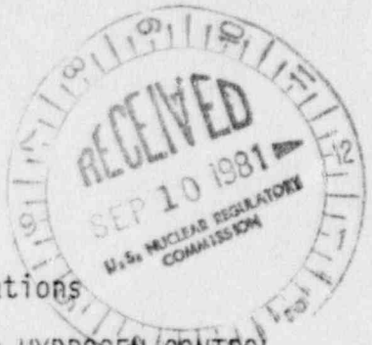
August 18, 1981

SECY-81-245A



RULEMAKING ISSUE

(Commission Meeting)

For: The Commissioners

From: William J. Dircks, Executive Director for Operations

Subject: INTERIM AMENDMENTS TO 10 CFR PART 50 RELATED TO HYDROGEN CONTROL

Purpose: To obtain Commission approval for publication of proposed and final amendments in the Federal Register.

Category: This paper covers a major policy question.

Issue:

(a) Whether applicants and licensees of light-water nuclear power plants should be required to provide inerted containment atmospheres for Mark I and II BWRs;

(b) Whether applicants and licensees of BWRs and PWRs that rely on purge/repressurization systems as the primary means for controlling combustible gases following a LOCA should be required to have certain types of hydrogen recombiner capability for use following the start of an accident.

(c) Whether applicants and licensees of Mark III BWRs and PWR Ice Condenser facilities should be required to provide hydrogen control systems that can handle large amounts of hydrogen;

(d) Whether applicants and licensees of BWRs and PWRs should be required to demonstrate the survivability of certain safety systems during and following a hydrogen burn; and

(e) Whether applicants and licensees of BWRs and PWRs should be required to perform and submit analyses concerning hydrogen control, containment structural integrity and safety system survivability.

Discussion: During the Policy Session on April 23, 1981, the Commission was briefed by the staff on Effective Interim Amendments to 10 CFR Part 50 Related to Hydrogen Control and Certain Degraded Core Considerations (SECY-81-245). As noted in Enclosure "A", the Commission indicated that further consideration would be given

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to the amendments at a later Commission meeting. During the Policy Session on April 30, 1981, the Commission reviewed SECY-81-246 and approved for publication in the Federal Register a notice of proposed rulemaking that would incorporate into 10 CFR Part 50 a set of TMI-2 requirements for operating license applications (Enclosure "B"). This proposed rule was published in the Federal Register on May 13, 1981 and a similar rule with respect to operating reactors was disapproved by the Commission (SECY-81-422 dated July 15, 1981) on August 6, 1981.

The Interim Rule (SECY-81-245), which was discussed with the Commission on April 23, 1981, covered the following specific items:

1. Inerting of Mark I and II BWRs
2. H_2 Control for Mark IIIs and Ice Condensers
3. Equipment Survivability
4. Analyses
5. Dedicated H_2 Control Penetrations
6. H_2 Recombiner Capability
7. High Point Vents
8. Post-Accident Protection of Safety Equipment and Areas
9. In-Plant Iodine Instrumentation
10. Post-Accident Sampling
11. Leakage Integrity Outside Containment
12. Accident Monitoring Instruments
13. Detection of Inadequate Core Cooling
14. Training and Human Engineering

Of the above list, items 5, and 7 to 14 were included in the proposed rule for operating license applications that was published on May 13, 1981. The remaining five items (i.e., 1 to 4, and 6) deal primarily with hydrogen control and are hereby being resubmitted for Commission consideration. Items 2 and 3, on hydrogen control for Mark III BWRs and ice condensers PWRs, and equipment survivability, were not previously published for comment. The implementation dates for these items have also been revised for consistency with the proposed rule on operating license applications.

In view of the fact that the requirements for inerting of Mark I and II BWRs and hydrogen recombiner capability were previously proposed for comment (45 FR 65466), the staff recommends that these items be published as a final rule (Enclosure "C"). The remaining hydrogen control requirements, namely hydrogen control for Mark III BWRs and ice condenser PWRs, assurance of containment structural integrity and equipment survivability during and following a hydrogen burn, and supporting analyses, should be published as a proposed rule for public comment since they were not previously proposed (Enclosure "D"). In order to specify more completely the analysis needed to support the hydrogen control

system sele[illegible] for Mark III and ice condenser containments and the assuran[illegible] containment structural integrity and equipment survivability, the staff is proposing to provide supplementary guidance to be used by the respective designers (see Enclosure "D").

Recommendations: That the Commission:

1. Approve the publication of final amendments, as set forth in Enclosure "C", which would require the inerting of Mark I and II BWR containments and hydrogen recombiner capability for certain LWRs.

2. Approve the publication of proposed amendments, as set forth in Enclosure "D", which would require hydrogen control systems for Mark III BWRs and ice condenser PWRs, assurance of containment structural integrity and equipment survivability during and following a hydrogen burn, and supporting analyses for certain LWRs.

3. Note:

   (a) That these amendments are applicable to LWRs whose CPs were issued prior to March 28, 1979. Other amendments pertaining to applicants with pending CP and manufacturing license applications were published for comment on March 23, 1981 and are also described in NUREG-0718, Rev. 1 dated July 14, 1981. Requirements for future generations of LWRs are under development.

   (b) That the notice of final rulemaking in Enclosure "C" will be published in the Federal Register to be effective 30 days after publication.

   (c) That the notice of proposed rulemaking in Enclosure "D" will be published in the Federal Register allowing 60 days for public comment.

   (d) That pursuant to § 51.5(d) of Part 51 of the Commission's regulations neither an environmental impact statement nor a negative declaration need be prepared in connection with the amendment since the amendment is nonsubstantive and insignificant from the standpoint of environmental impact.

   (e) The reporting requirements in connection with the analyses required by the proposed rule (Enclosure "D") are being submitted for OMB review and approval under the Paperwork Reduction Act.

   (f) That pursuant to the Regulatory Flexibility Act of 1980, the proposed rule contains a statement that the Commission

certifies that the rule will not, if promulgated, have a significant economic impact upon a substantial number of small entities and a copy of this certification will be forwarded to the Chief Counsel for Advocacy, SBA by the Division of Rules and Records, ADM.

