NOTATION VOTE

RESPONSE SHEET

TO: Annette Vietti-Cook, Secretary

FROM: Commissioner Baran

SUBJECT: SECY-19-0072: Denial of Petition for Rulemaking on Measurement and Control of Combustible Gas Generation and Dispersal (PRM-50-103; NRC-2011-0189)

Approved __X__ **Disapproved** ____ **Abstain** ____ **Not Participating** ____

COMMENTS: **Below** __X__ **Attached** __X__ **None** ____

I appreciate NRDC's thoughtful and detailed petition for rulemaking, which focuses on controlling the generation of combustible hydrogen during severe accidents. In the wake of the Fukushima accident, this was clearly an important safety issue. After NRDC filed the petition in late 2011, the NRC staff performed a significant amount of analysis on hydrogen control and mitigation as part of the Fukushima lessons learned effort. Based on the results of the staff's evaluation, I approve the recommendation to deny the petition for rulemaking. I also approve publication of the *Federal Register* notice announcing this decision, subject to the attached edits.

Entered in "STARS"
Yes __X__
No ____

SIGNATURE

9/25/19
DATE

[7590-01-P]

JMB edits

NUCLEAR REGULATORY COMMISSION

10 CFR Part 50

[Docket Nos. PRM-50-103; NRC-2011-0189]

Measurement and Control of Combustible Gas Generation and Dispersal

AGENCY: Nuclear Regulatory Commission.

ACTION: Petition for rulemaking; denial.

SUMMARY: The U.S. Nuclear Regulatory Commission (NRC) is denying a petition for rulemaking (PRM), dated October 14, 2011, submitted by Mr. Jordan Weaver (the petitioner) on behalf of the Natural Resources Defense Council, Inc. The petitioner requested that the NRC amend its regulations regarding the measurement and control of combustible gas generation and dispersal within a power reactor system. The petition was assigned Docket No. PRM-50-103 and the NRC published a notice of docketing in the *Federal Register* on January 5, 2012. The NRC is denying the petition ~~in its entirety~~ because the petitioner did not present ~~any~~ sufficient new information or arguments to warrant the requested changes to the regulations or provide substantial improvements for public safety, environmental protection, or ~~provide for~~ the common defense and security.

DATES: The docket for the petition for rulemaking, PRM-50-103, is closed on **[INSERT DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]**.

ADDRESSES: Please refer to Docket ID NRC-2011-0189 when contacting the NRC about the availability of information for this petition. You may obtain publicly-available information related to this petition by any of the following methods:

- **Federal Rulemaking Web Site:** Public comments and supporting materials related to this petition can be found at http://www.regulations.gov by searching on the petition Docket ID NRC-2011-0189. Address questions about NRC dockets to Carol Gallagher; telephone: 301-415-3463; e-mail: Carol.Gallagher@nrc.gov. For technical questions, contact the individuals listed in the FOR FURTHER INFORMATION CONTACT section of this document.

- **The NRC's Agencywide Documents Access and Management System (ADAMS):** You may obtain publicly-available documents online in the ADAMS Public Document collection at http://www.nrc.gov/reading-rm/adams.html. To begin the search, select "Begin Web-based ADAMS Search." For problems with ADAMS, please contact the NRC's Public Document Room (PDR) reference staff at 1-800-397-4209, 301-415-4737, or by e-mail to pdr.resource@nrc.gov. For the convenience of the reader, instructions about obtaining materials referenced in this document are provided in Section IV, "Availability of Documents."

- **The NRC's PDR:** You may examine and purchase copies of public documents at the NRC's PDR, O1-F21, One White Flint North, 11555 Rockville Pike, Rockville, Maryland 20852.

FOR FURTHER INFORMATION CONTACT: Joseph Sebrosky, Office of Nuclear Reactor Regulation; telephone: 301-415-1132; e-mail: Joseph.Sebrosky@nrc.gov; or Edward M. Lohr, Office of Nuclear Material Safety and Safeguards; telephone: 301-415-

0253; e-mail: Edward.Lohr@nrc.gov. Both are staff of the U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

SUPPLEMENTARY INFORMATION:

TABLE OF CONTENTS:

I. The Petition

Section 2.802 of title 10 of the *Code of Federal Regulations* (10 CFR), “Petition for rulemaking—requirements for filing,” provides an opportunity for any interested person to petition the Commission to issue, amend, or rescind any regulation. The NRC received a petition for rulemaking, dated October 14, 2011, from Mr. Jordan Weaver on behalf of the Natural Resources Defense Council, Inc. The NRC published a notice of docketing in the *Federal Register* on January 5, 2012. The petitioner requested that the NRC amend its regulations regarding the measurement and control of combustible gas generation and dispersal within a power reactor system.

When the NRC published the notice of docketing in 2012, the NRC elected not to seek public comment, as the issues raised in the petition were being addressed by the staff with regard to an ongoing effort at the time regarding SECY-11-0093, “Near-Term Report and Recommendations for Agency Actions Following the Events in Japan,” (Near-Term Task Force) recommendations on the Fukushima Dai-ichi accident in Japan, and those recommendations had not yet been resolved.

The NRC was in the process of holding public meetings on the Near-Term Task Force Report recommendations and indicated in the notice of docketing for the petition that “the NRC is not requesting public comment at this time but may do so in the future, if it decides public comment would be appropriate.” Because the NRC held several public meetings on the Near-Term Task Force Report recommendations~~,~~ and ~~therefore,~~ on the subjects raised by the petitioner, the NRC determined that additional public input was not needed to resolve the issues raised in this petition.

The NRC identified six issues in the petition. The petitioner raised various issues related to pressurized water reactors; boiling water reactors; or specific containment designs such as boiling water reactors Mark I, Mark II, or Mark III or pressurized water reactors with large dry containments, sub-atmospheric containments, and ice condenser containments. ~~Detailed NRC responses to the six issues are provided in Section II, “Reasons for Denial,” of this document.~~

II. Reasons for Denial

The NRC is denying the petition because the petitioner failed to present sufficient new information or arguments to warrant the requested changes to the NRC’s regulations. The NRC completed an assessment of potential regulatory changes related to hydrogen control following the March 2011 Fukushima accident in Japan. This assessment is summarized in SECY-16-0041, “Closure of Fukushima Tier 3 Recommendations Related to Containment Vents, Hydrogen Control, and Enhanced Instrumentation.” In SECY-16-0041, the NRC addressed Recommendation 6 of the Near-Term Task Force Report involving hydrogen control and mitigation inside containment or in other buildings, and other recommendations from the report that were provided in connection with implementing lessons learned from the 2011 accident at the Fukushima Dai-ichi nuclear power plant.

