revised to more closely reflect the rule intent. This revision removes the following statements from the draft regulatory guide: ''The analysis must address an accident that releases hydrogen generated from 100 percent fuel clad-coolant reaction accompanied by hydrogen burning. Systems necessary to ensure containment integrity must also be demonstrated to perform their function under these conditions.'' The above changes remove the misleading language and clarify the applicability of the section.

C. Monitoring Systems

A private citizen expressed concern about the adequacy and survivability of non safety-related hydrogen and oxygen monitors for assessing hydrogen and oxygen levels after an accident. A reactor licensee stated that the changes to the requirements for hydrogen and oxygen monitoring would actually increase the reliability of hydrogen and oxygen monitoring equipment. A monitor vendor indicated that high-quality commercial grade hydrogen monitors may be susceptible to radiation-induced calibration degradation. The vendor also indicated that these monitors are susceptible to damage from aerosols released during the accident. The vendor believes that commercial grade detectors located inside containment would probably not function in a post-accident environment without verification testing and test-based modifications. The vendor claimed the more severe the accident, the less likely the sensors would properly operate due to increased radiation exposure and increased aerosol loading. In addition, the vendor believes that remote sampling lines for monitors located outside of containment are susceptible to clogging from high-solid aerosols. The vendor suggests it is prudent to retain the safety-related status of hydrogen monitors to ensure comprehensive qualification testing.

The NRC believes that the changes to the requirements for hydrogen and oxygen monitors will continue to ensure acceptable monitor performance. If the changes result in a decrease in monitor reliability, it will not be significant and will not affect public health and safety because the functions served by the monitoring systems are not risk-significant for core melt accident sequences. This conclusion is supported by studies documented in the Feasibility Study (Attachment 2 to SECY–00–0198) which indicate the relatively low risk significance of monitoring systems. Because large, dry and sub-atmospheric containments are robust enough to withstand the effects of hydrogen combustion during full core melt accident sequences, hydrogen monitoring is not risk-significant for these containment designs. For BWR Mark I and Mark II containments, hydrogen monitoring systems are not risk-significant in the early stages of a core melt accident because these containments are inerted. For control of combustible gases generated by radiolysis in the late stage of a core melt accident, oxygen monitors are more important than hydrogen monitors for these designs. For this reason, the design and qualification requirements for oxygen monitors are more stringent than they are for hydrogen monitors. During core melt accidents in BWR Mark III and ice condenser containments, the hydrogen igniter systems are initiated by high containment pressure. Because hydrogen monitors are not needed to initiate or activate any mitigative features during these accidents, they are not risk-significant for reducing the combustible gas threat as long as the hydrogen igniters are operable. If the igniters are not operating (such as during station blackout) hydrogen monitoring does not reduce risk since the containment cannot be purged or vented without electrical power. Nevertheless, the amended rule requires licensees to retain hydrogen monitors (and oxygen monitors in Mark I and Mark II BWRs) for their containments because they are useful in implementing emergency planning and severe accident management mitigative actions for beyond design basis accidents.

As noted in sections III C. and D. of this Supplementary Information, as a consequence of eliminating the design-basis LOCA hydrogen release, the oxygen and hydrogen monitors are no longer required to mitigate potential consequences of combustible gases during design-basis LOCA accidents; thus the monitors are not required to be safety-related and need not meet the procurement, quality assurance, and environmental qualification requirements for safety-related components. Even though amended § 50.44 reclassifies requirements for monitoring systems, the hydrogen and oxygen monitoring systems are still required by the rule to be functional, reliable, and capable of continuously measuring the appropriate parameter in the beyond-design-basis accident environment. Thus, licensees must consider the effects of radiation exposure and high-solid aerosols on monitor performance if they will be present in the post-accident environment for the specific type of facility and monitoring system design. The change made by the amended rule is that licensees are no longer required to use only safety-grade monitoring equipment. For a particular facility and monitoring system design, licensees will, in many cases, be able to select appropriate, high quality, commercial-grade monitors that will meet the performance requirements in the rule. In other cases, if no suitable commercial-grade monitors are available, safety-grade monitors may still be necessary. Also, because there are more types and designs of commercial-grade monitors available than there are safety-grade, the ability to use commercial-grade equipment may make it possible for licensees to select a better-suited monitor for their particular application. For example, it is stated in Attachment 2 to SECY–00–0198 that existing safety-grade hydrogen monitors have a limited hydrogen concentration range and are not the optimum choice. Commercial-grade monitors have the ability to monitor a wider range of hydrogen concentration and could be a better solution.

Because the amended rule implements a performance-based requirement for hydrogen and oxygen monitors to be functional, reliable, and capable of continuously measuring the appropriate parameter in the beyond-design-basis accident environment, licensees will have to ensure that their procurement and quality assurance processes for such equipment address equipment reliability and operability in the beyond design basis accident environmental conditions for the specific facility and monitoring system design. Licensees who do not consider reliability and operability in appropriate environmental conditions when designing and procuring monitoring equipment could be found by NRC inspectors to be in violation of the amended rule.

Another vendor asked if additional requirements beyond commercial grade will be imposed on the monitor's pressure retaining components because the analyzer loop forms part of the containment boundary. The monitor's pressure retaining components must meet current regulations concerning containment penetrations. This vendor also asked if their conclusion that grab samples cannot replace continuous monitoring is correct. The NRC has determined that grab samples cannot replace continuous monitoring. However, grab samples may be taken to verify hydrogen concentrations in the latter stages of the accident response.

A vendor asked if two trains of equipment would be an appropriate solution for ensuring analyzer availability. The NRC cannot respond to such a question without more information about the reliability of each individual train. Licensees are required to meet the requirements of the rule. Individual licensees may determine how they will meet the functionality, reliability, and capability requirements of the rule, using appropriate guidance such as the regulatory guide, and subject to NRC review and inspection.

A licensee requested that section C.2.2 of the draft regulatory guide indicate that oxygen monitors are only required for plants that inerted containments. The NRC agrees with the commenter that oxygen monitors are only required for inerted containments, but disagrees with the suggested addition. The first sentence of section C.2.2 already states: ''The proposed Section 50.44 would require that equipment be provided for monitoring oxygen in containments that use an inerted atmosphere for combustible gas control.'' The final version of the regulatory guide continues to indicate that oxygen monitoring is only necessary for facilities that have inerted containments. Thus, the NRC believes that the existing guidance is sufficient. This licensee also requested that another statement in section C.2.2 of the draft regulatory guide regarding existing oxygen monitoring commitments be clarified to show that these systems meet the intent of the rule. The NRC agrees with the need for clarification. The statement has been revised to read: ''Existing oxygen monitoring systems approved by the NRC prior to the effective date of the rule are sufficient to meet this criterion.''

D. Purge

A licensee stated that the (model) safety evaluation (SE) should address the acceptability of eliminating containment purge as the design basis method for post-LOCA hydrogen control. The NRC disagrees. The NRC model SE only addresses requirements in the standard technical specifications or licensee technical specifications (TS). In this case, the NRC model SE is for the elimination of the requirements of hydrogen recombiners, and hydrogen and oxygen monitors from the TS. Because containment purging requirements are not in the standard technical specifications or licensees' technical specifications, the NRC model SE does not make conclusions regarding the acceptability of eliminating containment purging as the design basis method for post-LOCA hydrogen control. However, the following statement from the Statements of Considerations was added to the model SE to address the comment: ''. . . the NRC eliminated the hydrogen release associated with a design-basis LOCA from § 50.44 and the associated requirements that necessitated the need for the hydrogen recombiners and the backup hydrogen vent and purge systems.''

E. Station Blackout/Generic Safety Issue 189

The citizens group stated that the proposed § 50.44 should require the deliberate ignition systems in Mark III and ice condenser containments to be available during station blackout. This comment pertains to resolution of GSI–189. The NRC disagrees with the commenter. The evaluation and resolution of GSI–189 is ongoing and proceeding independently of the rule as noted in Section II of this Supplementary Information.

F. Containment Structural Uncertainties

The citizens group argues that the NRC does not have an adequate non-destructive tool to eliminate concerns that containments were built with voids in their walls, that all steel reinforcement bar was improperly installed during construction to ensure uniform structural integrity of containment walls, and that the concrete used in containment walls is of sufficient quality that leaching of containment walls has not weakened the structure. The commenter states that without such non-destructive tools, it is unreasonable to reduce the defense-in-depth strategy with the proposed rule. The commenter provided no technical basis or information to support the assertion that containments were inadequately constructed. The commenter also asserts that the proposed rule creates an undue risk to the public health and safety to solely accommodate the financial interest of the regulated industry. Again, no technical basis was provided to support the assertion of increased risk.