(g) That the Subcommittee on Nuclear Regulation of the Senate Committee on Environment and Public Works, the Subcommittee on Energy and the Environment of the House Committee on Interior and Insular Affairs, the Subcommittee on Energy Conservation and Power of the House Committee on Energy and Commerce, and the Subcommittee on Environment, Energy and Natural Resources of the House Committee on Government Operations will be informed.

(h) That a public announcement will be issued (Enclosure "E").

(i) That copies of the Notices of Final and Proposed Rulemaking will be distributed by TIDC, ADM to each affected licensee and other interested parties.

Sunshine Act: Recommend affirmation at an open meeting

William J. Dircks
Executive Director of Operations

Enclosures:
"A" - Memorandum Chilk to Dircks dated 4/27/81
"B" - Memorandum Chilk to Dircks dated 5/8/81
"C" - Notice of Final Rulemaking
"D" - Notice of Proposed Rulemaking
"E" - Draft Public Announcement

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[7590-01]

NUCLEAR REGULATORY COMMISSION

10 CFR Part 50

Interim Requirements Related to Inerted Reactor Containments and Hydrogen Recombiner Capability

AGENCY: Nuclear Regulatory Commission.

ACTION: Final Rule.

SUMMARY: The Nuclear Regulatory Commission is amending its regulations to require inerted containment atmospheres and additionally, hydrogen recombiner capability to reduce the likelihood of venting radioactive gases following an accident. The inerting requirement applies only to boiling water nuclear power reactors with either Mark I or Mark II type containments; the requirement for hydrogen recombiner capability applies to light-water nuclear power reactors that rely upon purge/repressurization systems as the primary means of hydrogen control.

EFFECTIVE DATE: [30 days following publication in the Federal Register]

FOR FURTHER INFORMATION CONTACT: Morton R. Fleishman, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, telephone 301-443-5981.

SUPPLEMENTARY INFORMATION: On October 2, 1980, the Nuclear Regulatory Commission published in the FEDERAL REGISTER (45 FR 65466) a notice of proposed rulemaking on "Interim Requirements Related to Hydrogen Control and Certain Degraded Core Considerations" (Interim Rule) inviting written comments or suggestions on the proposed rule by November 3, 1980. The

notice concerned proposed amendments to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," to improve hydrogen management in light-water reactor facilities and to provide specific design and other requirements to mitigate the consequences of accidents resulting in a degraded reactor core.

Thirty-five persons submitted comments regarding the proposed amendments. Although the comment period was scheduled to expire on November 3, 1980, comments received subsequent to that date have been considered, with the latest comment letter being dated February 9, 1981. The comments are part of the public record and may be examined and copied in the Commission's Public Document Room at 1717 H Street NW., Washington, D.C. A summary of the comments along with a comment analysis and a value/impact assessment are also available for inspection and copying in the Public Document Room.

These comments have been carefully reviewed and evaluated during preparation of this final rule. The final rule contains revisions to the proposed rule that reflect these comments. The commenters were about equally divided between those in favor of and those opposed to publishing the interim amendments. Whether or not the commenter favored publishing a final rule, additional detailed comments were generally provided on specific aspects of the proposed amendments.

The NRC's Office of Nuclear Reactor Regulation sent a letter on September 5, 1980 to all nuclear power plant licensees, applicants and construction permit holders providing a "Preliminary Clarification of the TMI Action Plan Requirements." This was followed by a series of four regional meetings, noticed by publication in the FEDERAL REGISTER (45 FR 60508) and held during the week of September 22, 1980, in order

to provide a more detailed explanation of the requirements and to obtain industry comments. Based on the discussions at the meetings and other comments received, the NRC revised the requirements and notified the applicants, licensees and construction permit holders to this effect by a letter dated October 31, 1980. The letter and revised requirements are included in NUREG-0737, "Clarification of TMI Action Plan Requirements."[1]

On May 13, 1981, the Commission published in the FEDERAL REGISTER (46 FR 26491) a notice of proposed rulemaking which proposed licensing requirements for pending operating license applications (OL Rule). The proposed OL Rule was based upon the requirements described in NUREG-0737 and includes, among others, many of the requirements originally included in the proposed Interim Rule published in October 1980.

Items originally proposed in the Interim Rule were:

1. Inerting of Mark I and II boiling water reactors (BWRs)
2. Design analyses for Mark III BWRs and pressurized water reactors (PWRs)
3. Dedicated hydrogen control penetrations
4. Hydrogen recombiner capability
5. High point vents
6. Post-accident protection of safety equipment and areas
7. In-plant iodine instrumentation
8. Post-accident sampling
9. Leakage integrity outside containment

[1]Copies of this report may be obtained from GPO Sales Program, Division of Technical Information and Document Control, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

10. Accident monitoring instrumentation

11. Detection of inadequate core cooling

12. Training to mitigate degraded core accidents

Of the above list, all except items 1, 2 and 4 were included in the proposed OL Rule and have been appropriately revised to reflect the comments received during the comment period on the final Interim Rule. Hence, those items included in the OL Rule have been deleted from this Interim Rule. Furthermore, those public comments received pertaining to the OL Rule items will not be discussed here. They may be examined and copied in the Commission's Public Document Room along with the response to the comments (SECY 81-245, "Interim Amendments to 10 CFR Part 50 Related to Hydrogen Control and Certain Degraded Core Considerations").

The final Interim Rule contains revisions to the proposed Interim Rule that reflect all of the applicable comments including those (a) given in response to the notice of proposed rulemaking, and (b) generated during the regional meetings and in response to the clarification letters of September 5, 1980 and October 31, 1980.