The NRC’s response to Near-Term Task Force Recommendation 6, as documented in SECY-16-0041, was based on a detailed holistic review of hydrogen control measures for power reactors. In SECY-16-0041, the NRC provided a high-level summary of the studies and evaluations related to hydrogen control, including studies ~~which were~~ issued in September of 2003 that supported requirements found in § 50.44, “Combustible gas control for nuclear power reactors.” In SECY-16-0041, the NRC discusses hydrogen-related issues that have been addressed in major studies, such as those documented in NUREG-1150, “Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants,” and NUREG-1935, “State-of-the-Art Reactor Consequence Analyses (SOARCA) Report.” Additionally, the NRC has been actively participating in various international efforts~~studies~~, including a working group studying hydrogen generation, transport, and risk management organized by the Organization for Economic Cooperation and Development/Nuclear Energy Agency.

In SECY-16-0041, the NRC concluded that additional regulatory actions were not needed based on: (1) the evaluations of event frequencies, plant responses, the timing of barrier failures, and conditional release fractions, and; (2) the significant margin that exists between the NRC’s quantitative health objectives as described in the NRC’s ~~“~~Safety Goal~~s for the Operations of Nuclear Power Plants; Correction and Republication of~~ Policy Statement~~,”~~ and estimated plant risks that might be reduced by improvement in hydrogen control.

~~In order to impose requirements on its licensees for existing operating reactors, the NRC is generally required to find that a regulatory action would at least result in a substantial increase in the overall protection of the public health and safety or the~~

~~common defense and security.~~ The NRC, in SECY-16-0041, documented that the risks to public health and safety from hydrogen generation during severe accidents were addressed by existing NRC requirements and programs undertaken by licensees and that additional requirements would, therefore, not provide a substantial safety improvement. For new reactors licensed after 2003, NRC regulations include more stringent~~conservative~~ hydrogen control and mitigation requirements. The NRC also documented in SECY-16-0041 that changes to NRC regulations related to hydrogen control and mitigation requirements for new reactors licensed after 2003 were not warranted.

The petitioner, in PRM-50-103, raised six issues and requested that the NRC address them in rulemaking. While the NRC's assessment in SECY-16-0041 of Near-Term Task Force Report, Recommendation 6, is closely related to the issues raised in PRM-50-103, SECY-16-0041 does not specifically address every aspect of the six issues raised in the petition. ~~However, t~~The conclusions in SECY-16-0041 and other sources are referenced in addressing the specific issues raised in PRM-50-103. The following explains each issue raised in the petition, the NRC's detailed response, and as appropriate, supplemental information beyond that provided in SECY-16-0041.

Issue 1: The petitioner requested that the NRC revise § 50.44 "to require that all PWRs (with large dry containments, sub-atmospheric containments, and ice condenser containments) and Mark IIIs operate with systems for combustible gas control that would effectively and safely control the potential total quantity of hydrogen that could be generated in different severe accident scenarios." The petitioner stated that the total quantity of hydrogen could exceed the amount generated from the metal-water reaction of 100 percent of the fuel cladding because of contributions produced by the metal-water reaction with non-fuel components of the reactor.

Response to Issue 1: The NRC has evaluated requirements related to hydrogen control for these~~the subject~~ containment types on several occasions. For example, hydrogen-related issues have been addressed in major studies, such as those documented in NUREG-1150 and NUREG-1935/SOARCA report. In SECY-16-0041, the NRC provided a detailed assessment of whether additional hydrogen controls were warranted for large dry containments, ice condenser containments, and Mark III containments. The NRC concluded ~~in SECY-16-0041~~ that the risks to public health and safety from hydrogen generation during severe accidents were addressed by existing NRC requirements and programs undertaken by licensees and that additional requirements for existing operating reactors would, therefore, not provide a substantial safety improvement and that changes to requirements for new reactors were not warranted.

For large dry and sub-atmospheric containments, § 50.44 does not include a requirement to assume a particular percentage of hydrogen generated from metal-water reactions for existing operating reactors. The NRC, in a *Federal Register* notice for the final rule for § 50.44, "Combustible Gas Control in Containment," published on September 16, 2003, stated that combustible gas generated from severe accidents was not considered to be risk significant for 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."

As documented in the draft report, "State-of-the-Art Reactor Consequence Analysis Project - Uncertainty Analysis of the Unmitigated Short-Term Station Blackout of the Surry Power Station" (Surry Power Station), the MELCOR best-estimate computer program was used to model the progression of hypothetical severe accidents at Surry

Power Station Units 1 and 2. The MELCOR computer program was developed by Sandia National Laboratories for the NRC to model the progression of severe accidents in nuclear power plants. The Surry Power Station MELCOR uncertainty analysis showed that the hydrogen that is produced in-vessel can vary between 250 kilograms (5th percentile) to 600 kilograms (95th percentile) with a mean of about 400 kilograms at 48 hours after the start of the accident. The corresponding fraction of cladding oxidized varies from 35 percent to 83 percent equivalent cladding mass with a mean of 55 percent. The typical timing for rapid initial hydrogen generation is about 1-2 hours after the start of hydrogen generation. None of the cases in the uncertainty analysis indicated early containment failure as a result of hydrogen combustion. Any c~~C~~ontainment failure would occur~~s~~ later, as a result of continued heat up of the containment, due to core–concrete interaction if cooling to the containment were~~is~~ not restored. The analysis also did not predict late failure due to hydrogen combustion because after breach of the reactor pressure vessel, ignition sources would be available to burn the hydrogen at lower flammability limits~~ (much like the ice condenser case that is discussed further in this document)~~.

