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Subject: Transmittal of Advanced Reactor Content of Application Project -Risk-informed, Performance-Based Fire Protection Program (for Operations) Draft White Paper Guidance
Attachments: RIPB Fire Protection Program ISG -for Operations.docx

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Mr. Afzali, Ms. Austgen, and Mr. Draffin,

The purpose of this email is to provide you with the attached Advanced Reactor Content of Application Project - Risk-informed, Performance-Based Fire Protection Program (for Operations) Draft White Paper Guidance. The attached document will be referenced in the NRC staff presentations during an upcoming advanced reactor stakeholder meeting tentatively scheduled for September 29, 2021. This email will be captured in ADAMS and the email will be made publicly available so that interested stakeholders will have access to the information prior to the meeting.

If you have questions regarding the attached documents please contact me.

Sincerely,

Joe Sebrosky
Senior Project Manager
Advanced Reactor Policy Branch
Office of Nuclear Reactor Regulation
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Hearing Identifier: NRR_DRMA
Email Number: 1339

Mail Envelope Properties (PH0PR09MB7436AD93539A166BAE041291F8D69)

Subject: Transmittal of Advanced Reactor Content of Application Project -Risk-informed, Performance-Based Fire Protection Program (for Operations) Draft White Paper Guidance
Sent Date: 9/10/2021 10:35:29 AM
Received Date: 9/10/2021 10:35:00 AM
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Files	Size	Date & Time
MESSAGE	1139	9/10/2021 10:35:00 AM
RIPB Fire Protection Program ISG -for Operations.docx		139658

Options

Priority: Normal

Return Notification: No

Reply Requested: No

Sensitivity: Normal

Expiration Date:

This draft staff white paper has been prepared and is being released to support ongoing public discussions. This draft white paper uses an interim staff guidance (ISG) format because the staff is considering using this format to provide staff guidance in the near future to support the review of advanced reactor applications.

This paper has not been subject to NRC management and legal reviews and approvals, and its contents are subject to change and should not be interpreted as official agency positions.



DANU [XX]-ISG-[YYYY-##]

Advanced Reactor Content of Application

**“Risk-informed, Performance-based Fire Protection Program
(for Operations)”**

Interim Staff Guidance

August X, 2021

**DANU [XX]-ISG-[YYYY-##]
 Advanced Reactor Content of
 Application
 “Risk-informed, Performance-Based
 Fire Protection Program (for
 Operations)”
 Interim Staff Guidance**

ADAMS Accession No.: MLxxxxxxxx

TAC: xxxxxx

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OFFICIAL RECORD COPY

INTERIM STAFF GUIDANCE

ADVANCED REACTOR CONTENT OF APPLICATION

“Risk-informed, Performance-Based Fire Protection Program (for Operations)”

DANU-ISG-YYYY-##

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC, or Commission) staff is providing this interim staff guidance (ISG) to facilitate the review of advanced reactor content of application guidance that is used to support reviews of non-light water reactors (non-LWRs), stationary micro reactors, and small modular LWRs submitting risk-informed applications for an operating license (OL) under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, “Domestic Licensing of Production and Utilization Facilities”; or for a combined license (COL) under 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants.” The guidance found in this ISG supports the development of the portion of an advanced reactor application associated with an applicant’s “Risk-informed, Performance-based Fire Protection Program (for Operations).”

It is anticipated that this guidance will be updated to use for reviews of advanced nuclear reactor license and permit applications submitted under 10 CFR Part 53, “Licensing and Regulation of Advanced Nuclear Reactors,” once the content of that regulation is developed.

The scope of this NRC staff guidance addresses the review of the application content regarding the fire protection program for operations including application descriptions of:

- Management policy and program direction and the responsibilities of those individuals responsible for the program/plan’s implementation.
- The integrated combination of procedures and personnel that will implement fire protection program activities.

BACKGROUND

This ISG is based on the advanced reactor content of application project (ARCAP), whose purpose is to develop technology-inclusive, risk-informed, performance-based application guidance. The ARCAP is broader than, and encompasses, the industry-led technology-inclusive content of application project (TICAP). The guidance found in this ISG supplements the guidance found in Division of Advanced Reactors and Non-power Production and Utilization Facilities (DANU)-ISG-YYYY-##, “Advanced Reactor Content of Application Guidance,” which provides a roadmap for developing all portions of an application. The guidance in this ISG is limited to the portion of an advanced reactor application associated with the development of risk-informed, performance-based fire protection program (for operations) for a nuclear reactor plant application for an OL or COL.

