

POLICY ISSUE
(Notation Vote)

May 29, 2015

SECY-15-0077

FOR: The Commissioners

FROM: Mark A. Satorius
Executive Director for Operations

SUBJECT: OPTIONS FOR EMERGENCY PREPAREDNESS FOR SMALL
MODULAR REACTORS AND OTHER NEW TECHNOLOGIES

PURPOSE:

The purpose of this paper is to seek Commission approval of the staff's recommendation to initiate a rulemaking to revise regulations and guidance for emergency preparedness (EP) for small modular reactors (SMRs) and other new technologies, such as non-light-water reactors (non-LWRs) and medical isotope production facilities. The staff has determined that Commission direction would be beneficial at this time.

SUMMARY:

This paper proposes a consequence-based approach to establishing requirements, as necessary, for offsite EP. This paper requests that the Commission authorize a rulemaking effort to establish EP requirements for SMRs and other new technologies that are commensurate with the potential consequences to public health and safety, and the common defense and security at these facilities. The need for EP is based upon projected offsite dose in the unlikely occurrence of a severe accident. The current EP framework for large light-water reactors (LWRs) governing emergency planning zones (EPZs) is based on U.S. Environmental Protection Agency (EPA) Protective Action Guides (PAG) dose guidelines for early phase protective actions in the unlikely event of a severe accident, at which point public protective

CONTACTS: Arlon Costa, NRO/DARR
301-415-6402

Patricia Milligan, NSIR/DPR
301-287-3739

SECY NOTE: THIS SECY PAPER, WITH THE EXCEPTION OF THE ENCLOSURE WILL BE RELEASED TO THE PUBLIC IN 10 WORKING DAYS

actions for those EPZs should be considered and undertaken. The NRC staff can establish an EP framework for SMRs and other new technologies based on PAG guidelines.

The staff proposes revising NRC regulations and guidance through rulemaking to require SMR license applicants to demonstrate how their proposed facilities achieve EPA PAG dose limits at specified EPZ distances, which may include the site boundary. This framework can be established generically without site- or design-specific information regarding source term, fission products, or projected offsite dose. The staff anticipates that the technical basis for this EP framework would be developed also as part of rulemaking. This would include quantitative guidelines and criteria for accident selection and evaluation specific to SMRs and other new technologies. The NRC technical staff will rigorously review design and licensing information to ensure that the information applicants provide on the offsite dose consequences is commensurate with the requested EPZ size and that the applicable requirements ensure adequate protection of public health and safety, and the environment. Commission direction regarding EP for SMRs and other new technologies, including EPZ sizes, will enable the NRC staff to develop regulations and guidance to provide for regulatory stability, predictability, and clarity in the licensing process, and would minimize or eliminate the uncertainty for applicants and inefficient use of agency resources caused by reliance on serial EPZ exemption requests.

BACKGROUND:

The existing EP regulatory basis and guidance resulted from a study by a joint NRC and EPA task force. The task force report, "Planning Basis for the Development of State and Local Government Radiological Emergency Response Plans in Support of Light Water Nuclear Power Plants," NUREG-0396 / EPA 520/1-78-016, (NUREG-0396), was published in 1978 (Agencywide Document Access and Management System (ADAMS) Accession No. ML051390356). NUREG-0396, which was based on NUREG-75/014 ("Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants (WASH-1400)," which was a study that considered various accident sequences for a large pressurized water reactor or boiling water reactor), recommended a plume exposure pathway EPZ of about 10 miles (16 kilometers) and an ingestion exposure pathway EPZ of about 50 miles (80 kilometers). The EPZs were established at 10 and 50 miles to provide dose savings to the population in areas where the projected dose from design-basis accidents could be expected to exceed the applicable PAGs (1-5 roentgen equivalent man (rem) total effective dose equivalent under unfavorable atmospheric conditions. NUREG-0396 states that "As in the DBA-LOCA [design-basis accident loss-of-coolant accident] class, the doses from 'melt-through' releases (involving thousands of curies) generally would not exceed even the most restrictive PAG beyond about 10 miles from a power plant."