Before discussing the comments and the specific revisions resulting from the comments, it should be noted that, while § 50.44 has applied only to light-water nuclear power reactors with zircaloy fuel cladding, the new amendments in the Interim Rule are not as limited and apply to light-water nuclear power reactors with either stainless steel or zircaloy fuel cladding. The Commission will be considering further modification of §50.44 during the long-term rulemaking effort relative to consideration of degraded or melted cores in safety regulation. Part of this long-term rulemaking will involve a thorough reevaluation of hydrogen generation and control. In the interim, the Commission wishes

to leave in place the existing provisions of §50.44 because of its requirements for dealing with design basis accidents. These include, for example, requiring:

1. The capability for measuring hydrogen concentrations in containment.
2. The capability for ensuring a mixed atmosphere in containment.
3. The capability for controlling combustible gas concentrations in containment following a postulated LOCA.
4. The capability to deal with hydrogen from radiolytic decomposition of the reactor coolant and the corrosion of metals. These have release characteristics that differ from those associated with metal-water reaction.
5. That the combustible gas control systems conform with the general requirements of Criteria 41, 42 and 43 of Appendix A of 10 CFR Part 50.

Several commenters have expressed concern that the various rulemakings currently being pursued by NRC should be integrated, i.e., safety goal, degraded core considerations, minimum engineered safety features, siting and emergency planning. The NRC shares this concern. On October 15, 1980 the Executive Director for Operations established a Degraded Cooling Steering Group to coordinate degraded cooling and related rules. This group has completed its work and prepared a plan to ensure future integration of these activities.

Numerous commenters have questioned many of the implementation dates specified in the rule, indicating that they cannot be met for a variety of reasons, such as procurement lead time, need for the design studies,

availability of acceptable equipment, etc. The staff agrees with these comments and has made appropriate changes to the implementation dates.

INERTING OF MARK I & II BWRs [§ 50.44(c)(3)(i)]

Some commenters, particularly those associated with Mark I boiling water reactors (BWRs), questioned the advisability of requiring inerting of containments and suggested that other hydrogen control options be permitted. This issue has been extensively reviewed and discussed among the Commission, NRC staff and industry participants. Numerous reports and letters have been written and many meetings held in order to thoroughly air the issue. Considering the information previously developed, the Commission continues to believe that it would be prudent, pending completion of the long term rulemaking on degraded core cooling, to require that all Mark I and II BWR containments be provided with an inerted atmosphere during normal operations.

The proposed rule's deadline for installation of inerting systems has been extended to account for delay in publication of a final rule. The rule has also been changed to clarify that the paragraph applies only to Mark I and II BWRs.

HYDROGEN RECOMBINER CAPABILITY [§ 50.44(c)(3)(ii)]

Several commenters have recommended that § 50.44(c)(3)(ii) be modified to allow the use of alternate means of hydrogen control, such as internal recombiners, rather than restrict the rule to external recombiners. The proposed rule was not intended to preclude this alternative.

In fact, if internal recombiners were present before or will be installed in the future, this section of the rule would not apply since purge/repressurization systems would not be the primary means for combustible gas control. This section of the rule only applies to facilities that rely upon purge/repressurization systems as the primary means of controlling combustible gases following a LOCA. It should also be noted that this section of the rule does not require actual installation of external recombiners, rather, it requires only the capability for installation. To avoid confusion, the rule has been clarified to indicate that internal recombiners are an acceptable alternative to the installation of external recombiner capability.

REGULATORY FLEXIBILITY ACT

In accordance with the Regulatory Flexibility Act of 1980, 5 U.S.C. 605(b), the Commission hereby certifies that this rule will not, if promulgated, have a significant economic impact on a substantial number of small entities. This 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 Small Business Size Standards set out in regulations issued by the Small Business Administration at 13 CFR Part 121. Since these companies are dominant in their service areas, this rule does not fall within the purview of the Act.

Accordingly, notice is hereby given that, pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended, and section 553 of title 5 of the United States Code, the

following amendments to 10 CFR Part 50 are published as a document subject to codification.

PART 50--DOMESTIC LICENSING OF PRODUCTION AND UTILIZATION FACILITIES

1. The authority citation for Part 50 reads as follows:

AUTHORITY: Secs. 103, 104, 161, 182, 183, 189, 68 Stat. 936, 937, 948, 953, 954, 955, 956, as amended (42 U.S.C. 2133, 2134, 2201, 2232, 2233, 2239); secs. 201, 202, 206, 88 Stat. 1243, 1244, 1246 (42 U.S.C., 5841, 5842, 5846), unless otherwise noted. 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). Sections 50.100-50.102 issued under sec. 186, 68 Stat. 955; (42 U.S.C. 2236). For the purposes of sec. 223, 68 Stat. 958, as amended; (42 U.S.C. 2273), §50.54 (i) issued under sec. 161i, 68 Stat. 949; (42 U.S.C. 2201(i)), §§50.70, 50.71 and 50.78 issued under sec. 161o, 68 Stat. 950, as amended; (42 U.S.C. 2201(o)) and the Laws referred to in Appendices.

2. Section 50.44 of Part 50 is amended by revising paragraph (c) to read as follows:

§50.44 Standards for combustible gas control system in light water cooled power reactors.

* * * * *

(c)(1) For each boiling or pressurized light-water nuclear power reactor fueled with oxide pellets within cylindrical zircaloy cladding, it shall be shown that during the time period following a postulated LOCA but prior to effective operation of the combustible gas control system,

either: (i) An uncontrolled hydrogen-oxygen recombination would not take place in the containment; or (ii) the plant could withstand the consequences of uncontrolled hydrogen-oxygen recombination without loss of safety function.

(2) If neither of these conditions can be shown, the containment shall be provided with an inerted atmosphere or an oxygen deficient condition in order to provide protection against hydrogen burning and explosions during this time period.