The NRC disagrees with the commenter. The NRC relies on several layers of protection to prevent, detect, and repair defects discovered during construction of concrete containments, including voids, improperly installed reinforcement bar, and low quality concrete. These layers of protection include:

(1) The implementation by the licensee of their NRC-approved 10 CFR Part 50, Appendix B, Quality Assurance (QA) program and the licensee's Quality Control (QC) program;

(2) The requirements of 10 CFR 50.55(e) that holders of Construction Permits identify, evaluate, and report defects and failures to comply with NRC requirements associated with substantial safety hazards to the NRC in a timely manner, generally within 60 days; and

(3) The verification by NRC inspectors as defined by the NRC's construction inspection program contained in NRC Inspection Manual Chapter 2512 that the construction is in accordance with approved design documents, that the licensee is properly and effectively implementing their QA/QC program, that construction defects are reported to NRC as required by 10 CFR 50.55(e), and that appropriate corrective actions are taken by the licensee.

Whenever there is a doubt about the proper locations of reinforcing bars, or voids in a concrete containment structure, appropriate non destructive examination methods and conservative analysis are used by the licensees to demonstrate that the containment and its vital components are able to perform their intended functions.

In addition, the pre-operational performance of the Structural Integrity Test (SIT) provides an added assurance by physically demonstrating the overall structural capability of a concrete containment. Also, 10 CFR 50.65, the maintenance rule, requires licensees to monitor the performance or condition of certain structures to provide reasonable assurance that the structures are capable of fulfilling their intended function throughout the life of the plant. Licensees must also periodically inspect and test their containments in accordance with the ASME Boiler and Pressure Vessel Code, Section XI, Subsection IWL, and Appendix J to 10 CFR Part 50. Finally, at plants that have renewed their licenses, aging management programs are in effect to monitor containment structures to ensure that aging does not significantly degrade their functional capability.

G. PRA/Accident Analysis

An individual submitted questions in three areas. First, the commenter asked why the 30-minute initiation time for initiating hydrogen monitoring was overly burdensome and suggested that the proposed 90-minute initiation time was arbitrary. The NRC disagrees with the commenter. The 30-minute initiation time was developed following the TMI–2 accident based on engineering judgement on the time within which the hydrogen monitors needed to be made functional. Putting this equipment into service within 30 minutes, as directed in NUREG–0737, was found by some utilities during severe accident training (*e.g.*, on nuclear power plant simulators) to be unnecessarily distracting to operators, because it took them away from more important tasks that needed to be implemented in the near term while the monitoring did not need to be initiated for a longer period. The NRC has determined that performance-based functional requirements rather than prescriptive requirements achieve the desired goal of hydrogen monitor functionality while giving licensees an opportunity to better use operators' time during an accident. The noted 90 minutes come from the time licensees found was needed to get the monitors running in a manner that still met the goal of monitoring hydrogen levels and allowed sufficient time for other operator actions based on severe accident emergency operating procedures. Thus, the 90 minute time period was a result of changing to a performance-based approach and was not arbitrarily specified as the time within which the operators had to act.

The individual also stated that the proposed rule was reducing ''defense in depth'' and that if a utility cannot afford to operate and maintain its nuclear power reactors with the requisite caution and oversight, then the utility should not operate them at all. The NRC disagrees with the commenter's assertion that the amended regulations do not provide adequate defense-in-depth. Defense-in-depth continues to be a prime consideration in NRC decision making. The NRC makes its decisions considering public safety first. Only after public safety is ensured are other issues such as public confidence and reduction of unnecessary burden considered. Defense-in-depth is an element of the NRC's safety philosophy that employs successive measures to prevent accidents or mitigate damage if a malfunction, accident, or naturally caused event occurs at a nuclear facility. It provides redundancy as well as the philosophy of a multiple-barrier approach against fission product releases. Defense-in-depth does not mean that equipment installed in a nuclear power plant never should be removed. Adequate defense-in-depth may be achieved through multiple means or paths.

The commenter also questioned whether the NRC staff has adequate data to demonstrate that the amount of residual and radiolytically-generated combustible gases generated during a design-basis LOCA would not be risk-significant—especially if the LOCA occurred in a plant with older fuel and SSCs than were present during the accident at Three Mile Island, Unit 2. The NRC disagrees with the commenter's assertion that insufficient information is known about hydrogen generation to support amending the current regulations. The amount of hydrogen generated during a design-basis LOCA is not affected by the relative age or vintage of reactor fuel or SSCs. The NRC has developed significant data and insights on the behavior of design-basis and severe accidents after the TMI–2 accident. In amending § 50.44 in 1985, the NRC recognized that an improved understanding of the behavior of accidents involving severe core damage was needed. During the 1980s and 1990s, the NRC devoted significant resources and sponsored a severe accident research program to improve the understanding of core melt phenomena; combustible gas generation, transport, and combustion; and to develop improved models to predict the progression of severe accidents. The results of this research have been incorporated into various studies (*e.g.*, NUREG–1150 and probabilistic risk assessments performed as part of the Individual Plant Examination (IPE) program) to quantify the risk posed by severe accidents for light water reactors. The result of these studies has been an improved understanding of combustible gas behavior during severe accidents. One of the insights from these studies is confirmation that the hydrogen release postulated from a design-basis LOCA was not risk-significant because it would not lead to early containment failure. In addition, it was found that the vast majority of the risk associated with hydrogen combustion was from beyond design-basis (*e.g.*, severe) accidents. The amended requirements are based on the NRC's careful consideration of the post-Three Mile Island information.

H. Passive Autocatalytic Recombiners

An individual questioned why the United States was allowing the removal of recombiners while the French are requiring the installation of passive autocatalytic recombiners in their reactors. The NRC has determined that passive autocatalytic recombiners (PARs) do not need to be considered for U.S. PWRs with large-dry containments or sub-atmospheric containments. This conclusion was drawn after applying the quantitative and qualitative criteria in the form of a framework for risk-informed changes to technical requirements of 10 CFR Part 50 (*See* attachment 1, SECY–00–0198). The NRC found that hydrogen combustion is not a significant threat to the integrity of large, dry containments or sub-atmospheric containments when compared to the 0.1 conditional large release probability of the framework document. In SECY–00–0198, the NRC also concluded that additional combustible gas control requirements for currently licensed large-dry and sub-atmospheric containments were unwarranted.

I. Reactor Venting

An individual expressed concern for the elimination of the requirement prohibiting venting the reactor coolant system if it would aggravate the challenge to containment. According to the comment, the venting could cause an increase in the radiological effluents released off site and an increase in public exposure. The NRC disagrees with the individual's conclusion. As noted in section III.F of this **SUPPLEMENTARY INFORMATION,** the requirement to install high point vents was imposed by the 1981 amendment to § 50.44. This requirement permitted venting of noncondensible gases that may interfere with the natural circulation pattern in the reactor coolant system. This process is regarded as an important safety feature in accident sequences that credit natural circulation of the reactor coolant system. In other sequences, the pockets of noncondensible gases may interfere with pump operation. The high point vents could be instrumental for terminating a core damage accident if ECCS operation is restored. Under these circumstances, venting noncondensible gases from the vessel allows emergency core cooling flow to reach the damaged reactor core and thus, prevents further accident progression.

For certain severe accident sequences, the use of reactor coolant system high point vents is intended to reduce the amount of core damage by providing an opportunity to restore reactor core cooling. Although the release of noncondensible and combustible gases from the reactor coolant system could, in the short term, ''aggravate'' the challenge to containment, the use of these vents will positively affect the overall course of the accident. The release of combustible gases from the reactor coolant system has been considered in the containment design and mitigative features that are required for combustible gas control. Any venting is highly unlikely to affect containment integrity or cause an increase in the radiological effluents released off site that could potentially increase public radiation exposure. However, such venting may reduce the likelihood of further core damage. The reduction in core damage would reduce both the generation of combustible gases and the magnitude of the radiological source term that could be released, thus reducing the potential for public exposure.

An industry organization requested a revision in a statement in section III.F in the statement of considerations (SOC) concerning the purposes of the high point vents from: ''* * * venting noncondensible gases from the vessel allows emergency core cooling flow to reach the damaged core and thus prevents further accident progression'' to '' * * * the purpose of the high point venting is to ensure that natural circulation cooling is an option for maintaining a long term safe stable state following a core damage accident in which significant amounts of noncondensible gases, such as hydrogen might be generated and retained in the reactor coolant system.'' The NRC disagrees with the comment and believes the current wording is adequate. Other information in section III.F adequately defines the purpose of high point vents by acknowledging their usefulness both for forced circulation scenarios and in the natural circulation mode.