Insights from NUREG/CR-7110, Vol 2, “State-of-the-Art Reactor Consequence Analyses Project - Volume 2: Surry Integrated Analysis,” which considered hydrogen generated from non-cladding sources, determined that high-steam concentrations are typically associated with scenarios that lead to large amounts of hydrogen generation from metal-water reactions. These high steam concentrations are sufficient to inert the containment and suppress hydrogen combustion in containments with large volumes.

In reviewing the issues raised in the petition, the NRC also considered compliance with EA-12-049, “Issuance of Order to Modify Licenses With Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,” which ensures that additional mitigation strategies are available for each operating reactor to reduce the risk of core damage from an extended loss of alternating current power event. Also, based on Commission direction in SRM-SECY-15-0065, “Proposed Rulemaking: Mitigation of Beyond-Design-Basis Events,” the reactor oversight process has been revised to address licensees’ implementation and maintenance of severe accident management guidelines. The severe accident management guidelines address hydrogen generation in large dry and sub-atmospheric containments to minimize the potential for containment failure from hydrogen combustion events.

For ice condenser and Mark III containments, § 50.44(b)(2)(ii), (b)(3), and (b)(5) require that these containment types have hydrogen igniters, and that licensees have performed an evaluation of equipment survivability and an evaluation of the consequences of large amounts of hydrogen generated if there is 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). As discussed in SECY-16-0041, the NRC performed additional analyses for these containments to determine if additional regulatory actions were warranted relative to hydrogen control. The NRC determined that such actions were not needed based on the underlying requirements in § 50.44 as supplemented by additional guidance to include backup power supplies for the igniters in Order EA-12-049. The Order requirements and the supporting guidance have been made generically applicable in the final Mitigation of Beyond-Design-Basis Eventsa rule in accordance with the Commission’s direction found in SRM-SECY-16-0142, “Final Rule: Mitigation of Beyond-Design-Basis Events (RIN 3150-AJ49).”

As documented in SECY-16-0041, assessments have been performed with best estimate simulations with MELCOR, which is consistent with the approach used in prior

State-of-the-Art Consequence Analyses efforts. Additional assessments are documented in NUREG/CR-7245, “State-of-the-Art Consequence Analyses (SOARCA) Project - Sequoyah Integrated Deterministic and Uncertainty Analyses,” dated November 2017. The NUREG/CR-7245 assessment included hydrogen generated from non-cladding sources. Based on the results of these studies, the NRC concluded that possible early containment failures could only occur on the first hydrogen burn for ice condenser containments in those cases where the hydrogen igniters were not credited. Subsequent hydrogen burns do not challenge the ice condenser containment integrity because they occur closer to the lower flammability limit of hydrogen due to the presence of active ignition sources (e.g., hot gases from the primary system or ex-vessel debris). The total amount of hydrogen produced by the first deflagration varies between 5 to 50 percent of equivalent cladding mass oxidized. Therefore, the NRC concluded in SECY-16-0041, that the existing requirement to consider hydrogen generation from a 75 percent cladding mass oxidation for ice condenser containments is appropriate. In those cases, when crediting the hydrogen igniters, containment failure was delayed and only occurred as a result of overpressure if heat removal systems were not restored.

For Mark III containments, calculations were performed in resolving Near-Term Task Force Recommendation 5.2 related to reliable hardened vents for containments other than Mark I and Mark II. Further, analysis performed in response to Near-Term Task Force Recommendation 6, associated with hydrogen control measures, showed that the total in-vessel hydrogen generation by the time of lower head failure is about 90 percent of equivalent cladding mass oxidized. These calculations were performed with a detailed MELCOR Grand Gulf nuclear power plant model (with credit for igniters), and outcomes indicate that containment failure by overpressure is significantly delayed in this scenario.

Compliance with Order EA-12-049, which has been made generically applicable in a rule in accordance with the Commission's direction found in SRM-SECY-16-0142, by licensees with Mark III containments results in extending reactor core isolation cooling system operation by cooling water in the suppression pool and thereby preventing or further delaying breaches of fission product barriers. Order EA-12-049 also includes guidance to provide backup power supplies for hydrogen igniters.

An assessment of event frequencies, plant responses, the timing of barrier failures, radioactive releases, and other factors show substantial margin to the criteria used to determine if additional regulatory actions were warranted. Therefore, even in the case where hydrogen generation is assumed to be 90 percent of equivalent cladding mass oxidized, the NRC determined that additional regulatory actions were not warranted above those found in § 50.44 and in response to Order EA-12-049.

The petitioner's request also applied to new reactors. The analysis stated in previous paragraphs centered on whether changing hydrogen control requirements for existing operating reactors would result in a substantial increase in safety. Section 50.44(c) sets forth combustible gas control requirements for water-cooled nuclear power reactor designs licensed after 2003 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. These requirements are more conservative than those for existing operating reactors and reflect the NRC's expectation that future designs will achieve a higher standard of severe accident performance in accordance with the NRC's "Policy Statement on Severe Reactor Accidents Regarding Future Designs and Existing Plants."

Section 50.44(c)(2) 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. As a result, new plants have design features such as hydrogen igniters for AP1000 design reactors and inerted containments and passive autocatalytic recombiners for the Economic Simplified Boiling Water Reactors. As described in SECY-16-0041, the NRC assessed the potential for further hydrogen control enhancements and found that such measures would not likely be justified under the finality provisions established under 10 CFR part 52, "Licenses, certifications, and approvals for nuclear power plants" (similar to the backfit requirements defined in § 50.109, "Backfitting"). In addition, based on the analysis described in previous paragraphs for various containment types, the NRC concludes that changing the existing § 50.44(c) requirements is not warranted.

In addition to the discussion for the various containment types described in previous paragraphs and new reactor requirements, the NRC also considered the petitioner's position that a hydrogen detonation inside containment can result in internally generated missiles that could damage structures, systems, and components used to maintain key safety functions of ensuring core cooling and containment integrity, as well as the petitioner's position that these types of events should be analyzed. While SECY-16-0041 does not specifically address this issue, the conclusions in SECY 16-0041 are based, in part, on the low risk associated with core damage events that could lead to large amounts of hydrogen being generated. Given the low probability ~~Consideration~~ of missiles being generated from a hydrogen combustion event (which assumes the core is substantially degraded), ~~could not be justified as a requirement for hydrogen control. This is because a significant margin exists between the NRC's quantitative health objectives described in the NRC's "Safety Goals for the Operations of~~

~~Nuclear Power Plants; Correction and Republication of Policy Statement," and~~ the estimated plant risks that might be reduced by ~~improvement in hydrogen control including~~ a proposed requirement to consider missiles generated from a hydrogen combustion event are not substantial.