(3) Notwithstanding paragraphs (c)(1) and (c)(2) of this section:

(i) [~~As-soon-as-practicable-but-not-later-than-June-30,-1981~~] Effective [4 months after the effective date of the rule] or 6 months after initial criticality, whichever is later,* an inerted atmosphere shall be provided for each boiling light-water nuclear power reactor with a Mark I or Mark II type containment; [~~facility-for-which-the-application-for-a containment-permit-was-docketed-between-March-15,-1964-and-July-1,-1972;~~] and

(ii)[~~(iv)--By-January-1,-1982,-facilities~~] Effective [24 months after the effective date of the rule] all light-water nuclear power reactors that rely upon purge/repressurization systems as the primary means for controlling combustible gases following a LOCA shall be provided with either internal recombiners or the capability to install external recombiners following the start of an accident. The internal or external recombiners must [~~that~~] meet the combustible gas control requirements in paragraph (d) of this section. The containment penetrations that are used must [~~meet-the-criteria-in-paragraphs-(c)(3)(A)-and-(c)(3)(B) of-this-section-applicable-to-external-recombiners;~~] either be:

*Comparative text. Additions shown by underline, deletions by bracket and crossout.

(A) dedicated to that service only, conform to the requirements of Criteria 54 and 56 of Appendix A of this part, be designed against postulated single failures for containment isolation purposes, and be sized to satisfy the flow requirements of the external recombiners, or

(B) of a combined design for use by either external recombiners or purge/repressurization systems and other systems, conform to the requirements of Criteria 54 and 56 of Appendix A of this part, be designed against postulated single failures both for containment isolation purposes and for operation of the external recombiners or purge/repressurization systems, and be sized to satisfy the flow requirements of the external recombiners or purge repressurization systems.

* * * * *

Dated at Washington, D.C. this _____ day of _____ 1981.

For the Nuclear Regulatory Commission.

_____

Samuel J. Chilk,
Secretary of the Commission.

ENCLOSURE D

[7590-01]

NUCLEAR REGULATORY COMMISSION

10 CFR Part 50

Interim Requirements Related to Hydrogen Control

AGENCY: Nuclear Regulatory Commission.

ACTION: Proposed Rule.

SUMMARY: The Nuclear Regulatory Commission is considering amending its regulations to improve hydrogen control capability during and following an accident in light-water reactor facilities.

The amendments would require improved hydrogen control systems for boiling water reactors with Mark III type containments and for pressurized water reactors with ice condenser type containments. All light-water nuclear power reactors not relying upon an inerted atmospnere for hydrogen control would be required to shcw that certain important safety systems must be able to function during and following hydrogen burning.

DATES: Comment period expires [60 days following publication in the FEDERAL REGISTER].

FOR FURTHER INFORMATION CONTACT: Morton R. Fleishman, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, telephone 301-443-5981.

ADDRESS: Written comments or suggestions for consideration in connection with the proposed amendments should be submitted to the Secretary of the

Commission, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Docketing and Service Branch. Copies of comments received may be examined in the Commission's Public Document Room at 1717 H Street NW., Washington, D.C.

SUPPLEMENTARY INFORMATION: The accident at Three Mile Island, Unit 2 (TMI-2) resulted in a severely damaged or degraded reactor core, a concomitant release of radioactive material to the primary coolant system, and a fuel cladding-water reaction which resulted in the generation of a large amount of hydrogen. The Nuclear Regulatory Commission has taken numerous actions to correct the design and operational limitations revealed by the accident. Included in these actions are several rulemaking proceedings intended to improve the hydrogen control capability of light-water nuclear power reactors. On October 2, 1980, the Nuclear Regulatory Commission published in the FEDERAL REGISTER (45 FR 65466) a notice of proposed rulemaking on "Interim Requirements Related to Hydrogen Control and Certain Degraded Core Considerations" (Interim Rule). The notice concerned proposed amendments to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," to improve hydrogen management in light-water reactor facilities and to provide specific design and other requirements to mitigate the consequences of accidents resulting in a degraded reactor core.

On March 23, 1981, the Commission published in the FEDERAL REGISTER (46 FR 18045) a notice of proposed rulemaking on "Licensing Requirements for Pending Construction Permit and Manufacturing License Applications." The notice proposed a set of licensing requirements applicable to construction permit applications that stemmed from lessons learned from the

TMI-2 accident. On May 13, 1981, the Commission published in the FEDERAL REGISTER (46 FR 26491) a notice of proposed rulemaking on "Licensing Requirements for Pending Operating License Applications" (OL Rule).

As a result of the various activities and considerations relative to the October 2, 1980 notice, the Commission decided to split the Interim Rule into two parts. One part was to be included in the OL Rule. The other part, limited only to hydrogen control, was to be issued separately. The details of this split are described in the companion FEDERAL REGISTER notice appearing elsewhere in this issue (see Table of Contents under NRC Rules and Regulations) related to inerting and hydrogen recombiner capability.

The Commission has also been considering the ability of all light-water reactors, particularly pressurized light-water reactor facilities with ice condenser type containments and boiling light-water reactor facilities with Mark III type containments, to withstand an accident with the concomitant generation of large amounts of hydrogen, such as the type which occurred at Three Mile Island, Unit 2 (TMI-2). As a result, three new amendments to the regulations are being proposed for public comment.

HYDROGEN CONTROL FOR MARK III BWRs AND ICE CONDENSER PWRs [§ 50.44(c)(3)(iii)]

It is proposed that boiling water reactor (BWR) facilities with Mark III type containments and pressurized water reactor (PWR) facilities with ice condenser type containments, for which construction permits were issued prior to March 28, 1979, be required to install hydrogen control systems capable of accommodating an amount of hydrogen equivalent to that generated from the reaction of 75% of the fuel cladding (surrounding the active fuel region) with water, without loss of containment integrity. This

new requirement is being contemplated as a result of safety issues raised during licensing reviews of new ice condenser and Mark III plants. In these reviews, it has become clear that additional protection is required to provide assurance that large amounts of hydrogen can be safely accommodated by these plants. The particular type of hydrogen control system to be selected is left to the discretion of the applicant or licensee; however, it must be found acceptable by the NRC based upon suitable programs of experiment and analysis. The selection should be supported by comparative analyses of alternative systems to show their relative advantages and disadvantages. These comparisons are to be submitted as part of the analyses required under § 50.44(c)(3)(v). At present, a distributed igniter system has been found acceptable for the Sequoyah plant with an ice condenser containment, but only as an interim solution while the hydrogen control matter is studied further. A post-accident inerting system has also been discussed for the ice condenser and Mark III containments. Whatever systems are finally proposed and approved for the long term, large amounts of hydrogen must be safely accommodated, and operation of the system, either intentionally or inadvertently, must not further aggravate the course of an accident or endanger the plant during normal operations. The amount of hydrogen to be assumed in the design of the hydrogen control system is that amount generated by assuming that 75% of the fuel cladding surrounding the active fuel region reacts with water. The 75% is judged to be representative of the maximum amount of hydrogen likely to be generated in an accident in which the threat to the containment is limited to the threat posed by the combustion of hydrogen. Events with metal-water reactions in excess of 75% are judged to have a very low probability of termination before core melt. This