J. Design Basis Accident Hydrogen Source Term

A private citizen questioned that because an unexpected hydrogen bubble and an unexpected hydrogen burn occurred during the accident at Three Mile Island, should hydrogen buildup be considered a known risk for which licensees should try to monitor and control as thoroughly as possible? The NRC agrees with the commenter that hydrogen generation during severe accidents is an expected phenomenon. After the TMI accident, the NRC has sponsored an extensive research program on the behavior of severe accidents. This program was designed improve the understanding of core melt phenomena; combustible gas generation, transport, and combustion; and to develop improved models to predict the progression of severe accidents. The results of this research have been incorporated into various studies (*e.g.*, NUREG–1150 and probabilistic risk assessments performed as part of the Individual Plant Examination (IPE) program) to quantify the risk posed by severe accidents for water-cooled reactors.

The result of these studies has been an improved understanding of combustible gas behavior during severe accidents and confirmation that the combustible gas release postulated from a design-basis LOCA was not risk-significant because it would not lead to early containment failure, and that the risk associated with gas combustion was from beyond-design-basis (*e.g.*, severe) accidents. Thus, the requirements for control and monitoring of combustible gases are being reduced for the non-risk-significant design-basis accident scenarios. The amended regulations are entirely consistent with and justified by the findings of the post-TMI studies.

K. Requested Minor Modifications

An industry group requested that the last paragraph of Section B of the draft regulatory guide be changed to read: ''The treatment requirements for the safety-significant components in the combustible gas control systems, the atmospheric mixing systems and the provisions for measuring and sampling are delineated in Section C, Regulatory Position.'' The NRC disagrees with the requested change. Section 50.44 is being revised to eliminate unnecessary requirements relating to combustible gas control in containment. The remaining requirements have been determined by the NRC to be necessary to mitigate the risk associated with combustible gas generation. The regulatory guide provides recommended treatments for all structures, systems, and components credited for meeting those requirements. Because the regulatory guide is only guidance, licensees are free to devise their own treatments for these structures, systems, and components, subject to NRC review and inspection.

L. Atmosphere Mixing

A private citizen suggested adding criteria to the regulatory guide to assess the adequacy of the performance of atmosphere mixing systems. The NRC disagrees with the commenter that these criteria are needed. The NRC has already evaluated the adequacy of atmosphere mixing at currently operating pressurized and boiling water reactors. However, for future water-cooled reactor designs, the NRC has decided to specify that containments must have the capability for ensuring a mixed atmosphere during ''design-basis and significant beyond design-basis accidents''. Other guidance on determining the adequacy of atmosphere mixing systems is also provided in the rule and the regulatory guide.

An industry group requested that the SOC and regulatory guide be revised to only impose requirements on safety-significant hydrogen (atmospheric) mixing systems. They contend that some large dry containments have hydrogen mixing systems in addition to containment fan cooler units. The fan cooler units are supposedly the prime mode of ensuring a mixed atmosphere; therefore, the hydrogen mixing systems are classified as low safety-significance. The industry group believes that regulatory requirements should not be imposed on low safety-significant equipment. The NRC disagrees with the requested change. Section 50.44 is being revised to eliminate unnecessary requirements relating to combustible gas control in containment. The remaining requirements have been determined by the NRC to be necessary to mitigate the risk associated with combustible gas generation. The regulatory guide provides recommended treatments for all structures, systems, and components credited for meeting those requirements. Because the regulatory guide only provides guidance, licensees are free to devise their own treatments for these structures, systems, and components, subject to NRC review and inspection.

M. Current Versus Future Reactor Facilities

An industry group requested that § 50.44(c) be amended to clarify that its requirements relate only to light-water reactors. The NRC acknowledges that the proposed requirements in § 50.44(c) were largely patterned after light-water reactor requirements and might not be specifically applicable to all types of future light-water and non light-water reactor designs. Therefore, the NRC has modified § 50.44(c) to apply only to future water-cooled reactors with characteristics such that the potential for production of combustible gases during design-basis and significant beyond design-basis accidents is comparable to current light-water reactor designs. In addition, the NRC has added a new paragraph (d) that specifies combustible gas control information to be provided by applicants for future reactor designs when the potential for the production of combustible gases is not comparable to current light-water reactor designs. The purpose of this information is to determine if combustible gas generation is technically relevant to the proposed design; and, if so, to demonstrate that safety impacts of combustible gases generated during design-basis and significant beyond design-basis accidents have been addressed in the design of the facility to ensure adequate protection of public health and safety and common defense and security.

The industry group also commented that the regulatory guide is unclear on what parts are applicable to existing reactors and what parts are applicable to future reactors. The Introduction and section B do not agree. The NRC agrees. The regulatory guide has been modified to clarify the applicability of the revised § 50.44 to present and future water-cooled and non water-cooled reactors. The industry group also noted that the proposed language, the draft regulatory guide, and the proposed change to the Standard Review Plan incorrectly assume that all new reactor designs will be light-water reactors and will present the same combustible gas hazard. Future reactors, whether light-water or non-light-water may use different materials, cooling, or moderating mediums that may not result in the production of the same combustible gases, or quantities of combustible gas as the current light-water reactor designs. The NRC agrees. For the reasons given above, the final rule, the regulatory guide, and the standard review plan have all been modified to clarify their applicability to future reactor designs.

N. Equipment Qualification/Survivability

A licensee suggested adding a clarifying statement to the SOC concerning equipment survivability for Mark III and ice condenser plants. The commenter requested a statement clearly stating that no new equipment survivability requirements are being imposed and that existing equipment survivability and environmental analyses remain valid for compliance with the revised rule. The NRC agrees with commenter that the rule does not impose any additional equipment survivability requirements on licensees; existing equipment survivability and environmental analyses remain valid. The hydrogen and oxygen monitoring systems are required by the rule to be functional, reliable, and capable of continuously measuring the appropriate parameter in the beyond design-basis accident environment.

This licensee also noted that, due to the reclassification of the hydrogen and oxygen monitors from RG 1.97 Category I to lower categories, these monitors no longer have to be qualified in accordance with 10 CFR 50.49. The NRC agrees that the monitoring equipment need not be qualified in accordance with § 50.49. The hydrogen and oxygen monitoring systems are still required by the rule to be functional, reliable, and capable of continuously measuring the appropriate parameter in the beyond design-basis accident environment.

The licensee suggested that the NRC clarify that the revised rule will not affect the requirements or environmental conditions used by licensees to demonstrate compliance with § 50.49. The NRC agrees with the commenter that existing licensee analyses and environmental conditions used to establish compliance with 10 CFR 50.49 will not be affected by the amended rule and that no new analyses or environmental conditions are imposed by these amendments to § 50.44.

V. Petitions for Rulemaking—PRM–50–68

The NRC received a petition for rulemaking submitted by Bob Christie of Performance Technology, Knoxville, Tennessee, in the form of two letters dated October 7, 1999, and November 9, 1999. The petition requested that the NRC amend its regulations concerning hydrogen control systems at nuclear power plants. The petitioner believes that the current regulations on hydrogen control systems at some nuclear power plants are detrimental and present a health risk to the public. The petitioner believes that similar detrimental situations may apply to other systems as well (such as the requirement for a 10-second diesel start time). The petitioner believes his proposed amendments would eliminate those situations associated with hydrogen control systems that present adverse conditions at nuclear power plants. The petition was docketed as PRM–50–68 on November 15, 1999. On January 12, 2000 (65 FR 1829), the NRC published a notice of receipt of this petition in the **Federal Register** that summarized the issues it contains.

Specifically, the petitioner performed a detailed review of the San Onofre Task Zero Safety Evaluation Report (Pilot Program for Risk-Informed Performance-Based Regulation) conducted by the NRC staff and dated September 3, 1998, concerning that plant's hydrogen control system. The petitioner requested that the NRC:

1. Retain the existing requirement in § 50.44(b)(2)(i) for inerting the atmosphere of existing Mark I and Mark II containments.

2. Retain the existing requirement in § 50.44(b)(2)(ii) for hydrogen control systems in existing Mark III and PWR ice condenser containments to be capable of handling hydrogen generated by a metal/water reaction involving 75 percent of the fuel cladding.

3. Require all future light water reactors to postulate a 75 percent metal/water reaction (instead of the 100 percent required by the current rule) for analyses undertaken pursuant to § 50.44(c).

4. Retain the existing requirements in § 50.44 for high point vents.

5. Eliminate the existing requirement in § 50.44(b)(2) for a mixed atmosphere in containment.

6. Eliminate the existing requirement for hydrogen releases during design basis accidents of an amount equal to that produced by a metal/water reaction of 5 percent of the cladding.