The 10 CFR Part 53 regulation is under development, and as such, the guidance found in this ISG is subject to change based on the outcome of this rulemaking. As the 10 CFR Part 53

requirements are developed, this ISG will be supplemented, as necessary, to provide guidance for developing fire protection programs to reflect any differences in requirements between 10 CFR Part 50/52 and 10 CFR Part 53. The goal of the 10 CFR Part 53 rulemaking effort is to develop the regulatory infrastructure to support the licensing of advanced nuclear reactors. The term “advanced nuclear reactor,” for purposes of this rulemaking, means “a nuclear fission or fusion reactor with significant improvements compared to commercial nuclear reactors operating on the date of enactment of the Energy Act of 2020” or under construction as of January 2019. This rulemaking would revise the NRC’s regulations by adding a risk-informed, technology-inclusive regulatory framework for advanced nuclear reactors, in response to a growing interest in possible licensing and deployment of advanced nuclear reactors and the related requirements of the Nuclear Energy Innovation and Modernization Act (NEIMA; Public Law 115-439), as amended by the Energy Act of 2020. Key documents related to the 10 CFR Part 53 rulemaking, including preliminary proposed rule language and stakeholder comments, can be found at www.Regulations.gov under Docket ID NRC-2019-0062.

RATIONALE

Note – this section will be updated with additional stakeholder interactions – expected during the monthly ARCAP meetings.

APPLICABILITY

This ISG is applicable to applicants for non-LWRs, stationary micro reactors, and small modular LWRs submitting risk-informed applications for an OL under 10 CFR Part 50 or for a COL under 10 CFR Part 52. Once the content of 10 CFR Part 53 is developed and this ISG is updated where necessary, this guidance will also apply to applicants for a power reactor OL or COL under 10 CFR Part 53.¹

GUIDANCE

10 CFR 50.48, “Fire protection,” requires each holder of an OL issued under 10 CFR Part 50 or COL issued under 10 CFR Part 52 to have a fire protection plan [also referred to in this ISG as a program description] that satisfies Criterion 3 “Fire protection,” of Appendix A, “General Design Criteria for Nuclear Power Plants,” to 10 CFR Part 50. However, the general design criteria (GDCs) of 10 CFR Part 50, Appendix A are considered only guidance for applicants for non-LWRs and stationary micro-reactors or those using the Licensing Modernization Project (LMP) process endorsed in Regulatory Guide (RG) 1.233, “Guidance for a Technology-Inclusive Risk-Informed, and Performance-Based Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certification, and Approvals for Non-Light-Water Reactors.” These applicants must propose principal design criteria per 10 CFR 50.34 and 10 CFR 52.79. Light-water small modular reactors (SMRs) may be required to follow the GDCs in 10 CFR Part 50, Appendix A, if they do not use the LMP process. 10 CFR 50.48 and Appendix A to 10 CFR Part

¹ This document does not provide guidance regarding the licensing requirements for fire protection requirements prior to receipt of byproduct, source, or special nuclear material under 10 CFR Parts 30, 40, and 70. A CP applicant may address these fire protection licensing requirements with its CP application (in accordance with 10 CFR 50.31) or separately from the CP application.

50 both refer to structures, systems, and components (SSCs) that are “important-to-safety.” In place of this term, this ISG refers to “safety-significant” SSCs to be consistent with terminology used in TICAP and ARCAP reference documents.

The fire protection program description should establish the fire protection policy for the protection of safety-significant SSCs at each plant and the procedures, equipment, and personnel required to implement the program at the plant site. This fire protection program description should:

1. Describe the overall fire protection program for the facility;
2. Identify the various positions within the licensee's organization that are responsible for the program;
3. State the authorities that are delegated to each of these positions to implement those responsibilities; and
4. Outline the plans for fire protection, fire detection and suppression capability, and limitation of fire damage.

The program description should also describe specific features necessary to implement the program such as:

1. Administrative controls and personnel requirements for fire prevention and manual fire suppression activities; and
2. The means to limit fire damage to safety-significant SSCs so their capability to perform safety functions is maintained.