75% value also appears to be reasonable because it is sufficiently greater than the fuel cladding-water reaction analyzed to have occurred at TMI-2 to provide a conservative estimate for the cladding reaction that may occur during a TMI type degraded core accident. It is expected that the 75% value will permit plants that are either completed or are well along in the construction stage to have a hydrogen control system added without the need for major modifications to their containment structures. Research now in place will, over the next several years, yield data on the likelihood of termination of sequences with large amounts of cladding interaction.

Owners of Mark III BWRs now under construction have been surveyed by the NRC staff to determine the effect on their plant designs of the requirement that they do not exceed ASME Service Level A Limits or the Service Load Category during inadvertent full inerting of a post-accident inerting system. This survey was conducted because a post-accident inerting system (rather than a distributed ignition system) was thought to be the preferred approach for the Mark III containments. Based on their responses, the Commission has concluded that there would be no significant impact in specifying these requirements for inadvertent full inerting. Modest deviations from these ASME criteria will be permitted if good cause is shown. A comparable survey was not conducted for ice condenser plants because the distributed ignition system apparently is the approach preferred by the owners of these plants.

There are ongoing programs of research in a number of areas of hydrogen generation, release, burning, and control. These include the analysis of accident sequences, the chronology of hydrogen and steam injection (from the primary system into containment), the analysis of operations

to recover coolability, and an assessment of equipment survivability. These studies are expected to reveal the advantages and disadvantages of various hydrogen control systems, including those that involve deliberate burning of the hydrogen within containment. Based on the state of technology as of August 1981, the Commission believes that control methods that do not involve burning provide protection for a wider spectrum of accidents than do those that involve burning.

As a result of the review of the deliberate ignition systems installed at Sequoyah and McGuire, the staff has identified issues which need to be investigated further. A spectrum of degraded core accident scenarios, including those which may lead to inadvertent suppression of combustion in the lower compartment due to a steam rich atmosphere, and several hydrogen combustion phenomena are continuing to be reviewed. In addition, there is incomplete verification of analytical models and equipment survivability. These issues are being addressed in ongoing research by NRC and the nuclear industry. The Commission concludes that the issues are sufficiently resolved to warrant interim approval of deliberate ignition systems for ice condenser plants. However, the Commission has required in individual licensing proceedings and in the section of this rule on analyses (§50.44(c)(3)(v)) that studies of alternative hydrogen management systems be performed prior to the long-term approval of any particular method.

SURVIVABILITY OF CERTAIN SAFETY SYSTEMS DURING AND FOLLOWING A HYDROGEN BURN [§ 50.44(c)(3)(iv)]

A new requirement is being considered on safety system survivability. (In this context, survivability differs from qualification, as used elsewhere, in that generous application of safety margins is not required.) It would apply to all BWRs and PWRs, for which construction permits were issued prior to March 28, 1979, that do not have an inerted containment atmosphere for hydrogen control. That is, plants for which there exists the possibility that substantial amounts of hydrogen can be burned in the containment will be covered by the proposed new requirement. Safety systems provided on these plants that are needed (a) to shut down the reactor and maintain the reactor in a safe shutdown condition, and (b) to prevent loss of containment integrity, must survive the environmental conditions associated with hydrogen burning and local detonations. Thus, for example, if a distributed igniter system is selected for controlling large amounts of hydrogen, the applicants or licensees must assure that the specified safety systems can survive and continue to perform their needed safety functions during and following hydrogen burning. If no new hydrogen control system is required, as is likely to be the case for PWRs with large dry containments, these applicants and licensees would still have to perform analyses to: (1) show containment structural integrity, as defined in § 50.44(c)(3)(iii) can be maintained; and (2) assure that the specified safety systems can continue to perform their needed safety functions during and following hydrogen burning and local detonations. This survivability requirement for certain identified essential systems is needed because the environmental pressures and temperatures associated with hydrogen burning and local detonations can

be more severe than the conditions for which the equipment has been previously qualified.

ANALYSES [§ 50.44(c)(3)(v)]

The proposed Interim Rule required that for all PWR and BWR plants, except the Mark I and II BWRs, design analyses must be performed for new hydrogen control measures. Many commenters indicated that the description of the design analyses was not precise enough to elicit the desired response. Furthermore, several commenters have suggested that it is inappropriate to have a regulation requiring hydrogen control design studies in view of the fact that unambigious event descriptions and acceptance criteria are not supplied. The Commission agrees with these comments in part. As a result, the Commission intends to provide supplementary guidance concerning acceptable procedures that should be used, both for design of the hydrogen control systems per § 50.44(c)(3)(iii), for the demonstration of equipment survivability per § 50.44(c)(3)(iv), and for the analysis of containment structural integrity.

The Commission is considering three different approaches concerning the supplementary guidance to be provided for performing the analyses. In the first approach, the Commission would identify accident sequences or scenarios which are found by probabilistic risk assessment techniques to be significant contributors to the likelihood of core degradation and thus pose a significant hydrogen threat. The licensee would then perform analyses, using these sequences, to determine the time variation of the hydrogen and steam release rates to the containment building. The analyses, which would include the failure assumptions of the different

scenarios as well as the accident recovery phase and allowances for uncertainties, would provide the pressure and temperature histories to which the containment would be exposed. A list of possible accident sequences being considered under this approach is given in Table I. The scenarios include the production of substantial amounts of hydrogen as part of core-melt sequences; they were selected, based on experience and engineering judgment, because they are the more probable severe accident sequences which could be terminated short of primary vessel melt-through with available recovery techniques.