7. Eliminate the requirement for hydrogen recombiners or purge in LWR containments.

8. Eliminate the existing requirements for hydrogen and oxygen monitoring in LWR containments.

9. Revise GDC 41—Containment Atmosphere Cleanup—to require systems to control fission products and other substances that may be released into the reactor containment for accidents only where there is a high probability that fission products will be released to the reactor containment.

10. Issue an interim policy statement applicable to all NRC staff to ensure that the NRC Executive Director for Operations was promptly notified whenever staff discovered cases where compliance with design-basis accident requirements was detrimental to public health.

The NRC received five comment letters on PRM–50–68. The commenters included two nuclear power plant licensees, a nuclear reactor vendor, a nuclear power plant owners group, and the Nuclear Energy Institute (NEI). Copies of the public comments on PRM–50–68 are available for review in the NRC Public Document Room, 11555 Rockville Pike, Rockville, Maryland. All commenters were supportive of some of the issues raised by the petition. One of the reactor licensees commented that analytical and risk bases exist to support the proposed changes for Mark I Boiling Water Reactor containments. The other licensee endorsed the comments submitted by NEI. The reactor vendor commented that the petitioner's proposal simplifies the language and requirements of the regulation while retaining an equivalent level of safety. However, the vendor also noted that the proposal does not appear to address the structural integrity of the containment as in the existing language at § 50.44(c)(3)(iv). The owner's group commented that the changes requested by the petitioner for large, dry containments were also applicable to ice condenser containments and suggested that the requirement for all hydrogen control measures in § 50.44 be reexamined and made ''consistent with many other portions of plant operation and maintenance.'' The NEI agreed with the petitioner that the San Onofre hydrogen control licensing actions could be applied generically for pressurized water reactors with large, dry (including subatmospheric) containments. One licensee, the reactor vendor and the NEI disagreed with the petitioner's position that an interim policy statement is necessary to instruct the NRC staff how to proceed in instances when ''adherence to design basis requirements would be detrimental to public health.'' The other commenters were silent regarding the request for an interim policy statement.

The NRC has evaluated the technical issues and the associated public comments and has determined that the specific issues contained in PRM–50–68 should be granted in part and denied in part as discussed in the following paragraphs.

Issue 1: Retain the existing requirement for inerting the atmosphere of existing Mark I and Mark II containments.

Resolution of Issue 1: Consistent with the petitioner's request, § 50.44(b)(2)(i) of the final rule retains the current requirement for inerting of existing Mark I and Mark II containments. The NRC's basis for this decision is provided in section III A. of this document.

Issue 2: Retain the existing requirement for hydrogen control systems in existing Mark III and PWR ice condenser containments to be capable of handling hydrogen generated by a metal/water reaction involving 75 percent of the fuel cladding.

Resolution of Issue 2: Consistent with the petitioner's request, § 50.44(b)(2)(ii) of the final rule retains the above requirement for hydrogen control systems in existing Mark III and PWR ice condenser containments to be capable of handling hydrogen generated by a metal/water reaction involving 75 percent of the fuel cladding. The NRC's basis for this decision is provided in section III A. of this document.

Issue 3: Require all future light water reactors to postulate a 75 percent metal/water reaction (instead of the 100 percent required by the current rule) for analyses under § 50.44(c).

Resolution of Issue 3: The NRC declines to adopt this request. For future water-cooled reactors, the final rule retains the previous requirement to postulate hydrogen generation by a 100 percent metal/water reaction when performing structural analyses of reactor containments under accident conditions. Future containments that cannot structurally withstand the consequences of this amount of hydrogen must be inerted or must be equipped with equipment to reduce the concentration of hydrogen during and following an accident. The NRC's basis for this decision is provided in section III E. of this document.

Issue 4: Retain the existing requirements for high point vents.

Resolution of Issue 4: Consistent with the petitioner's request, the requirements for high point vents in former 10 CFR 50.44(c)(3)(iii) have been retained in the final rule, but have been modified slightly to clarify the acceptable use of these vents during and following an accident. Because the need for high point vents is relevant to ECCS performance during severe accidents and is not pertinent to combustible gas control, these high point venting requirements have been removed from 10 CFR 50.44 and relocated to 10 CFR 50.46a where the remaining requirements for ECCS are located. The basis for this decision is provided in section III F. of this document.

Issue 5 Eliminate the existing requirement in § 50.44(b)(2) to ensure a mixed atmosphere in containment.

Resolution of Issue 5: The NRC declines to adopt this request. The final rule retains the requirement for all containments to ensure a mixed atmosphere to prevent local accumulation of combustible or detonable gasses that could threaten containment integrity or equipment operating in a local compartment. The NRC's basis for retaining this requirement is provided in section III A. of this document.

Issue 6: Eliminate the existing requirement for postulating design basis accident hydrogen releases of an amount equal to that produced by a metal/water reaction of 5 percent of the cladding.

Resolution of Issue 6: The NRC grants this request. The NRC has determined that hydrogen release during design basis accidents is not risk-significant because it does not contribute to the conditional probability of a large release of radionuclides up to approximately 24 hours after the onset of core damage. The NRC believes that accumulation of combustible gases beyond 24 hours can be managed by implementation of severe accident management guidelines. The NRC's technical basis for eliminating this requirement is discussed in greater detail in section III B. of this document.

Issue 7: Eliminate the requirement for hydrogen recombiners or purge in light-water reactor containments.

Resolution of Issue 7: The NRC grants this request. As noted in Issue 6 above, the NRC has determined that hydrogen release during design basis accidents is not risk-significant because it does not contribute to the conditional probability of a large release of radionuclides up to approximately 24 hours after the onset of core damage. The NRC believes that accumulation of combustible gases beyond 24 hours can be managed by implementation of severe accident management guidelines. Thus, hydrogen recombiners and hydrogen vent and purge systems are not required. The NRC's basis for eliminating these requirements is discussed in greater detail in section III B. of this document.

Issue 8: Eliminate the existing requirements for hydrogen and oxygen monitoring in light-water reactor containments.

Resolution of Issue 8: The NRC declines to adopt this request. The final rule retains the existing requirement for monitoring hydrogen in the containment atmosphere for all plant designs. Hydrogen monitors are required to assess the degree of core damage during beyond design-basis accidents. Hydrogen monitors are also used in conjunction with oxygen monitors to guide licensees in implementation of severe accident management strategies. Also, the NRC has decided to codify the existing regulatory practice of monitoring oxygen in containments that use an inerted atmosphere for combustible gas control. If an inerted containment became de-inerted during a beyond design-basis accident, other severe accident management strategies, such as purging and venting, would need to be considered. Monitoring of both hydrogen and oxygen is necessary to implement these strategies. The NRC's bases for these requirements are discussed in greater detail in sections III C. and III D. of this document.

Issue 9: Revise GDC 41—Containment Atmosphere Cleanup—to require systems to control fission products and other substances that may be released into the reactor containment for accidents only when there is a high probability that fission products will be released to the reactor containment.

Resolution of Issue 9: The NRC declines to adopt the petitioner's request on this issue. The NRC believes that the amended rule alleviates the need to revise Criterion 41. In a December 4, 2001, letter from the petitioner to the NRC, the petitioner inferred that the intent of the proposed change was to focus Criterion 41 on the containment capability when a severe accident occurs. This concern is addressed in the final § 50.44 that establishes the design criteria for reactor containment and associated equipment for controlling combustible gas released during a postulated severe accident. The General Design Criteria in Appendix A of 10 CFR Part 50 were established to set the minimum requirements for the principal design criteria for water-cooled nuclear power plants. The postulated accidents used in the development of these minimum design criteria are normally design-basis accidents. The NRC believes it is not appropriate to address severe accident design requirements in the General Design Criteria.

Issue 10: The petitioner requested the NRC to issue an interim policy statement applicable to the NRC staff to ensure that the NRC Executive Director for Operations was promptly notified whenever the staff discovered cases where compliance with design-basis accident requirements was detrimental to public health.

Resolution of Issue 10: The petitioner's additional request for an interim policy statement is not part of the petition for rulemaking. Nevertheless, the NRC has evaluated the request and associated public comments and has concluded that hydrogen control requirements referenced by the petitioner have been modified in the final rule so that design basis requirements ensure adequate protection of public health and safety. The NRC also believes that if NRC staff members discover future situations when design basis requirements detract from safety, the staff will elevate these issues for management review; thus, no NRC staff guidance in this area is necessary.

Petition for Rulemaking—PRM–50–71

The NRC also received a petition for rulemaking submitted by NEI. The petition, dated April 12, 2000, was published in the **Federal Register** for public comment on May 31, 2000 (65 FR 34599). The petitioner requested that the NRC amend its regulations to allow nuclear power plant licensees to use zirconium-based cladding materials other than Zircaloy or ZIRLO, provided the cladding materials meet the requirements for fuel cladding performance and have been approved by the NRC staff. The petitioner believes the proposed amendment would improve the efficiency of the regulatory process by eliminating the need for individual licensees to obtain exemptions to use advanced cladding materials that have already been approved by the NRC.