Therefore, the NRC concludes that the petitioner did not present sufficient new information or arguments to warrant the requested amendment. The NRC determined that the analyses and plant changes requested by the petitioner in issue 1 of the petition for existing operating reactors would not provide substantial safety enhancements. For reactors licensed after 2003 (new reactors), the NRC determined that changes to the requirements in § 50.44(c)(2) are not warranted. The NRC continues to conclude that the current design and licensing requirements for both operating and new reactors for the control of hydrogen provide adequate protection of public health and safety.

Issue 2: The petitioner requested that the NRC revise § 50.44 to "require that BWR Mark Is and BWR Mark IIs operate with systems for combustible gas control or inerted containments that would effectively and safely control the potential total quantity of hydrogen that could be generated in different severe accident scenarios." The petitioner stated that the total quantity of hydrogen could exceed the amount generated from the metal-water reaction of 100 percent of the fuel cladding because of contributions produced by the metal-water reaction with non-fuel components of the reactor.

Response to Issue 2: The NRC has evaluated requirements related to hydrogen control for Mark I and Mark II containments on several occasions. In SECY-16-0041, the NRC provided a detailed assessment of whether additional hydrogen controls were warranted for these containment types and concluded that additional regulatory controls beyond § 50.44 and those associated with Order EA-13-109, "Final

Proposed EA-13-109 Reliable Severe Accident Capable Hardened Containment Venting System," and the severe accident management guidelines were not warranted. For hydrogen combustion events outside primary containment, assessments performed with best estimate simulations (e.g., NUREG-1935/SOARCA report) included hydrogen generated from non-cladding sources. In resolving the issue, the NRC considered the international evaluations referenced by the petitioner in support of the request to modify the NRC's regulations. The NRC was a participant in the international working groups that developed these evaluations and used them in developing current NRC regulations and guidance.

Mark I and Mark II containments, per the requirements in § 50.44, have an inerted atmosphere that greatly reduces the possibility of hydrogen combustion inside primary containment. The Fukushima accident highlighted the possible migration of hydrogen to buildings outside the primary containment and the need to evaluate possible features or procedures to prevent explosion in the reactor building or other structures.

The NUREG/CR-7155, "State-of-the-Art Reactor Consequence Analyses Project - Uncertainty Analysis of the Unmitigated Long-Term Station Blackout of the Peach Bottom Atomic Power Station," predicted that the hydrogen that is produced in-vessel can vary between about≈ 1100 kilograms (5th percentile) to about≈ 1600 kilograms (95th percentile) with a mean of about 1300 kilograms. The corresponding fraction of equivalent cladding mass oxidized, therefore, varies from 62 percent to 90 percent (mean at 73 percent).

The more recent calculations in support of the containment protection and release reduction proposed rulemaking (NUREG-2206, "Technical Basis for the Containment Protection and Release Reduction Rulemaking for Boiling Water Reactors with Mark I and Mark II Containments"), shows that equivalent cladding mass oxidation varies between 60 percent to 77 percent. The typical timing for rapid initial hydrogen generation is about 2-3 hours after the start of hydrogen generation. The assessment in SECY-16-0041 concluded that adding hydrogen control requirements beyond those already included in NRC regulations, Order EA-13-109, and the severe accident management guidelines would~~do~~ not provide a substantial safety improvement, and therefore, were not warranted.

In SECY-16-0041, the NRC references the technical analyses for Order EA-13-109, and the proposed Containment Protection and Release Reduction draft regulatory basis for rulemaking, "Draft Regulatory Basis for Containment Protection and Release Reduction for Mark I and Mark II Boiling Water Reactors (10 CFR Part 50)." ~~In SRM-SECY-15-0085, "Evaluation of the Containment Protection and Release Reduction for Mark I and Mark II Boiling Water Reactors Rulemaking Activities (10 CFR Part 50) (RIN-3150-AJ26)," the Commission directed the staff not to undertake rulemaking and to "leverage the draft regulatory basis to the extent applicable to support resolution of the post-Fukushima Tier 3 item related to containments of other designs."~~ Order EA-13-109 and the Containment Protection and Release Reduction draft regulatory basis show that the threat of explosions from combustible gases outside primary containment is significantly reduced by effective venting strategies. Additionally, the severe accident water addition/severe accident water management approaches are part of implementing Order EA-13-109. In SECY-16-0041, the NRC concluded that additional measures for addressing hydrogen control do not themselves directly support the cooling of core debris, but could help for some selected scenarios, to maintain barriers to the release of radioactive material and prevent explosions that could hamper severe accident management activities. The potential benefits of the measures requested by the petitioner would be comparable or less than the alternatives analyzed in SECY-16-0041, which were determined to be below the threshold for warranting further regulatory actions.

Therefore, the NRC concludes that the petitioner did not present sufficient new information or arguments to warrant the requested requirement~~amendment~~. The NRC determined that the analyses and plant changes requested by the petitioner in issue 2 of the petition would not provide substantial safety enhancements. The NRC continues to conclude that the current design and licensing requirements for the control of hydrogen provide adequate protection of public health and safety.

Issue 3: The petitioner requested that the NRC revise § 50.44 "to require that pressurized water reactors and BWR Mark IIIs operate with systems for combustible gas control that would be capable of precluding local concentrations of hydrogen in the containment from exceeding concentrations that would support combustions, fast deflagrations, or detonations that could cause a loss of containment integrity or loss of necessary accident mitigating features."