For operating nuclear power plants, 10 CFR 50.48(c), “National Fire Protection Association Standard NFPA 805,” establishes the requirements for using National Fire Protection Association (NFPA) Standard 805, “Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants, 2001 Edition” (NFPA 805) as an alternative to the requirements associated with 10 CFR 50.48(b) and Appendix R, “Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979,” or the fire protection license conditions for plants licensed after January 1, 1979. This regulation incorporates by reference NFPA 805, with certain exceptions, clarifications, and expansions. In general, the fire protection program operational requirements are found in NFPA 805, Chapter 3, “Fundamental Fire Protection Program and Design Elements.”

Although 10 CFR 50.48(c) is not applicable to non-LWRs, stationary micro reactors, and small modular LWRs, elements and concepts in NFPA 805 as well as the guidance in RG 1.205, Revision 2, “Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants,” and RG 1.189, Revision 4, “Fire Protection for Nuclear Power Plants,” can be applied to non-LWRs, stationary micro reactors, and small modular LWRs with justified exceptions and/or deviations, where appropriate.

This ISG is only for NRC staff use in evaluating the operational program aspects of fire protection. It does not address fire protection system design or the fire hazards analysis within the probabilistic risk assessment (PRA). RG 1.233, addresses a broad set of hazards, including fire, as part of the licensing basis event evaluation, SSC classification and associated special

treatment, and defense-in-depth adequacy. RG 1.233 endorses Nuclear Energy Institute (NEI) 18-04, Revision 1, "Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development." The fire protection design is informed by the method described in NEI 18-04, Revision 1. The associated guidance on the design is in other parts of the ARCAP/TICAP guidance.

A. Regulatory Basis

The acceptance criteria in the ISG are based on meeting the relevant requirements of the following Commission fire protection regulations, guidance, and industry standards:

1. Either the applicant's proposed principal design criteria required per regulations in 10 CFR 50.34 and 10 CFR 52.79 that have been deemed acceptable by the NRC or 10 CFR Part 50, Appendix A, Criterion 3, for light water reactors.
2. 10 CFR 50.48(a), which requires that each operating nuclear power plant have a fire protection plan that meets the requirements of either 10 CFR Part 50, Appendix A, Criterion 3 for LWRs or the applicant's proposed principal design criteria that have been deemed acceptable by the NRC.
3. 10 CFR 50.48(c), risk-informed, performance-based fire protection program requirements, which incorporates NFPA 805 (2001 Edition) by reference, with certain exceptions. This regulation allows licensees to apply for a license amendment to comply with the 2001 Edition of NFPA 805.
4. RG 1.189, Revision 4 which provides a comprehensive fire protection guidance document and to identify the scope and depth of fire protection that the NRC staff would consider acceptable for nuclear power plants.
5. RG 1.205, Revision 2 which provides NRC guidance on an acceptable approach to meeting 10 CFR 50.48(c).
6. NFPA 804, "Standard for Fire Protection for Advanced Light Water Reactor Electric Generating Plants."
 - i. Provides useful information when used in conjunction with NRC regulations and guidance – the NRC has not formally endorsed NFPA 804, and some of the information in the NFPA standard may conflict with regulatory requirements.
 - ii. Provides a deterministic approach to the fire protection program.
7. NFPA 805, 2001 Edition.
8. NFPA 806, "Performance-Based Standard for Fire Protection for Advanced Nuclear Reactor Electric Generating Plants Change Process," which describes a performance-based fire protection change process for advanced nuclear reactor electric generating plants.

B. Fire Protection Program (administrative programs during operations)

The NRC staff should ensure that the applicant's fire protection program description provided in the application addresses each of the following elements:

1. **Applicable Industry Codes and Standards** – The fire protection program description should identify what industry codes and standards related to fire protection were used to develop the program and to design fire protection systems and features. Exceptions to the referenced code and standard should be justified. The standards of record related to the design and installation of fire protection systems and features sufficient to satisfy NRC requirements in new reactor designs are those NFPA codes and standards in effect 6 months prior to the submittal of the application under 10 CFR Part 50 or 10 CFR Part 52. If the COL references a design certification (DC) or manufacturing license (ML), the codes and standards of record are governed by the DC/ML for aspects of the fire protection program described in the DC/ML. The COL should use industry codes and standards within 6 months of the COL application date for any aspects of the program not covered in the DC/ML.
2. **Organization, Staffing, and Responsibilities** - The fire protection program description should include a discussion of the organizational structure and responsibilities for its establishment and implementation. These responsibilities include program policy; program management (including program development, maintenance, updating, and compliance verification); fire protection staffing and qualifications; engineering and modification; inspection, testing, and maintenance of fire protection systems, features, and equipment; fire prevention; emergency response (e.g., fire brigades and offsite mutual aid); and general employee, operator, and fire brigade training. Other topics that should be addressed include:
 - i. Interfaces with other organizations;
 - ii. Identification of the various plant positions having the authority for implementing the various areas of the fire protection program; and
 - iii. Identification of Authority Having Jurisdiction (AHJ).

Refer to RG 1.189, Regulatory Position C.1.1 for additional guidance, and NFPA 805, Section 3.2.2 for additional information.

3. **Fire Protection Staff Training and Qualification** – The fire protection program description should include a description of the training and qualification for fire protection staff. This description should be consistent with the guidance in RG 1.189, Regulatory Position C.1.6.1.

The training description should address the following elements:

- i. Post-fire procedures and implementation of the recovery actions; and
 - ii. Containment and monitoring of potentially contaminated gaseous and liquid effluents (typically smoke and suppression water).
4. **General Employee Training** – The fire protection program description should include a description of the training given to general employees (i.e., not part of the fire protection organization). This description should address the familiarization with plant fire protection procedures, fire event reporting, and plant emergency alarms. RG 1.189 Regulatory Position C.1.6.2 contains guidance in this area, and NFPA 805, Section 3.3.3.1(1) contains additional information.
 5. **Fire Brigade Training and Qualification** - The fire protection program description should include a description of the fire brigade training and qualification program.

The description should describe the periodic classroom instruction, firefighting practice, and fire drills necessary to establish and maintain the capability to fight credible and challenging fires. RG 1.189, Regulatory Position C.1.6.4 references various NFPA standards that contain acceptable criteria for training. The description should include descriptions of the qualifications of fire brigade members. Refer to RG 1.189, Regulatory Position C.1.6.4 for guidance.

6. **Chemical Fires** – The fire protection program description should include a discussion of a training and qualification program related to the unique features of chemical fires associated with the reactor design. The training program should address:
 - i. The chemical and combustion properties of the flammable material(s) of concern;
 - ii. The health effects on humans if they come in contact with the material(s) and/or their combustion products;
 - iii. Other hazards associated with manually fighting chemical fires (e.g., visibility, potential radiation hazard, inert gas pockets, hydrogen generation/burning/explosion);
 - iv. When should manual fire-fighting be attempted;
 - v. Provisions for the protection of fire-fighting personnel; and
 - vi. Special provisions regarding manual fire-fighting of chemical fires such as size and location of the fire, prohibiting the use of water, location, and labeling retardants for use on chemical fires.
7. **Fire Protection Program Documentation and Changes, Configuration Control and Quality Assurance** – All analyses related to the program should be documented to demonstrate compliance. The intent of the documentation is that the assumptions be clearly defined and that the results be easily understood, that results be clearly and consistently described, and that sufficient detail be provided to allow future review of the analyses. The documentation should be retained for the life of the plant. One example of a fire protection program design basis document is discussed in Section 2.7.1.2 of NFPA 805.

The fire protection program description should address how changes to the program are implemented. All changes to the approved program should be reported to the NRC, along with the final safety analysis report (FSAR) revisions required by 10 CFR 50.71(e). The fire protection program description should detail any fire protection license condition that allows self-approval of certain fire protection program changes. RG 1.189, Regulatory Position C.1.8 provides guidance in this area.

The plant's quality assurance (QA) organization should manage the fire protection QA program. This control consists of (1) formulating the fire protection QA program and verifying that it incorporates suitable requirements and is acceptable to the management responsible for fire protection, and (2) verifying the effectiveness of the QA program for fire protection through review, surveillance, and audits. RG 1.189 Regulatory Position C.1.7 provides additional guidance in this area.