Specifically, the petitioner states that the NRC's current regulations require uranium oxide fuel pellets, used in commercial reactor fuel, to be contained in cladding material made of Zircaloy or ZIRLO. The petitioner indicates that the requirement to use either of these materials is stated in § 50.44 and § 50.46. The petitioner notes that subsequent to promulgation of these regulations, commercial nuclear fuel vendors have developed and continue to develop materials other than Zircaloy or ZIRLO that the NRC reviews and approves for use in commercial power reactor fuel. Each of these approvals requires the NRC to grant an exemption to the licensee that requests to use fuel with these cladding materials. The petitioner requests that the NRC amend its regulations to allow licensees discretion to use zirconium-based cladding materials other than Zircaloy or ZIRLO, provided that the cladding materials meet the fuel cladding performance requirements and have been reviewed and approved by the NRC staff. The petitioner notes that during the past nine years there have been at least eight requests for exemptions and that each exemption has cost more than $50,000. The petitioner states that the requests for exemptions have become increasingly more frequent, causing significant administrative confusion and having a potentially adverse effect on efficient and effective use of NRC, licensee, and vendor resources.

The petitioner believes the NRC should amend § 50.44 and § 50.46 to allow the use of other zirconium-based alloys in addition to those specified in the current regulations. The petitioner states that the stated goal of the existing regulations is to ensure adequate cooling for reactor fuel in case of a design-basis accident. However, the petitioner asserts that the proposed amendment does not degrade the ability to meet that goal. The petitioner believes it removes an unwarranted licensing burden without increasing risk to public health and safety.

The NRC received 11 comment letters on PRM 50–71. Seven comments were from nuclear reactor licensees, two from individual members of the public, one from a nuclear reactor vendor and one from a nuclear industry trade association (NEI). Five of the nuclear reactor licensees were supportive of the petition and endorsed the comments and positions provided by NEI in their comments on the petition. One licensee stated that the proposed rule should note that if a fuel vendor's cladding has met the requirements for use on a generic basis, a process for the implementing utility to use that fuel under their existing license already exists. Another licensee agreed that industry needs relief on use of zirconium-based cladding, but because cladding is a critical safety barrier, the basis for relief should come from proven, in-reactor performance. A better approach would be to update the approved list of allowed fuel rod cladding materials as more products demonstrate reliable, in-reactor performance.

Two comments were received from individuals. One individual opposed the petition because it did not contain the specific review and acceptance criteria that NRC would utilize when reviewing and approving future cladding materials under the proposed rule. The commenter also opposed the practice of allowing lead fuel assembly tests to demonstrate performance of new materials in commercial reactors before NRC approval, but also stated that long term performance testing of materials was necessary, must take into account any differences at individual utilities, and must consider future performance in dry cask storage systems. Another individual commented that the petition should be denied because the evaluations of cladding materials do not account for the realities of plant operation under normal conditions and the loss of coolant accident environment. This commenter stated that NRC approval of materials whose properties fell ''within'' acceptance criteria was unacceptable because an approval might be issued for a material whose properties were ''right to the limit'' without an adequate margin of safety. With respect to hydrogen generation, the commenter opposed generic approvals of new materials because site-specific material variations might yield unexpected results.

The nuclear reactor vendor supported adoption of the proposed rule changes published in the **Federal Register** and agreed with the suggested revision of § 50.46(e) proposed by NEI in its comments on the document. The vendor also recommended consideration of a direct final rule process to implement the petition. The NEI provided revised wording for proposed language in § 50.46(e) and urged the NRC to promulgate the revision as a direct final rule.

After evaluating the petition and public comments, the NRC has determined that the petition should be denied in part. The final § 50.44 rule has been written so that it does not refer to specific types of zirconium cladding; instead, the rule applies to all boiling and pressurized water reactors. When the NRC approves the use of boiling or pressurized water reactor fuel with other types of cladding, no exemptions from § 50.44 will be needed. Thus, even though the final rule does not contain the language specifically requested to be added by the petitioner, the rule accomplishes the petitioner's intended purpose with respect to § 50.44. Also, the NRC did not utilize the direct final rulemaking process because the other provisions being amended in § 50.44 were too complex to allow the promulgation of a direct final rule. The NRC is making no decision at this time on the part of the petition regarding the request to amend the regulations in § 50.44 to allow the use of other zirconium-based alloys in addition to those specified in the current regulations. The NRC will evaluate that portion of the NEI petition in a separate action.

VII. Section-by-Section Analysis of Substantive Changes

Section 50.34—Contents of Applications; Technical Information

Paragraph (a)(4) on ECCS performance is revised to reference the reactor coolant system high point venting requirements located in § 50.46a. These requirements were relocated to § 50.46a from § 50.44.

Paragraph (g) is redesignated as paragraph (h) and a new paragraph (g) is added, that requires applications for future reactors to include the analyses and descriptions of the equipment and systems required by § 50.44.

Section 50.44—Combustible Gas Control in Containment

Paragraph (a), *Definitions.* Paragraph (a) adds definitions for two previously undefined terms, ''mixed atmosphere,'' and ''inerted atmosphere.''

Paragraph (b), *Requirements for currently-licensed reactors.* This paragraph sets forth the requirements for control of combustible gas in containment for currently-licensed reactors. All BWRs with Mark I and II type containments are required to have an inerted containment atmosphere, and all BWR Mark III type containments and PWRs with ice condenser type containments are required to include a capability for controlling combustible gas generated from a metal water reaction involving 75 percent of the fuel cladding surrounding the active fuel region (excluding the cladding surrounding the plenum volume) so that there is no loss of containment integrity. Current requirements in § 50.44(c)(i), (iv), (v), and (vi) are incorporated in to the amended regulation without substantial change. Previously reviewed and installed combustible gas control mitigation features to meet the existing regulations are considered to be sufficient to meet this section. Because these requirements address beyond design-basis combustible gas control, it is acceptable for structures, systems, and components provided to meet these requirements to be non safety-related and may be procured as commercial grade items.

Paragraph (b)(1), *Mixed atmosphere.* The requirement for capability ensuring a mixed atmosphere in all containments is consistent with the current requirement in § 50.44(b)(2) and does not require further analysis or modifications by current licensees. The intent of this requirement is to maintain those plant design features (*e.g.*, availability of active mixing systems or open compartments) that promote atmospheric mixing. The requirement may be met with active or passive systems. Active systems may include a fan, a fan cooler, or containment spray. Passive capability may be demonstrated by evaluating the containment for susceptibility to local hydrogen concentration. These evaluations have been conducted for currently licensed reactors as part of the IPE program.

Paragraph (b)(3) retains the existing requirements for BWR Mark III and PWR ice condenser facilities that do not use inerting to establish and maintain safe shutdown and containment structural integrity to use structures, systems, and components capable of performing their functions during and after exposure to hydrogen combustion.

Paragraph (b)(4)(i) codifies the existing regulatory practice of monitoring oxygen in containments that use an inerted atmosphere for combustible gas control. The rule does not require further analysis or modifications by current licensees but certain design and qualification criteria are relaxed. The rule requires that equipment for monitoring oxygen be functional, reliable and capable of continuously measuring the concentration of oxygen in the containment atmosphere following a beyond design-basis accident. Equipment for monitoring oxygen must perform in the environment anticipated in the severe accident management guidance. The oxygen monitors are expected to be of high-quality and may be procured as commercial grade items. Existing oxygen monitoring commitments for currently licensed plants are sufficient to meet this rule.

Paragraph (b)(4)(ii) retains the requirement in § 50.44(b)(1) for measuring the hydrogen concentration in the containment. The rule does not require further analysis or modifications by current licensees but certain design and qualification criteria are relaxed. The rule requires that equipment for monitoring hydrogen be functional, reliable and capable of continuously measuring the concentration of hydrogen in the containment atmosphere following a significant beyond design-basis accident of comparable severity to the accident at Three Mile Island. Equipment for monitoring hydrogen must perform in the environment anticipated in the severe accident management guidance. The hydrogen monitors may be procured as commercial grade items. Existing hydrogen monitoring commitments for currently licensed plants are sufficient to meet this rule.

Paragraph (b)(5) retains the current analytical requirements in § 50.44(c)(3)(iv) that BWR Mark III and PWR ice condenser containments be provided with a hydrogen control system justified by a suitable program of experiment and analysis that can handle without loss of containment integrity an amount of hydrogen equivalent to that generated by a metal-water reaction involving 75 percent of the fuel cladding surrounding the active fuel. Existing licensee hydrogen control systems and analyses are expected to be sufficient to demonstrate compliance with this requirement.