Response to Issue 3: As stated in the NRC's response to issue 1 of the petition, additional hydrogen controls for large dry and sub-atmospheric containments do not yield a substantial safety benefit. In addition, the NRC, in the *Federal Register* notice for the § 50.44 final rule, "Combustible Gas Control in Containment," provides additional insights for the basis for removing hydrogen recombiners as a requirement for these containment types. The NRC, in the *Federal Register* notice references Attachment 2 to 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)." In Attachment 2, a discussion is provided regarding why the large volumes and likelihood of spurious ignition in large dry and sub-atmospheric containment help prevent the build-up of detonable concentrations.

The petitioner stated that the small volumes and confined spaces found in ice condenser and Mark III containments make them susceptible to hydrogen pocketing. Analyses performed by the NRC, and documented in SECY-16-0041, confirm that hydrogen accumulation and potential combustion could challenge the integrity of these containment types if igniters were not required.

However, t~~T~~o meet the requirements of § 50.44(b)(2)(ii), (b)(3), and (b)(5), ice condenser and Mark III containments must have hydrogen igniters for combustible gas control. For most accident sequences, the hydrogen igniters address the threat from combustible gas buildup~~ such that additional regulatory actions are not warranted~~. In addition, as part of compliance with Order EA-12-049, licensees with these containment types have taken action to ensure power is available to the igniter systems during station blackout conditions. Licensees with these containment types follow the severe accident management guidelines to minimize the potential for containment failure from hydrogen combustion events. The location of the igniters prevents the hydrogen (or any other combustible gas) from accumulating in large quantities.

The petitioner's request also applied to new reactors. As stated in the NRC's response to issue 1 of the petition, § 50.44(c) sets forth combustible gas control requirements for water-cooled nuclear power reactor designs licensed after 2003, which are more stringent~~conservative~~ than those for existing operating reactors. These requirements reflect the NRC's expectation that future designs will achieve a higher standard of severe accident performance in accordance with the NRC's "Policy Statement on Severe Reactor Accidents Regarding Future Designs and Existing Plants." As a result, new plants have design features such as hydrogen igniters for AP1000 design reactors and inerted containments and passive autocatalytic recombiners for the

Economic Simplified Boiling Water Reactors. ~~As described in SECY-16-0041, the NRC assessed the potential for further hydrogen control enhancements for existing operating reactors and found that such measures would not likely be justified under the finality provisions established under 10 CFR part 52 (similar to backfit requirements defined in § 50.109, "Backfitting").~~

Therefore, as it relates to issue 3 of the petition, the NRC concludes that the petitioner did not present sufficient new information or arguments to warrant the requested requirement~~amendment~~. Although SECY-16-0041 did not specifically consider this issue raised by the petitioner, the NRC's assessments in the SECY-16-0041 paper did consider the contributions to the risk to public health and safety from severe accidents and related hydrogen generation and concluded that those contributions were not substantial. The NRC determined that the analyses and plant changes requested by the petitioner in issue 3 of the petition for existing operating reactors would not provide substantial safety enhancements and therefore, were not warranted. For reactors licensed after 2003, the NRC also determined that changes to the requirements in § 50.44(c)(2) are not warranted. The NRC continues to conclude that the current design and licensing requirements the control of hydrogen for both operating and new reactors provide adequate protection of public health and safety.

Issue 4: The petitioner stated that "[t]he current requirement that hydrogen monitors be functional within 90-minutes after the initiation of safety injection is inadequate for protecting public and plant worker safety." To correct this issue, the petitioner requested that the NRC revise § 50.44 to "require that PWRs and BWR Mark IIIs operate with combustible gas and oxygen monitoring systems that are qualified in accordance with 10 CFR 50.49." The petitioner also requested that NRC revise § 50.44 "to require that after the onset of a severe accident, combustible gas monitoring systems be functional within a timeframe that enables the proper monitoring of quantities of hydrogen indicative of core damage and indicative of a potential threat to the containment integrity."

Response to Issue 4: Hydrogen monitoring in containment in § 50.44 includes requirements that hydrogen monitors be functional. Functional requirements are also provided in Item II.F.1, Attachment 6, of NUREG-0737, "Clarification of TMI Action Plan Requirements," which states that hydrogen monitors are to be functioning within 30 minutes of the initiation of safety injection. This requirement was imposed by confirmatory orders in 1983 following the accident at Three Mile Island Unit 2.

Since NUREG-0737 was issued, the NRC has determined that the 30-minute requirement can be ~~overly burdensome~~unnecessarily stringent. This is documented in the *Federal Register* notice for the § 50.44 final rule and in Regulatory Guide 1.7, Revision 3, "Control of Combustible Gas Concentrations in Containment." Through a confirmatory order, "Confirmatory Order Modifying Post-TMI Requirements Pertaining to Containment Hydrogen Monitors for Arkansas Nuclear One, Units 1 and 2 (TAC NOS. MA1267 and 1268)," the NRC developed a method for licensees to adopt a risk-informed functional requirement in lieu of the 30-minute requirement. As described in the confirmatory order, an acceptable functional requirement would meet the following requirements:

(1) Procedures shall be established for ensuring that indication of hydrogen concentration in the containment atmosphere is available in a sufficiently timely manner to support the role of information in the emergency plan (and related procedures) and related activities such as guidance for the severe accident management plan.

(2) Hydrogen monitoring will be initiated on the basis of the following considerations:

a. The appropriate priority for establishing indication of hydrogen concentration within containment in relation to other activities in the control room.

b. The use of the indication of hydrogen concentration by decision-makers for severe accident management and emergency response.

c. Insights from experience or evaluation pertaining to possible scenarios that result in significant generation of hydrogen that would be indicative of core damage or a potential threat to the integrity of the containment building.

The NRC has determined that adoption of this risk-informed functional requirement by licensees results in the hydrogen monitors being functional within 90 minutes after the initiation of safety injection.