8. **Verification and validation (V&V) of fire models** – The fire protection program description should identify the V&V of fire models. An applicant may propose the use of fire models that have not specifically undergone V&V by the NRC; however, applicants are responsible for providing evidence of acceptable V&V of these fire models. RG 1.189, Regulatory Position C.1.8.7 and RG 1.205 Regulatory Position C.4.2 provide guidance on V&V of fire models.
9. **Review of physical plant changes and procedure changes for impact on the fire protection program** – The fire protection program description should describe how the plant change process addresses impacts to the fire protection program. A plant change evaluation is a required step in the methodology for all changes to previously approved fire protection program elements. One example of a risk-informed change process is described in NFPA 805 Section 2.4.4.

The change process under risk-informed, performance-based regulatory framework requires the explicit consideration of risk. The evaluation of risk is limited to the determination of whether an increase has occurred, and if so, whether the increase is within acceptable limits. The NRC staff should ensure that the fire protection program description in the OL/COL application describes how the PRA is used and updated to (a) reflect site- and plant-specific information that may not have been available at the early (e.g., construction permit) design stage; and (b) evaluate plant changes over the life of the plant using a risk-informed approach. RG 1.189, Regulatory Position C.1.8.1 provides guidance on the change evaluation process. RG 1.205, Regulatory Position C.3.2 provides guidance on the change process in the NFPA 805 context.

10. **Inspection, testing, and maintenance for fire protection systems and features credited by the fire protection hazard analysis** – The fire protection program description should describe the administrative controls regarding the implementation of modifications to fire protection systems and features (e.g., breaching fire barriers or fire stops, impairment of fire detection and suppression systems) and transient fire hazard conditions, such as those associated with maintenance activities. The program should require appropriate compensatory measures, such as fire watches or temporary fire barriers, to ensure adequate fire protection and reactor safety. The maintenance program should include a review of performance trends.
11. **Monitoring Program** – The fire protection program description should include a monitoring program to ensure the availability and reliability of the fire protection systems and features, assess the performance of the fire protection program in meeting the performance criteria, and ensure the assumptions in the engineering analyses remain valid. The Maintenance Rule (10 CFR 50.65) and NFPA 805 Monitoring Programs are examples of acceptable monitoring programs. Plants may choose to utilize their Maintenance Rule program for their monitoring program.

RG 1.205, Regulatory Position 2.2.7 provides guidance on monitoring programs.

The program description should address the following areas:

- i. Program Scope – a description of the plant SSCs and fire equipment that are within the program scope;
 - ii. Screening Process – a description of the screening process to be used to determine the appropriate level of monitoring;
 - iii. Developing Target Values of Reliability and Availability – a description of the process to be used to determine target values of reliability and availability for the fire protection equipment and other SSCs within the scope of the program; and
 - iv. Implementation – a description of how the information will be periodically gathered, trended, and evaluated. The implementation description should include a description of the periodic assessments performed to determine program effectiveness.
12. **Defined strategies for fighting fires** – The fire protection program description should describe the development of procedures to control actions by the fire brigade and to define firefighting strategies. The program description should address the development of pre-fire plans. Additional guidance in this area is found in RG 1.189, Regulatory Position C.3.5.1.3.
13. **Reporting** – The fire protection program description should address reporting requirements. RG 1.189, Regulatory Positions C.1.8.1.5 and C.1.8.5 provide additional guidance in this area.
14. **Control of combustibles, hazardous materials, and ignition sources** – The fire protection program description should include administrative controls for fire prevention that address procedures to control handling and use of combustibles, prohibit storage of combustibles in plant areas with safety-significant SSCs, establish designated storage areas with appropriate fire protection, and control use of specific combustibles (e.g., wood) in plant areas where safety-significant SSCs are located. Refer to RG 1.189, Regulatory Positions C.2.1 and C.2.2 for additional guidance in this area.
15. **Housekeeping** - The fire protection program description should describe administrative controls to minimize fire hazards in areas containing safety-significant SSCs. These controls should govern removal of waste, debris, scrap, oil spills, and other combustibles after completion of a work activity or at the end of the shift. Administrative controls should also include procedures for performing and maintaining periodic housekeeping inspections to ensure continued compliance with fire protection controls. Refer to RG 1.189, Regulatory Position C.2.3 for additional guidance in this area.
16. **Manual firefighting capabilities** – The fire protection program description should address the administrative controls and personnel requirements for manual fire suppression activities. Multiple Regulatory Positions in RG 1.189 address this area. Topics should include the following:
 - i. General manual suppression systems and equipment;
 - ii. Fire brigade organization and staffing;
 - iii. Fire brigade equipment;