Paragraph (c), *Requirements for future water-cooled reactor applicants and licensees.* Paragraph (c) promulgates requirements for combustible gas control in containment for all future water-cooled reactor construction permits or operating licenses under Part 50 and for all water-cooled reactor design approvals, design certifications, combined licenses, or manufacturing licenses under Part 52, whose reactor designs have comparable potential for the production of combustible gases as current light water reactor designs. The current requirements in § 50.34(f)(2)(ix) and (f)(3)(v) are retained without material change, but have been consolidated and reworded to be more concise. Paragraph (c)(1) requires a mixed containment atmosphere during design-basis and significant beyond design-basis accidents. This wording was chosen to specify a mixed atmosphere requirement during important accident scenarios similar to the current requirements for PWR and BWR containments. Paragraph (c)(2) requires all containments to 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 percent fuel-clad coolant reaction, uniformly distributed, to less than 10 percent and maintain containment structural integrity and appropriate accident mitigating features. Structures, systems, and components (SSCs) provided to meet this requirement must be designed to provide reasonable assurance that they will operate in the severe accident environment for which they are intended and over the time span for which they are needed. Equipment survivability expectations under severe accident conditions should consider the circumstances of applicable initiating events (such as station blackout [1] or earthquakes) and the environment (including pressure, temperature, and radiation) in which the equipment is relied upon to function. The required system performance criteria will be based on the results of design-specific reviews which include probabilistic risk-assessment as required by § 52.47(a)(1)(v). Because these requirements address beyond design-basis combustible gas control, SSCs provided to meet these requirements need not be subject to the environmental qualification requirements of § 50.49; quality assurance requirements of 10 CFR Part 50, Appendix B; and redundancy/diversity requirements of 10 CFR Part 50, Appendix A. Guidance such as that found in Appendices A and B of RG 1.155, ''Station Blackout,'' is appropriate for equipment used to mitigate the consequences of severe accidents. Paragraph (c) also promulgates requirements for ensuring a mixed atmosphere and monitoring oxygen and hydrogen in containment, consistent with the requirements for current plants set forth in paragraphs (b)(1), and (b)(4)(i) and (ii).

Paragraph (d), *Requirements for future non water-cooled reactor applicants and licensees and certain water-cooled reactor applicants and licensees.* A new paragraph (d) is added to specify information that must be submitted by future reactor applicants to determine if combustible gas generation is technically relevant to the proposed design. If combustible gas generation is technically relevant, the applicant must submit additional information to demonstrate that safety impacts of combustible gases generated during design-basis and significant beyond-design-basis accidents have been addressed in the design of the facility to ensure adequate protection of public health and safety and common defense and security. Paragraph (d) is applicable to non water-cooled reactors and water-cooled reactors that have different characteristics regarding the production of combustible gases from current light water reactors. The information must address the potential for producing combustible gases during design basis accidents and significant beyond design-basis accidents comparable to accident scenarios that were evaluated for combustible gas generation at current light water reactors.

Section 50.46a—Acceptance Criteria for Reactor Coolant System Venting Systems

Section 50.46a is a new section that contains the relocated requirements for high point vents currently contained in § 50.44. The amendment includes a change that eliminates a requirement prohibiting venting the reactor coolant system if it could ''aggravate'' the challenge to containment. Any venting is highly unlikely to affect containment integrity; however, such venting will reduce the likelihood of further core damage. The NRC continues to view use of the high point vents as an important strategy that should be considered in a plant's severe accident management guidelines.

Section 52.47—Contents of Applications

Section 52.47 is amended to eliminate the reference to paragraphs within § 50.34(f) for technically relevant requirements for combustible gas control in containment for future design certifications. Under the final rule, the technical requirements for combustible gas control will be set forth in § 50.44, rather than in § 50.34(f).

VIII. Availability of Documents

The NRC is making the documents identified below available to interested persons through one or more of the following methods as indicated.

Public Document Room (PDR). The NRC Public Document Room is located at One White Flint North, Public File Area O 1F21, 11555 Rockville Pike, Rockville, Maryland.

Rulemaking Web site (Web). The NRC's interactive rulemaking Web site is located at *http://ruleforum.llnl.gov.* These documents may be viewed and downloaded electronically via this Web site.

NRC's Electronic Reading Room (ERR). The NRC's public electronic reading room is located at *http://www.nrc.gov/NRC/ADAMS/index.html.* (Provide accession number for each document.)

The NRC staff contact (NRC Staff). Richard Dudley, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, DC 20555–0001; telephone (301) 415–1116; e-mail *rfd@nrc.gov.*

Document	PDR	Web	ERR	NRC staff
Comments received	X	X	X	
Regulatory Analysis	X	X	ML031640482	
RG 1.7, Rev. 3	X	X	ML031640498	X
Rev. SRP, Section 6.2.5	X	X	ML031640518	X

A free single copy of Regulatory Guide 1.7 may be obtained by writing to the Office of the Chief Information Officer, Reproduction and Distribution Services Section, U.S. Nuclear Regulatory Commission, Washington, DC 20555–0001, or E-mail: *DISTRIBUTION@nrc.gov* or Facsimile: (301) 415–2289.

Copies of NUREGS may be purchased from The Superintendent of Documents, U.S. Government Printing Office, Mail Stop SSOP, Washington, DC 20402–0001; Internet: bookstore@gpo.gov; (202) 512–1800. Copies are also available from the National Technical Information Service, Springfield, VA 22161–0002; *http://www.ntis.gov;* 1–800–533–6847 or, locally, (703) 605–6000. Some publications in the NUREG series are posted at NRC's technical document Web site *http://www.nrc.gov/NRC/NUREGS/indexnum.html.*

IX. Voluntary Consensus Standards

The National Technology Transfer and Advancement Act of 1995, Pub. L. 104–113, requires that Federal agencies use technical standards that are developed or adopted by voluntary consensus standards bodies unless using such a standard is inconsistent with applicable law or is otherwise impractical. In this final rule, the NRC is using the following Government-unique standard: 10 CFR 50.44, U.S.

[1] Section 50.44 does not require the deliberate ignition systems used by BWRs with Mark III type containments and PWRs with ice condenser type containments to be available during station blackout events. The deliberate ignition systems should be available upon the restoration of power. Additional guidance concerning the availability of deliberate ignition systems during station blackout sequences is being developed as part of the NRC review of Generic Safety Issue 189: ''Susceptibility of Ice Condenser and Mark III Containments to Early Failure from Hydrogen Combustion During a Severe Accident.''

Nuclear Regulatory Commission, October 27, 1978 (43 FR 50163), as amended. No voluntary consensus standard has been identified that could be used instead of the Government-unique standard.

X. Finding of No Significant Environmental Impact: Environmental Assessment

The NRC has determined under the National Environmental Policy Act of 1969, as amended, and the Commission's regulations in Subpart A of 10 CFR Part 51, that this rule is not a major Federal action significantly affecting the quality of the human environment and, therefore, an environmental impact statement is not required. The basis for this determination reads as follows:

This action endorses existing requirements and establishes regulations that reduce regulatory burdens for current and future licensees and consolidates combustible gas control regulations for future reactor applicants and licensees. This action stems from the NRC's ongoing effort to risk-inform its regulations. The final rule reduces the regulatory burdens on present and future power reactor licensees by eliminating the LOCA design-basis accident as a combustible gas control concern. This change eliminates the requirements for hydrogen recombiners and hydrogen purge systems and relaxes the requirements for hydrogen and oxygen monitoring equipment to make them commensurate with their safety and risk significance.

This action does not significantly increase the probability or consequences of an accident. No changes are being made in the types or quantities of radiological effluents that may be released off site, and there is no significant increase in public radiation exposure because there is no change to facility operations that could create a new or affect a previously analyzed accident or release path. There may be a reduction of occupational radiation exposure since personnel will no longer be required to maintain or operate, if necessary, the hydrogen recombiner systems which are located in or near radiologically controlled areas.

With regard to non-radiological impacts, no changes are being made to non-radiological plant effluents and there are no changes in activities that would adversely affect the environment. Therefore, there are no significant non-radiological impacts associated with the proposed action.

The primary alternative to this action would be the no action alternative. The no action alternative would continue to impose unwarranted regulatory burdens for which there would be little or no safety, risk, or environmental benefit.

The determination of this environmental assessment is that there is no significant offsite impact to the public from this action.

The NRC requested the views of the States on the environmental assessment for this rule. No comments were received.