Subsequent to the issuance of the confirmatory order, the NRC issued a notice of availability of a model in the *Federal Register* titled, "Notice of Availability of Model Application Concerning Technical Specification Improvement to Eliminate Hydrogen Recombiner Requirement, and Relax the Hydrogen and Oxygen Monitor Requirements for Light Water Reactors Using the Consolidated Line Item Improvement Process," for referencing in license amendment applications for licensees wanting to relax safety classifications and the licensee commitments to certain design and qualification criteria for hydrogen monitors. Therefore, licensees can choose to remove containment hydrogen monitoring requirements from their license through a license amendment process. For example, such a license amendment was approved for Arkansas Nuclear One, Unit 1 in August 2004~~, in license amendment "Arkansas Nuclear One, Unit 1, License Amendment 222 regarding Elimination of Requirements for Hydrogen Recombiners and Hydrogen Monitors~~.~~"~~ The basis for the NRC approving the license amendment request concluded that the hydrogen monitors were not risk-significant. However, because the monitors are required to diagnose the course of beyond-design-basis accidents, each licensee should verify that it has, and make a regulatory commitment to maintain, a hydrogen monitoring system capable of diagnosing beyond-design-basis accidents.

Section 50.44 requires that equipment used for monitoring hydrogen in containment to be functional, reliable, and capable of continuously measuring the concentration of hydrogen in the containment atmosphere following a significant beyond-design-basis accident. In the *Federal Register* notice for the § 50.44 final rule, it states that the NRC determined that the monitoring equipment need not be qualified in accordance with § 50.49 because the requirements found in § 50.44 address beyond-design-basis combustible gas control. As a result of the Fukushima lessons learned, the NRC also reviewed whether enhancements to reactor and containment instrumentation to withstand beyond-design-basis accident conditions were warranted. As documented in Enclosure 2 to SECY-16-0041, the NRC concluded that regulatory actions to require enhancements to reactor and containment instrumentation to support the response to severe accidents would not provide a substantial safety enhancement and, therefore, were not warranted.

Additionally, ~~in accordance with Commission direction provided in SRM-SECY-15-0065,~~ the reactor oversight process has been revised to address licensees' implementation and maintenance of severe accident management guidelines. The severe accident management guidelines are based on the concept of using available resources (including instrumentation) to mitigate a severe accident, such that if a key instrument is not available for any reason, alternate instruments are used. The instrumentation that is available and that might be used before, during, and after a severe accident are discussed in Regulatory Guide 1.97, Revision 3, "Instrumentation for Light-Water Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident," licensing documents, severe accident management guidelines, and supporting technical guidance documents. The severe accident management guidelines include guidance to address hydrogen generation from metal-water reactions and actions to take to minimize the potential for containment failure from hydrogen combustion events.

The petitioner stated that effective and safe use of hydrogen igniters used in ice condenser and Mark III containments is a complex issue that needs to be thoroughly analyzed, including consideration of the safety of using the igniters at certain times in a severe accident. ~~The conclusions in SECY-16-0041 are based, in part, on the low risk associated with core damage events that lead to large amounts of hydrogen being generated.~~ The severe accident management guidelines for ice condenser and Mark III containments include guidelines for the use of the igniters.

Therefore, as it relates to issue 4 of the petition, the NRC concludes that the petitioner did not present sufficient new information or arguments to warrant the requested requirement~~amendment~~. The NRC determined that the analyses and plant changes requested by the petitioner in issue 4 of the petition would not provide substantial safety enhancements.

~~Although the staff did not specifically consider this issue raised in the petition in SECY-16-0041, the NRC's assessment did consider the contributions to the risk to public health and safety from severe accidents and related hydrogen generation and concluded that those contributions were not substantial. Based on the NRC's determination that the risk contribution was not substantial, measures to reduce the risk as proposed by issue 4 of the petition do not meet the NRC's requirements for imposing~~

~~additional regulations upon licensees. The NRC continues to conclude that the current design and licensing requirements for the control of hydrogen provide adequate protection of public health and safety.~~

Issue 5: The petitioner requested that the NRC revise § 50.44 to "require that licensees of PWRs and BWR Mark IIIs perform analyses that demonstrate containment structural integrity would be retained in the event of a severe accident." Additionally, the petitioner requested that the NRC revise § 50.44 to require licensees of Mark Is and Mark IIs to perform analyses "using the most advanced codes, which demonstrate containment structural integrity would be retained in the event of a severe accident."

Response to Issue 5: For large dry and sub-atmospheric pressurized water reactor containments, § 50.44 does not require that containment structural integrity analysis to be performed for hydrogen combustion events. Studies, including "Feasibility Study for a Risk-Informed Alternative to 10 CFR 50.44 'Standards for Combustible Gas Control System in Light-water cooled Power Reactors'" (Attachment 2 to SECY-00-0198), NUREG-1935/SOARCA report, SECY-16-0041 evaluations, and "State-of-the-Art Reactor Consequence Analysis Project - Uncertainty Analysis of the Unmitigated Short-Term Station Blackout of the Surry Power Station" (draft report), have indicated that these containments have very large internal volumes and are predicted to fail at about three times their design pressure. These studies also have determined that these containments have significant capacity for withstanding the pressure load associated with hydrogen deflagrations. Detonations of sufficient magnitude to cause failure of these types of containments were determined to have a low probability of occurrence.

In SECY-16-0041, the NRC determined that the longer times to over-pressurize large dry containments in long-term station blackout scenarios provides additional opportunities for emergency responders to restore key safety functions prior to the containment being breached. The low latent cancer fatality risks estimated in NUREG-1935/SOARCA report, which reflect the ability of large dry containments to limit the release of radioactive material for many hours, confirm the NRC's assessment of the adequacy of containment performance and finding that additional regulatory actions such as requiring improved containment vents are not warranted for large dry containments. The staff concludes requiring licensees to perform detailed structural analysis of the containment using different or advanced codes (as the petitioner requested) to demonstrate that containment structural integrity would be retained in the event of a severe accident is not warranted~~cannot be justified~~. This is because the risks associated with large dry containment overpressure events from severe accidents are lower than the NRC's quantitative health objectives described in the NRC's "Safety Goals for the Operations of Nuclear Power Plants; Correction and Republication of Policy Statement."

For ice condenser and Mark III containments, § 50.44(b)(5)(v)(A) requires that containment structural integrity must be demonstrated by the use of an analytical technique that is accepted by the NRC for hydrogen combustion events. The demonstration must include sufficient supporting justification to show that the technique describes the containment response to the structural loads involved. In SECY-16-0041, additional analyses performed by the NRC confirmed that hydrogen accumulation and potential combustion could challenge the integrity of these containments and showed the benefit of igniters to address this concern. Therefore, the NRC continues to find that the structural analysis associated with hydrogen deflagration events regarding the use of the igniters that is required by § 50.44(b)(5)(v)(A) is appropriate.