In the second approach, a base sequence would be chosen by the Commission based on its significance and characteristics from the standpoint of hydrogen threat. Key aspects of this scenario would then be parametrically varied, by the licensee, in determining the acceptability of the hydrogen control system or the containment response. This would provide a wider range than that of the selected base sequence alone. The acceptability of the analyses used in this approach would depend on the selection and range of the parameters being varied. The range must be chosen to include the effects of physically realistic degraded core accident scenarios with recovery. Table II represents a preliminary list of parameter variations that appear to provide reasonable extensions of a PWR small-break scenario (Item 1 of Table I). A corresponding BWR list has not yet been prepared.

In the third approach, the Commission would use a set of accident sequences as in Table I, and perform analyses which would define a reasonable envelope of time histories of hydrogen and steam release rates into the containment building. This envelope definition could be based on variations in the progression of different sequences and/or variations

Table I. Accident Sequences Leading to a Significant Hydrogen Threat

PWR	1.	Small LOCA with temporary loss of emergency core cooling (ECC) injection.
	2.	Transient with temporary loss of all feedwater and the high pressure ECC system.
	3.	Interruption of all AC electric power with failure of the auxiliary feedwater system.
BWR	4.	Transient with reactor isolation and temporary failure of all coolant make-up systems.
	5.	Small LOCA with temporary failure of ECC injection.
	6.	Transient with failure of reactor shutdown systems and interruption of ECC systems.

Table II. Parametric Variations of a PWR Small-Break Scenario

Rate of H_2 Release† (lb/min)	Timing of H_2 Release	Rate of Steam/ Enthalpy Release (lb/min (millions of Btu/min))	Concurrent, Failures & Recoveries
2 10 30 100 1,000	- Starting at Time of Uncovering of Top of Core - Prior to major steam release - Concurrent with major steam release - Following major steam release	- 600(1) - 3,600(6) - 10,000(16)*	- Fans - Containment Sprays - All AC power - Recirculation

*This high rate of steam release may occur for about 10 min. during ECC recovery.

†These rates should be assumed to be constant during the period of release and represent release from the primary system to the containment building.

due to uncertainties within a particular sequence. The envelope of hydrogen and steam source terms to the containment would then be provided to all licensees for use in subsequent analyses. This approach would avoid the need for case-by-case sequence analyses using codes like MARCH and involving extensive iterative review of the MARCH analyses with the Commission. The intent would be for the Commission to provide hydrogen and steam source terms generic to each reactor type (BWR or PWR) and let the licensees' and NRC's ensuing attention be on the containment analysis. (The staff intends to publish for comment these generic source term analyses during the comment period for this proposed rule.)

The Commission particularly welcomes comments concerning which of the above approaches is prefered as well as suggestions regarding improvements or other alternatives.

The proposed rule has also been modified to clarify the types of analyses required. They can be grouped into four classes, depending upon containment design, as follows:

1. BWRs with Mark I and II type containments are required to be inerted by the companion rule on inerted containments appearing elsewhere in this issue. (See Table of Contents under NRC Rules and Regulations.) There are no further analyses required of these plants.

2. Effective [one year after the effective date of the rule], or the date of issuance of a license authorizing operation above 5 percent of full power, whichever is later, analyses would be required for BWRs with Mark III type containments and PWRs with ice condenser type containments to demonstrate that the installed hydrogen control system is adequate and will perform its intended function in a manner that provides adequate safety margins. Analyses should also be performed to assess the effectiveness of alternative systems.

3. Effective [one year after the effective date of the rule] or the date of issuance of a license authorizing operation above 5 percent of full power, whichever is later, additional analyses would be required for BWRs with Mark III type containments and PWRs with ice condenser type containments, identical to that described under item 4, to show that safe shutdown will be asured and containment structural integrity maintained during degraded core accidents.

4. Owners of all other containments would be required to perform and submit by [two years after the effective date of the rule] or the date of issuance of a license authorizing operation above 5 percent of full power, whichever is later: (i) analyses to assure that during degraded core accidents containment structural integrity will be maintained; and (ii) equipment survivability analyses to assure continued containment integrity and safe shutdown capability. These degraded core accidents will be assumed to produce hydrogen releases tc the containment resulting from the reaction of up to and including 75% of the fuel cladding surrounding the active fuel region with water for a range of time periods consistent with the accident scenarios analyzed.

The analyses required by this section serve two purposes. First, they support continued re iance on the interim requirements of this rule. Second, the results will be considered in a longer term rulemaking on degraded cores.

PAPERWORK REDUCTION ACT

The proposed rule will be submitted to the Office of Management and Budget for clearance of the application requirements that may be appropriate under the Paperwork Reduction Act (Pub. L. 96-511). The SF-83

"Request for Clearance," Supporting Statement, and related documentation submitted to OMB will be placed in the NRC Public Document Room at 1717 H Street NW., Washington, D.C. 20555. The material will be available for inspection and copying for a fee.

REGULATORY FLEXIBILITY ACT

In accordance with the Regulatory Flexibility Act of 1980, 5 U.S.C. 605(b), the Commission hereby certifies that this rule will not, if promulgated, have a significant economic impact on a substantial number of small entities. This proposed 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 Small Business Size Standards set out in regulations issued by the Small Business Administration at 13 CFR Part 121. Since these companies are dominant in their service areas, this proposed rule does not fall within the purview of the Act.

Accordingly, notice is hereby given that, pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended, and section 553 of title 5 of the United States Code, adoption of the following amendments to 10 CFR Part 50 is contemplated.