XI. Paperwork Reduction Act Statement

This final rule decreases the burden on new applicants to complete the hydrogen control analysis required to be submitted in a license application, as required by sections 50.34 or 52.47. The public burden reduction for this information collection is estimated to average 720 hours per request. Because the burden for this information collection is insignificant, Office of Management and Budget (OMB) clearance is not required. Existing requirements were approved by the Office of Management and Budget, approval numbers 3150–0011 and 3150–0151.

XII. Public Protection Notification

The NRC may not conduct or sponsor, and a person is not required to respond to, a request for information or an information collection requirement unless the requesting document displays a currently valid OMB control number.

XIII. Regulatory Analysis

The NRC has prepared a regulatory analysis on this regulation. The analysis examines the costs and benefits of the alternatives considered by the NRC. The regulatory analysis is available as indicated under the Availability of Documents heading of the Supplementary Information section.

XIV. Regulatory Flexibility Certification

In accordance with the Regulatory Flexibility Act (5 U.S.C. 605(b)), the Commission certifies that this rule does not have a significant economic impact on a substantial number of small entities. This final rule affects only the licensing and operation of nuclear power plants. The companies that own these plants do not fall within the scope of the definition of ''small entities'' set forth in the Regulatory Flexibility Act or the size standards established by the NRC (10 CFR 2.810).

XV. Backfit Analysis

The NRC has determined that the backfit rule does not apply to this final rule; and therefore, a backfit analysis is not required for this final rule because these amendments do not impose more stringent safety requirements on 10 CFR Part 50 licensees. For current licensees, the amendments either maintain without substantive change existing requirements or provide voluntary relaxations to current regulatory requirements. Voluntary relaxations (*i.e.*, relaxations that are not mandatory) are not considered backfitting as defined in 10 CFR 50.109(a)(1). For future applicants and future licensees, the amendments also do not involve backfitting as defined in 10 CFR 50.109(a)(1) because the changes have only a prospective effect on future design approval and design certification applicants and future applicants for licensees under 10 CFR Part 50 and 52. As the Commission has indicated in other rulemakings, sec., *e.g.*, 54 FR 15372, April 18, 1989 (Final Part 52 Rule), the expectations of future applicants are not protected by the Backfit Rule. Therefore, the NRC has not prepared a backfit analysis for this final rule.

XVI. Small Business Regulatory Enforcement Fairness Act

In accordance with the Small Business Regulatory Enforcement Fairness Act of 1996, the NRC has determined that this action is not a major rule and has verified this determination with the Office of Information and Regulatory Affairs of OMB.

List of Subjects

10 CFR Part 50

Antitrust, Classified information, Criminal penalties, Fire protection, Intergovernmental relations, Nuclear power plants and reactors, Radiation protection, Reactor siting criteria, Reporting and record keeping requirements.

10 CFR Part 52

Administrative practice and procedure, Antitrust, Backfitting, Combined license, Early site permit, Emergency planning, Fees, Inspection, Limited work authorization, Nuclear power plants and reactors, Probabilistic risk assessment, Prototype, Reactor siting criteria, Redress of site, Reporting and record keeping requirements, Standard design, Standard design certification.

■ For the reasons set out in the preamble and under the authority of the Atomic Energy Act of 1954, as amended; the Energy Reorganization Act of 1974, as amended; and 5 U.S.C. 552 and 553, the

NRC is adopting the following amendments to 10 CFR Parts 50 and 52.

PART 50—DOMESTIC LICENSING OF PRODUCTION AND UTILIZATION FACILITIES

■ 1. The authority citation for Part 50 continues to read as follows:

Authority: Secs. 102, 103, 104, 105, 161, 182, 183, 186, 189, 68 Stat. 936, 938, 948, 953, 954, 955, 956, as amended, sec. 234, 83 Stat. 444, as amended (42 U.S.C. 2132, 2133, 2134, 2135, 2201, 2232, 2233, 2239, 2282); secs. 201, as amended, 202, 206, 88 Stat. 1242, as amended, 1244, 1246 (42 U.S.C. 5841, 5842, 5846).

Section 50.7 also issued under Pub. L. 95–601, sec. 10, 92 Stat. 2951, as amended by Pub. L. 102–486, sec. 2902, 106 Stat. 3123 (42 U.S.C. 5851). Section 50.10 also issued under secs. 101, 185, 68 Stat. 936, 955, as amended (42 U.S.C. 2131, 2235); sec. 102, Pub. L. 91–190, 83 Stat. 853 (42 U.S.C. 4332). Sections 50.13, 50.54(dd), and 50.103 also issued under sec. 108, 68 Stat. 939, as amended (42 U.S.C. 2138). Sections 50.23, 50.35, 50.55, and 50.56 also issued under sec. 185, 68 Stat. 955 (42 U.S.C. 2235). Sections 50.33a, 50.55a and Appendix Q also issued under sec. 102, Pub. L. 91–190, 83 Stat. 853 (42 U.S.C. 4332). Sections 50.34 and 50.54 also issued under Pub. L. 97–415, 96 Stat. 2073 (42 U.S.C. 2239). Section 50.78 also issued under sec. 122, 68 Stat. 939 (42 U.S.C. 2152). Sections 50.80—50.81 also issued under sec. 184, 68 Stat. 954, as amended (42 U.S.C. 2234). Appendix F also issued under sec. 187, 68 Stat. 955 (42 U.S.C. 2237).

■ 2. In § 50.34, paragraph (a)(4) is revised, paragraph (g) is redesignated as paragraph (h), and a new paragraph (g) is added to read as follows:

§ 50.34 Contents of applications; technical information.

(a) * * *

(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 the margins of safety during normal operations and transient conditions anticipated during the life of the facility, and 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 must be performed in accordance with the requirements of § 50.46 and § 50.46a of this part for facilities for which construction permits may be issued after December 28, 1974.

* * * * *

(g) *Combustible gas control.* All applicants for a reactor construction permit or operating license under this part, and all applicants for a reactor design approval, design certification, or license under part 52 of this chapter, whose application was submitted after October 16, 2003, shall include the analyses, and the descriptions of the equipment and systems required by § 50.44 as a part of their application.

* * * * *

■ 3. Section 50.44 is revised to read as follows:

§ 50.44 Combustible gas control for nuclear power reactors.

(a) *Definitions.*

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

(2) *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.

(b) *Requirements for currently-licensed reactors.* Each boiling or pressurized water nuclear power reactor with an operating license on October 16, 2003, except for those facilities for which the certifications required under § 50.82(a)(1) have been submitted, 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.* (i) All boiling water reactors with Mark I or Mark II type containments must have an inerted atmosphere.

(ii) All boiling water reactors with Mark III type containments and all pressurized water reactors with ice condenser containments must have the capability for controlling combustible gas generated from a metal-water reaction involving 75 percent 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.

(3) *Equipment Survivability.* All boiling water reactors with Mark III containments and all pressurized water reactors with ice condenser 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 must be equivalent to that generated from a metal-water reaction involving 75 percent of the fuel cladding surrounding the active fuel region (excluding the cladding surrounding the plenum volume).

(4) *Monitoring.* (i) Equipment must be provided for monitoring oxygen in containments that use an inerted atmosphere for combustible gas control. Equipment for monitoring oxygen must be functional, reliable, and capable of continuously measuring the concentration of oxygen in the containment atmosphere following a significant beyond design-basis accident for combustible gas control and accident management, including emergency planning.

(ii) Equipment must be provided for monitoring hydrogen in the containment. Equipment for monitoring hydrogen must be functional, reliable, and capable of continuously measuring the concentration of hydrogen in the containment atmosphere following a significant beyond design-basis accident for accident management, including emergency planning.

(5) *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 perform an analysis that:

(i) 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 percent 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;

(ii) Includes the period of recovery from the degraded condition;

(iii) 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.

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

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

(A) Containment structural integrity is maintained. Containment structural integrity must be demonstrated by use of an analytical technique that is accepted by the NRC staff in accordance with § 50.90. 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

(B) 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.

(c) *Requirements for future water-cooled reactor applicants and licensees.*[2] The requirements in this paragraph apply to all water-cooled reactor construction permits or operating licenses under this part, and to all water-cooled reactor design approvals, design certifications, combined licenses or manufacturing licenses under part 52 of this chapter, any of which are issued after October 16, 2003.

(1) *Mixed atmosphere.* All containments must have a capability for ensuring a mixed atmosphere during design-basis and significant beyond design-basis accidents.

(2) *Combustible gas control.* All containments must have an inerted atmosphere, or must limit hydrogen concentrations in containment during and following an accident that releases an equivalent amount of hydrogen as would be generated from a 100 percent fuel clad-coolant reaction, uniformly distributed, to less than 10 percent (by volume) and maintain containment structural integrity and appropriate accident mitigating features.