Further, the NRC concludes that the additional requirements proposed by the petitioner to use the most advanced codes, such as computational fluid dynamic codes, to model hydrogen distribution in the containment and loads from flame acceleration, are not required. In SECY-16-0041, the NRC assessed whether additional regulatory controls, such as a hardened containment vent or additional hydrogen control and mitigation, were warranted for these containment types. The assessments, which used the best-estimate computer program MELCOR, concluded that sufficient safety margins exist between estimated plant risks that might be influenced by improvements in containment performance or hydrogen control and the NRC's quantitative health objectives described in the NRC's "Safety Goals for the Operations of Nuclear Power Plants; Correction and Republication of Policy Statement." ~~Thus, the staff determined that additional regulatory actions were not warranted.~~ Therefore, because the requirements for existing structural analysis for these containment designs provide sufficient margin to ensure safety, requiring licensees to continually update this structural evaluation using updated codes would not provide a substantial safety benefit, the staff concluded that no regulatory action is warranted.

For Mark I and Mark II containments, § 50.44 does not require that containment structural integrity analysis be performed for hydrogen combustion events. As required by § 50.44, Mark I and Mark II primary containments are inerted. Because the primary containments are inerted, hydrogen combustion inside the primary containment is highly unlikely, rendering the need to perform primary containment structural analysis associated with hydrogen combustion events unnecessary. In addition, for Mark I and Mark II containments, Order EA-13-109 requires the installation of reliable hardened containment vents capable of operation under severe accident conditions. In SECY-16-0041, the technical analyses for Order EA-13-109 and NUREG-2206 show that the threat of explosions from combustible gasses in secondary containment is significantly reduced by effective venting strategies and that severe accident water addition/severe accident water management approaches are being taken as part of the implementation of Order EA-13-109.

Severe accident management guidelines also include specific measures to monitor and vent Mark I and Mark II containments to address containment over-pressurization events and hydrogen issues. The enhancements provide some further risk reductions by improving the control of hydrogen in Mark I and Mark II containments. even though more specific regulatory actions would likely not be justified given the large margins between plant risks and the NRC's quantitative health objectives described in the NRC's "Safety Goals for the Operations of Nuclear Power Plants; Correction and Republication of Policy Statement." Using different or advanced codes (as the petitioner requested) to demonstrate that containment structural integrity would be retained in the event of a severe accident, is not necessarycould not be justified for these containment designs because: 1) hydrogen combustion events are highly unlikely in the primary containment given the inerted containment, 2) the severe accident hardened containment vent being installed in these primary containments reduce the already low likelihood of containment failure to levels below the levels where additional regulatory actions are warranted, and 3) as documented in SECY-16-0041, reduction of pressure in the primary containment using the severe accident capable hardened vents reduces the already low likelihood of secondary containment failure due to hydrogen combustion events to levels below where additional regulatory actions are warranted.

For new reactors, § 50.44(c) sets forth combustible gas control requirements for water-cooled nuclear power reactor designs licensed after 2003 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. These requirements are more conservative stringent than those for existing operating reactors and reflect the NRC's expectation that future designs will achieve a higher standard of severe accident performance in accordance with the NRC's "Policy Statement on Severe Reactor Accidents Regarding Future Designs and Existing Plants." Section 50.44(c)(5) requires a structural analysis be performed that demonstrates containment structural integrity. This demonstration must use an analytical technique that is accepted by the NRC and must 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 a 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. Therefore, for reactors licensed after 2003 with similar characteristics to current pressurized water reactors and Mark III boiling water reactors, the kind of structural analysis requested by the petitioner is already required.

Therefore, as it relates to issue 5 of the petition, the NRC concludes that the petitioner did not present sufficient new information or arguments to warrant the requested amendments. The NRC determined that the analyses and plant changes for existing operating reactors requested by the petitioner in issue 5 of the petition would not provide substantial safety enhancements. For reactors licensed after 2003, for reasons stated in previous paragraphs, the NRC determined that changes to the requirements in § 50.44(c)(5) are not warranted. The NRC continues to conclude that the current design and licensing requirements for operating and new reactors for the control of hydrogen provide adequate protection of public health and safety.

Issue 6: The petitioner requested that the NRC revise § 50.44 to "require that licensees of PWRs with ice condenser containments and BWR Mark IIIs (and any other NPPs that would operate with hydrogen igniter systems) perform analyses that demonstrate hydrogen igniter systems would effectively and safely mitigate hydrogen in different severe accident scenarios."

Response to Issue 6: The NRC's assessment in SECY-16-0041 concluded that hydrogen igniters would likely delay containment failures in ice condenser and Mark III containments. The NRC determined that additional improvements beyond those already included in NRC regulations and Order EA-12-049 would not provide a substantial safety improvement.

The NRC concluded that compliance with Order EA-12-049 ensures that additional mitigation strategies are available for each operating reactor to reduce the risk of core damage from an extended loss of alternating current power event. ~~In accordance with the Commission's direction provided in SRM-SECY-15-0065, ~~T~~t~~he reactor oversight process has been revised to address licensees' implementation and maintenance of severe accident management guidelines. The severe accident management guidelines include guidance to address hydrogen generation in these containment designs and the use of the igniters to minimize the potential for containment failure from hydrogen detonation.

For new reactors, ~~as stated in NRC's response to issue 1 of the petition,~~ § 50.44(c) sets forth combustible gas control requirements for water-cooled nuclear power reactor designs licensed after 2003 that are more stringent~~conservative~~ than those requirements for existing operating reactors. These requirements reflect the NRC's expectation that future designs will achieve a higher standard of severe accident performance in accordance with the NRC's "Policy Statement on Severe Reactor Accidents Regarding Future Designs and Existing Plants." As a result, new plants have design features such as hydrogen igniters for AP1000 design reactors. As described in SECY-16-0041, the NRC assessed potential further hydrogen control enhancements and found that such measures were not warranted~~could not be justified under the finality provisions established under 10 CFR part 52 (similar to backfit requirements defined in § 50.109, "Backfitting")~~. The NRC further notes that development of severe accident management guidelines, which include guidance for the use of the igniters to minimize the potential for containment failure for hydrogen detonation, is addressed by combined license holders for the AP1000 design in accordance with the AP1000 design certification.