PART 50--DOMESTIC LICENSING OF PRODUCTION AND UTILIZATION FACILITIES

1. The authority citation for Part 50 reads as follows:

AUTHORITY: Secs. 103, 104, 161, 182, 183, 189, 68 Stat. 936, 937, 948, 953, 954, 955, 956, as amended (42 U.S.C. 2133, 2134, 2201, 2232, 2233, 2239); secs. 201, 202, 206, 88 Stat. 1243, 1244, 1246 (42 U.S.C., 5841,

5842, 5846), unless otherwise noted. 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). Sections 50.100-50.102 issued under sec. 186, 68 Stat. 955; (42 U.S.C. 2236). For the purposes of sec. 223, 68 Stat. 958, as amended; (42 U.S.C. 2273), §50.54 (i) issued under sec. 161i, 68 Stat. 949; (42 U.S.C. 2201(i)), §§50.70, 50.71 and 50.78 issued under sec. 161o, 68 Stat. 950, as amended; (42 U.S.C. 2201(o)) and the Laws referred to in Appendices.

2. Section 50.44 of Part 50 is amended by adding the following paragraphs to paragraph (c) to read as follows:

§50.44 Standards for combustible gas control system in light water cooled power reactors.

* * * * *

(c) ***

(3) ***

(iii) Effective [one year after effective date of the rule], or the date of issuance of a license authorizing operation above 5 percent of full power, whichever is later, each boiling light-water nuclear power reactor with a Mark III type containment and each pressurized light-water nuclear power reactor with an ice condenser type containment, for which a construction permit was issued prior to March 28, 1979, shall be provided with an acceptable hydrogen control system justified by suitable programs of experiment and analysis. The hydrogen control system must be capable of handling an amount of hydrogen equivalent to that generated from the reaction of 75% of the fuel cladding surrounding the active fuel region (excluding the cladding surrounding the plenum volume) with water,

without loss of containment structural integrity (i.e., steel containments must meet the requirements of the ASME Boiler and Pressure Vessel Code, Section III, Division 1, Subsubarticle NE-3220, Service Level C Limits, except that evaluation of instability is not required, considering pressure and dead load alone. Concrete containments must meet the requirements of the ASME Boiler and Pressure Vessel Code, Section III, Division 2, Subsubarticle CC-3720, Factored Load Category, considering pressure and dead load alone. These subsubarticles have been submitted for approval for incorporation by reference by the Director of the FEDERAL REGISTER. A notice of any changes made to the material incorporated by reference will be published in the Federal Register. Copies of the ASME Boiler and Pressure Vessel Code may be purchased from the American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, N.Y. 10017. It is also available for inspection at the Nuclear Regulatory Commission's Public Document Room, 1717 H Street NW., Washington, D.C.) If the hydrogen control system relies on post-accident inerting, the containment structure must be capable of withstanding the increased pressure (A) during the accident, where it must not exceed Service Level C Limits or the Factored Load Category (as previously specified in this paragraph) and (B) following inadvertent full inerting that may occur during normal plant operations, where it must not exceed either Service Level A Limits (for a steel containment) or the Service Load Category (for a concrete containment). Equipment required to maintain safe shutdown and containment integrity must be designed and qualified for the environment caused by post-accident inerting. Furthermore, inadvertent full inerting during normal plant operations must not adversely effect systems and components needed for safe operation of the plant. Modest

deviations from these criteria will be considered by the Commission if good cause is shown.

(iv) Effective [one year after effective date of the rule] or the date of issuance of a license authorizing operation above 5 percent of full power, whichever is later, each boiling and pressurized light-water nuclear power reactor, for which a construction permit was issued prior to March 28, 1979, that does not rely upon an inerted atmosphere to control hydrogen inside the containment, shall be provided with systems necessary to assure safe shutdown and maintain containment integrity that are capable of performing their functions during and after being exposed to the environmental conditions created by the burning (or local detonation) of hydrogen. The amount of hydrogen to be considered is equivalent to that generated from the reaction of 75% of the fuel cladding surrounding the active fuel region (excluding the cladding surrounding the plenum volume) with water.

(v) Analyses shall be performed and submitted to the Director of Nuclear Reactor Regulation for light-water nuclear power reactors, for which a construction permit was issued prior to March 28, 1979, to evaluate the consequences of large amounts of hydrogen generated after the start of an accident (hydrogen resulting from the reaction of up to and including 75 percent of the fuel cladding surrounding the active fuel region with water) including consideration of hydrogen control measures as appropriate. Each analysis must include the period of recovery from the degraded condition. The accident scenarios to be used in the analyses must be acceptable to the NRC staff. The scope and implementation requirements for the analyses for the various types of light-water nuclear power reactors are as follows:

(A) For each boiling light-water nuclear power reactor with a Mark III type containment and each pressurized light-water nuclear power reactor with an ice condenser type containment, analyses shall be performed that justify the selection of the hydrogen control system required by § 50.44 (c)(3)(iii). These analyses shall be completed and submitted by [one year after the effective date of the rule], or the date of issuance of a license authorizing operation above 5 percent of full power, whichever is later.

(B) For each light-water nuclear power reactor that does not rely upon an inerted atmosphere to control hydrogen inside the containment, analyses shall be performed to show that containment structural integrity as defined in § 50.44(c)(3)(iii) will be maintained, and systems and components necessary to assure safe shutdown and maintain containment integrity will be capable of performing their functions during and after being exposed to the environmental conditions created by the burning of hydrogen, including the effect of local detonations. These analyses shall be completed and submitted as follows: for boiling light-water nuclear power reactors with Mark III type containments and pressurized light-water nuclear power reactors with ice condenser type containments, by [one year after the effective date of the rule] or the date of issuance of a license authorizing operation above 5 percent of full power, whichever is later; for the other light-water nuclear power reactors requiring these analyses, by [two years after the effective date of the rule] or the date of issuance

of a license authorizing operation above 5 percent of full power, whichever is later.

Dated at Washington, D.C. this _____ day of _____ 1981.