- iv. Fire brigade performance assessment; and
- v. Offsite manual firefighting resources
 - (1) Capabilities
 - (2) Training
 - (3) Agreements and plant exercises

C. Acceptance Criteria

In reviewing the advanced reactor application that includes applicant's fire protection program description, the NRC staff should determine whether reasonable assurance exists that the requirements for the fire protection program are met for the application under review. This determination should be based on whether the information provided in the application is sufficient to make a conclusion on the acceptability of the program. The following are areas of emphasis used in combination with Section B above.

1. The fire protection program description is in compliance with applicable Regulatory Positions of RG 1.189 or provide a basis for any deviations.
2. The program description provides clear delineations of organization, staffing, and responsibilities, consistent with RG 1.189.
3. The fire protection program change process identifies changes that require prior NRC review and approval, consistent with RG 1.189.
4. The monitoring program includes bases for failure probability assumptions used in the fire PRA, methods used to monitor availability, reliability, and performance of fire protection systems and features, and processes for identifying and implementing corrective actions.
5. The V&V of fire models is consistent with RG 1.189.
6. The fire protection program QA requirements are consistent with RG 1.189.
7. The fire protection program description adequately addresses the evaluation of compensatory measures for interim use for adequacy and appropriate length of use.
8. Fire protection staff, fire brigade staff, and general employee training regarding the fire protection program is consistent with Sections B.3, 4, 5, and 6 of this ISG.

IMPLEMENTATION

The NRC staff will use the information discussed in this ISG to determine the following:

[Identify how the information will facilitate staff review of license amendments, license renewal applications, etc.]

BACKFITTING AND ISSUE FINALITY DISCUSSION

[OGC provides this discussion, but the staff can propose text for OGC consideration].

Example: The NRC staff issuance of this ISG is not considered backfitting as defined in 10 CFR 50.109(a)(1), nor is it deemed to be in conflict with any of the issue finality provisions in 10 CFR Part 52.

CONGRESSIONAL REVIEW ACT

[OGC provides this discussion to support issuance of the final ISG. However, the staff can propose text for OGC consideration].

Example: This ISG is a rule as defined in the Congressional Review Act (5 U.S.C. §§ 801-808). However, the Office of Management and Budget has not found it to be a major rule as defined in the Congressional Review Act.

FINAL RESOLUTION

By [insert date], this information will be transitioned into [identify the appropriate regulatory process (Standard Review Plan (SRP), Regulatory Guide (RG))]. Following the transition of this guidance to the [SRP, RG], this ISG will be closed.

APPENDIX

- A. Resolution of Public Comments

APPENDIX A

Resolution of Public Comments

A notice of opportunity for public comment on this ISG was published in the *Federal Register* (*insert FR Citation #*) on [date] for a 30-60 day comment period. [Insert number of commenters] provided comments which were considered before issuance of this ISG in final form.

Comments on this ISG are available electronically at the NRC's electronic Reading Room at <http://www.nrc.gov/reading-rm/adams.html>. From this page, the public can gain entry into ADAMS, which provides text and image files of NRC's public documents. Comments were received from the following individuals or groups:

Letter No.	ADAMS No.	Commenter Affiliation	Commenter Name	Abbreviation
1				
2				
3				
4				
5				

The comments and the staff responses are provided below.

Comment 1: [Each comment summary must clearly identify the entity that submitted the comment and the comment itself].

NRC Response: Comment responses should begin with a direct statement of the NRC staff's position on a comment, e.g., "the NRC staff agrees with the comment" or the "NRC staff disagrees with the comment".

- If the NRC staff agrees, explain why and provide a clear statement as to how the relevant language was revised or supplemented to address the comment. Include the following language at the end of the comment response: "The final ISG was changed by *<describe the change; if necessary by quoting the newly revised language>*."
- If the NRC disagrees with a comment and no change was made to the generic communication, then explain why and provide the following language at the end of the comment response: "No change was made to the final ISG as a result of this comment."