Therefore, the ~~NRC concludes that the petitioner's requested rulemaking is not warranted. The~~ NRC determined that the analyses and plant changes requested by the petitioner in issue 6 of the petition for existing operating reactors would not provide substantial safety enhancements. For reactors licensed after 2003, the NRC determined that changes to the requirements in § 50.44(c) are not needed for the reasons discussed in previous paragraphs. The NRC concludes that the current design and licensing requirements for the control of hydrogen for both operating and new reactors provide adequate protection of public health and safety.

III. Availability of Documents

The documents identified in the following table are available to interested persons through one or more of the following methods, as indicated.

DOCUMENT	**ADAMS ACCESSION NO. / WEB LINK / *FEDERAL REGISTER* CITATION**
Petition request from the Natural Resources Defense Council, Inc., dated October 14, 2011.	ML11301A094
Federal Register notice, "Measurement and Control of Combustible Gas Generation and Dispersal," January 5, 2012.	77 FR 441

SECY-16-0041, “Closure of Fukushima Tier 3 Recommendations Related to Containment Vents, Hydrogen Control, and Enhanced Instrumentation,” March 31, 2016.	ML16049A079 (Package)
SECY-11-0093, “Near-Term Report and Recommendations for Agency Actions Following the Events in Japan,” July 12, 2012.	ML11186A950 (Package)
Federal Register notice for § 50.44 file rule, “Combustible Gas Control in Containment,” dated September 16, 2003.	68 FR 54123
NUREG-1150, “Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants,” issued December 1990.	ML120960691
NUREG-1935, “State-of-the-Art Reactor Consequence Analyses (SOARCA) Report,” issued in November 2012.	ML12332A053 (Package)
“Safety Goals for the Operations of Nuclear Power Plants; Correction and Republication of Policy Statement,” published August 21, 1986.	ML011210381
Draft report “State-of-the-Art Reactor Consequence Analysis Project - Uncertainty Analysis of the Unmitigated Short-Term Station Blackout of the Surry Power Station,” dated August 2015.	ML15224A001
NUREG/CR-7245, “State-of-the-Art Reactor Consequence Analyses (SOARCA) Project - Sequoyah Integrated Deterministic and Uncertainty Analyses,” dated November 2017.	ML17340B209
NUREG/CR-7110, Vol 2, “State-of-the-Art Reactor Consequence Analyses Project - Volume 2: Surry Integrated Analysis,” dated January 2012.	ML120260681
Order EA-12-049, “Issuance of Order to Modify Licenses With Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,” dated March 12, 2012.	ML12054A735
Order EA-13-109, “Final Proposed EA-13-109 Reliable Severe Accident Capable Hardened Containment Venting System,” dated June 6, 2013.	ML13130A067
SRM-SECY-15-0065, “Proposed Rulemaking: Mitigation of Beyond-Design-Basis Events (RIN 3150-AJ49),” dated August 27, 2015.	ML15239A767
SRM-SECY-16-0142, “Final Rule: Mitigation of Beyond-Design-Basis Events (RIN 3150-AJ49)” dated January 24, 2019.	ML19023A038
Federal Register notice, “Policy Statement on Severe Reactor Accidents Regarding Future Designs and Existing Plants,” dated August 8, 1985.	50 FR 32138
NUREG/CR-7155, “State-of-the-Art Reactor Consequence Analyses Project - Uncertainty Analysis of the Unmitigated Long-Term Station Blackout of the Peach Bottom Atomic Power Station,” dated May 2016.	ML16133A461

NUREG-2206, "Technical Basis for the Containment Protection and Release Reduction Rulemaking for Boiling Water Reactors with Mark I and Mark II Containments," March 2018.	ML18065A048
"Draft Regulatory Basis for Containment Protection and Release Reduction for Mark I and Mark II Boiling Water Reactors (10 CFR Part 50)," dated May 2015.	ML15022A214
SRM-SECY-15-0085, "Evaluation of the Containment Protection and Release Reduction for Mark I and Mark II Boiling Water Reactors Rulemaking Activities (10 CFR Part 50) (RIN-3150-AJ26)," dated August 19, 2015.	ML15231A471
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)," dated September 14, 2000.	ML003747725 (Package)
NUREG-0737, "Clarification of TMI Action Plan Requirements," dated November 1980.	ML051400209
Regulatory Guide 1.7, Revision 3, "Control of Combustible Gas Concentrations in Containment," dated March 2007.	ML070290080
"Confirmatory Order Modifying Post-TMI Requirements Pertaining to Containment Hydrogen Monitors for Arkansas Nuclear One, Units 1 and 2 (TAC NOS. MA1267 and 1268)," dated September 28, 1998.	ML021270103
Federal Register notice, "Notice of Availability of Model Application Concerning Technical Specification Improvement to Eliminate Hydrogen Recombiner Requirement and Relax the Hydrogen and Oxygen Monitor Requirements for Light Water Reactors Using the Consolidated Line Item Improvement Process," dated September 25, 2003.	68 FR 55416
License amendment, "Arkansas Nuclear One, Unit 1, License Amendment 222 regarding Elimination of Requirements for Hydrogen Recombiners and Hydrogen Monitors," dated August 12, 2004.	ML042290464 (Package)
Regulatory Guide 1.97, Revision 3, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident," dated May 1983	ML003740282

IV. Conclusion

For the reasons cited in this document, the NRC is denying PRM-50-103. The petitioner ~~failed to~~did not present sufficient new information or arguments to warrant the requested requirements~~amendments~~. The NRC continues to conclude that the current design and licensing requirements for the control of hydrogen for both operating and new reactors provide adequate protection of public health and safety.

Dated at Rockville, Maryland, this day of , 2019.

For the Nuclear Regulatory Commission.

Annette L. Vietti-Cook,
Secretary of the Commission.