For the Nuclear Regulatory Commission

_____
Samuel J. Chilk
Secretary of the Commission

ENCLOSURE E

NRC ADOPTS FINAL RULE ON HYDROGEN CONTROL FOR NUCLEAR POWER REACTORS; PROPOSES ADDITIONAL REQUIREMENTS

The Nuclear Regulatory Commission is amending its regulations to improve methods of controlling hydrogen generated during nuclear power reactor accidents. At the same time, the Commission also is considering additional amendments for hydrogen control capability for power reactors.

The accident at Three Mile Island 2 in March 1979 resulted in the release of radioactive material to the coolant system and the generation of hydrogen from fuel cladding-water reaction well in excess of amounts required to be assumed for reactor design purposes.

As part of its response to that accident, the NRC has initiated a long-term rulemaking proceeding to determine to what extent nuclear power reactors should be designed to deal effectively with damaged and melted fuel accidents.

In the interim, the Commission has determined that changes covered by this rule are of such safety significance that they should be implemented pending completion of the long-term rulemaking.

Consequently, the Commission has set out specific hydrogen control requirements in a FEDERAL REGISTER notice published on _____.

The new rules require that:

· boiling water reactors having Mark I or II containments inert the containment atmosphere (remove oxygen) to provide protection against hydrogen burning and explosions during accidents involving generation of large amounts of hydrogen.

· nuclear power reactors which rely on venting have the capability to install external hydrogen recombiners so that means other than venting would be available for hydrogen control.

The amendments to Part 50 of NRC regulations will become effective 30 days after publication in the FEDERAL REGISTER.

The additional amendments being considered by the Commission that also would improve hydrogen control capabilities would require that:

· boiling water reactors having Mark III containments and pressurized water reactors with an ice condenser-type containment be provided with a system capable of handling an amount of hydrogen--equivalent to that which would be generated if there were at least a 75% fuel cladding-water reaction--without loss of containment integrity.

· each boiling water reactor and pressurized water reactor that does not rely on an inerted atmosphere for hydrogen control be provided with safety systems--needed for assuring safe shutdown and maintaining containment integrity--that can function after the burning of substantial amounts of hydrogen.

· analyses be performed for the reactor categories mentioned above to justify the hydrogen control systems selected and to assure containment structural integrity and survivability of needed safety systems during a hydrogen burn.

The proposed amendments to Part 50 are being published in the FEDERAL REGISTER on _____. Interested persons are invited to submit written comments or suggestions for consideration in connection with the proposed amendments to the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Docketing and Service Branch, by _____.

ENCLOSURE A

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555

OFFICE OF THE
SECRETARY

ACTION - Minogue / Denton

April 27, 1981

Cys: Dircks
Cornell
Rehm
Fleishman
Denton
Stello
Shapar
Vollmer

MEMORANDUM FOR: William J. Dircks, Executive Director
for Operations

FROM: Samuel J. Chilk, Secretary

SUBJECT: STAFF REQUIREMENTS - BRIEFING ON EFFECTIVE INTERIM AMENDMENTS TO 10 CFR 50 ON HYDROGEN CONTROL AND CERTAIN DEGRADED CORE CONSIDERATIONS (SECY-81-245), 10:00 A.M., THURSDAY, APRIL 23, 1981, COMMISSIONERS' CONFERENCE ROOM, D.C. OFFICE
(OPEN TO PUBLIC ATTENDANCE)

The Commission was briefed by staff on the proposed interim rule on hydrogen control and certain degraded core considerations.

Commissioner Gilinsky would like to have the staff explain to him why the evaluation of instability is not required for steel containments (reference pages 21-22 of Enclosure C to SECY-81-245). (NRR) - Suspense 5-15-81

The Commission agreed to deletion of the last sentence of the paragraph ending on page 22 of Enclosure C to SECY-81-245 from the proposed rule.
(EDO) (RES)

The Commission reached no decision at the meeting. The Chairman indicated that further consideration would be given to the proposal at a Commission meeting at a later date.

cc: Chairman Hendrie
Commissioner Gilinsky
Commissioner Bradford
Commissioner Ahearne
Commission Staff Offices
Public Document Room

Enclosure "A"

ENCLOSURE B

IN RESPONSE, PLEASE
REFER TO: M810430A

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555

OFFICE OF THE
SECRETARY

May 8, 1981

REVISED

ACTION - Denton
Cys: Dircks
Cornell
Rehm
Eisenhut
Olshinski
Minogue
Fleishman
Shapar
Stello
Besaw
Felton
Philips

MEMORANDUM FOR: William J. Dircks, Executive Director for Operations

FROM: Samuel J. Chilk, Secretary

SUBJECT: STAFF REQUIREMENTS - PROPOSED RULE ON OL APPLICATIONS (SECY-81-246) AND INTERIM AMENDMENTS ON HYDROGEN CONTROL, (SECY-81-245) 10:10 A.M., THURSDAY, APRIL 30, 1981, COMMISSIONERS' CONFERENCE ROOM, D.C. OFFICE (OPEN TO PUBLIC ATTENDANCE)

The Commission, by a vote of 3-1 (Commissioner Bradford dissenting), approved a Federal Register Notice as modified below seeking comment on a proposed rule that incorporates into 10 CFR Part 50 a set of TMI-2 requirements for operating license applications.

The Commission requested that the Federal Register Notice be modified:

1. to indicate in the Statement of Consideration that a similar rulemaking with respect to operating reactors will be published for comment in the near future;

2. to incorporate those items on the attached errata sheet that was distributed by staff at the meeting; and

3. to solicit comment on the effective date and its application to pending proceedings.

The Commission requested that the Federal Register Notice be sent to all known interested persons.

Commissioner Bradford dissented from the publication of the proposed rule on the grounds that the subject matter was too broad to be dealt with coherently and effectively in a single rulemaking.

Attachment:
As Stated

FRN to Secy 5/5/81

cc: Chairman Hendrie
Commissioner Gilinsky
Commissioner Bradford
Commissioner Ahearne
Commission Staff Offices
Public Document Room

Dupe of
8105210424

Enclosure "b"

ENCLOSURE C