(3) *Equipment Survivability.* Containments that do not rely upon an inerted atmosphere 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 must be equivalent to that generated from a fuel clad-coolant reaction involving 100 percent of the fuel cladding surrounding the active fuel region.

(4) *Monitoring.* (i) Equipment must be provided for monitoring oxygen in containments that use an inerted atmosphere for combustible gas control. Equipment for monitoring oxygen must be functional, reliable, and capable of continuously measuring the concentration of oxygen in the containment atmosphere following a significant beyond design-basis accident for combustible gas control and accident management, including emergency planning.

(ii) Equipment must be provided for monitoring hydrogen in the containment. Equipment for monitoring hydrogen must be functional, reliable, and capable of continuously measuring the concentration of hydrogen in the containment atmosphere following a significant beyond design-basis accident for accident management, including emergency planning.

(5) *Structural analysis.* An applicant must perform an analysis that demonstrates containment structural integrity. This demonstration must use an analytical technique that is accepted by the NRC 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 percent fuel clad-coolant reaction accompanied by hydrogen burning. Systems necessary to ensure containment integrity must also be demonstrated to perform their function under these conditions.

(d) *Requirements for future non water-cooled reactor applicants and licensees and certain water-cooled reactor applicants and licensees.* The requirements in this paragraph apply to all construction permits and operating licenses under this part, and to all design approvals, design certifications, combined licenses, or manufacturing licenses under part 52 of this chapter, for non water-cooled reactors and water-cooled reactors that do not fall within the description in paragraph (c), footnote 1 of this section, any of which are issued after October 16, 2003. Applications subject to this paragraph must include:

(1) Information addressing whether accidents involving combustible gases are technically relevant for their design, and

(2) If accidents involving combustible gases are found to be technically relevant, information (including a design-specific probabilistic risk assessment) demonstrating that the safety impacts of combustible gases during design-basis and significant beyond design-basis accidents have been addressed to ensure adequate protection of public health and safety and common defense and security.

■ 4. Section 50.46a is added to read as follows:

§ 50.46a Acceptance criteria for reactor coolant system venting systems.

Each nuclear power reactor must 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. High point vents are not required for the tubes in U-tube steam generators. Acceptable venting systems must meet the following criteria:

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

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

(c) The vent system must be designed to ensure that:

(1) The vents will perform their safety functions; and

(2) There would not be inadvertent or irreversible actuation of a vent.

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

■ 5. The authority citation for Part 52 continues to read as follows:

Authority: Secs. 103, 104, 161, 182, 183, 186, 189, 68 Stat. 936, 948, 953, 954, 955, 956, as amended, sec. 234, 83 Stat. 444, as amended (42 U.S.C. 2133, 2201, 2232, 2233, 2236, 2239, 2282); secs. 201, 202, 206, 88 Stat. 1242, 1244, 1246, as amended (42 U.S.C. 5841, 5842, 5846).

■ 6. In § 52.47, paragraph (a)(1)(ii) is revised to read as follows:

§ 52.47 Contents of applications.

(a) * * *

(1) * * *

(ii) Demonstration of compliance with any technically relevant portions of the

[2] The requirements of this paragraph apply only to water-cooled reactor designs with characteristics (*e.g.*, type and quantity of cladding materials) such that the potential for production of combustible gases is comparable to light water reactor designs licensed as of October 16, 2003.

Three Mile Island requirements set forth in 10 CFR 50.34(f) except paragraphs (f)(1)(xii), (f)(2)(ix) and (f)(3)(v);

* * * * *

Dated at Rockville, Maryland, this 10th day of September 2003.

For the Nuclear Regulatory Commission.

Annette Vietti-Cook,

Secretary of the Commission.

[FR Doc. 03–23554 Filed 9–15–03; 8:45 am]

BILLING CODE 7590–01–P

NUCLEAR REGULATORY COMMISSION

10 CFR Part 72

RIN 3150–AG93

Geological and Seismological Characteristics for Siting and Design of Dry Cask Independent Spent Fuel Storage Installations and Monitored Retrievable Storage Installations

AGENCY: Nuclear Regulatory Commission.

ACTION: Final rule.

SUMMARY: The Nuclear Regulatory Commission (NRC) is amending its licensing requirements for dry cask modes of storage of spent nuclear fuel, high-level radioactive waste, and power reactor-related Greater than Class C (GTCC) waste in an independent spent fuel storage installation (ISFSI) or in a U.S. Department of Energy (DOE) monitored retrievable storage installation (MRS). These amendments update the seismic siting and design criteria, including geologic, seismic, and earthquake engineering considerations. The final rule allows the NRC and its licensees to benefit from experience gained in the licensing of existing facilities and to incorporate rapid advancements in the earth sciences and earthquake engineering. The amendments make the NRC regulations that govern certain ISFSIs and MRSs more compatible with the 1996 amendments that addressed uncertainties in seismic hazard analysis for nuclear power plants. The amendments allow certain ISFSI or MRS applicants to use a design earthquake level commensurate with the risk associated with an ISFSI or MRS.

EFFECTIVE DATE: This final rule is effective on October 16, 2003.

FOR FURTHER INFORMATION CONTACT: Keith K. McDaniel, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555–0001, telephone: (301) 415–5252, e-mail: *kkm@nrc.gov*.

SUPPLEMENTARY INFORMATION:

I. Background

In 1980, the NRC added 10 CFR part 72 to its regulations to establish licensing requirements for the independent storage of spent nuclear fuel and high-level radioactive waste (HLW) (45 FR 74693; November 12, 1980). In 1988, the NRC amended part 72 to provide for licensing the storage of spent nuclear fuel and HLW in an MRS (53 FR 31651; August 19, 1988). Subpart E of Part 72 contains siting evaluation factors that must be investigated and assessed with respect to the siting of an ISFSI or MRS, including a requirement for evaluation of geological and seismological characteristics. ISFSI and MRS facilities are designed and constructed for the interim storage of spent nuclear fuel that has aged for at least one year, other solidified radioactive materials associated with spent fuel storage, and power reactor-related GTCC waste, that are pending shipment to a high-level radioactive waste repository or other disposal site.

The original regulations envisioned ISFSI and MRS facilities as spent fuel pools or single, massive dry storage structures. The regulations required seismic evaluations equivalent to those for a nuclear power plant (NPP) when the ISFSI or MRS is located west of the Rocky Mountain Front (west of approximately 104° west longitude), referred to hereafter as the western U.S., or in areas of known seismic activity east of the Rocky Mountain Front (east of approximately 104° west longitude), referred to hereafter as the eastern U.S. A seismic design requirement, equivalent to the requirements for an NPP (appendix A to 10 CFR part 100) seemed appropriate for these types of facilities, given the potential accident scenarios. For those sites located in the eastern U.S., and not in areas of known seismic activity, the regulations allowed for less stringent alternatives.

For other types of ISFSI or MRS designs, the regulation required a site-specific investigation to establish site suitability commensurate with the specific requirements of the proposed ISFSI or MRS. The NRC explained that for ISFSIs which do not involve massive structures, such as dry storage casks and canisters, the required design earthquake will be determined on a case-by-case basis until more experience is gained with the licensing of these types of units (45 FR 74697).

For sites located in either the western U.S. or in areas of known seismic activity in the eastern U.S., the regulations in 10 CFR part 72 currently require the use of the procedures in appendix A to part 100 for determining the design basis vibratory ground motion at a site. appendix A requires the use of ''deterministic'' approaches in the development of a single set of earthquake sources. The applicant develops for each source a postulated earthquake to be used to determine the ground motion that can affect the site, locates the postulated earthquake according to prescribed rules, and then calculates ground motions at the site.

Advances in the sciences of seismology and geology, along with the occurrence of some licensing issues not foreseen in the development of appendix A to part 100, have caused a number of difficulties in the application of this regulation. Specific problematic areas include the following:

1. Because the deterministic approach does not explicitly recognize uncertainties in geoscience parameters, probabilistic seismic hazard analysis (PSHA) methods were developed that allow explicit expressions for the uncertainty in ground motion estimates and provide a means for assessing sensitivity to various parameters. Appendix A to part 100 does not allow this application.

2. The limitations in data and geologic/seismic analyses, and the rapid evolution in geosciences have required considerable latitude in technical judgment. The inclusion of detailed geoscience assessments in Appendix A has inhibited the use of needed judgment and flexibility in applying basic principles to new situations; and

3. Various sections of Appendix A are subject to different interpretations. For example, there have been differences of opinion and differing interpretations among experts as to the largest earthquakes to be considered and ground motion models to be used, thus often making the licensing process less predictable.

In 1996, the NRC amended 10 CFR parts 50 and 100 to update the criteria