In addition to identifying the recommended EPZ sizes for planning, NUREG-0396 also stated the following: "Further, the range of possible selections for a planning basis is very large, starting with a zero point of requiring no planning at all because significant offsite radiological accident consequences are unlikely to occur, to planning for the worst physically possible accident regardless of its extremely low likelihood." Both the NRC policy statement of October 23, 1979 (published in the *Federal Register* (FR), 44 FR 61123) and EPA's policy statement of January 15, 1980 (45 FR 2893), endorsed the task force recommendation in NUREG-0396. The NRC codified the 10- and 50-mile EPZs through the rulemaking process in

August 1980 (45 FR 55402). The EPZ sizes were reflected in revisions to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.47(c)(2), and Appendix E (“Emergency Planning and

Preparedness for Production and Utilization Facilities”) to Part 50, “Domestic Licensing of Production and Utilization Facilities.” Additionally, 10 CFR 50.47(c)(2) included a provision allowing for a case-by-case determination of the appropriate EPZ for reactors with an authorized power level less than 250 megawatts thermal and for gas-cooled reactors.

The NRC withdrew the October 23, 1979, policy statement on January 20, 1995 (60 FR 4071) because it was incorporated into the rule. The underlying objectives of the recommended EPZs in NUREG-0396 were to ensure that pre-planned protective actions would be identified and practiced and to reduce dose in the unlikely event of a large release that would exceed the PAGs offsite. The development of EP requirements, including the 10- and 50-mile EPZs, complemented the prevention measures and mitigation measures existing in the agency’s defense-in-depth approach to protecting people and the environment against the harms of radiation in the unlikely event of a severe radiological accident resulting in offsite dose.

The staff has previously communicated to the Commission its intention to consider EP issues related to designs that differ from those of the current fleet of large LWRs. In SECY-93-092¹, the staff suggested that there be no change to existing regulations governing EP for advanced reactors and stated that regulatory direction would be provided at or before the start of the design certification phase in such a way that design implications for EP could be addressed. In a July 30, 1993, SRM², the Commission directed that, “...the staff should submit to the Commission recommendations for proposed technical criteria and methods to use to justify simplification of existing emergency planning requirements.”

In SECY-97-020³, the staff stated, “Because industry has not petitioned for changes to EP requirements for evolutionary and passive advanced LWRs, the staff did not dedicate the resources to fully evaluate these issues. The staff remains receptive to industry petitions for changes to EP requirements for evolutionary and passive advanced LWRs.”

In March 2010, the staff noted in SECY-10-0034⁴ that EP is a key technical issue for licensing SMRs because of its role in defense-in-depth for protection of the public, as well as its relationship to the SMR accident source-term key technical issue. The staff recognizes that EP requirements, particularly concerning potentially reduced EPZ sizes, is an important factor for reducing regulatory uncertainty for SMR design certification and combined license (COL) applications. Also, industry has indicated that the EPZ issue will be a key factor in the business case for SMR feasibility and development.

¹ SECY-93-092, “Issues Pertaining to the Advanced Reactor (PRISM, MHTGR, and PIUS) and CANDU 3 Designs and Their Relationship to Current Regulatory Requirements,” dated April 8, 1993 (ADAMS Accession No. ML040210725).

² SRM to SECY-93-092 dated July 30, 1993 (ADAMS Accession No. ML003760774).

³ SECY-97-020, “Results of Evaluation of Emergency Planning for Evolutionary and Advanced Reactors,” dated January 27, 1997 (ADAMS Accession No. ML992920024).

⁴ SECY-10-0034, “Potential Policy, Licensing, and Key Technical Issues for Small Modular Nuclear Reactor Designs,” dated March 28, 2010 (ADAMS Accession No. ML093290245).

Following public meetings with industry stakeholders and review of other SMR issues, the staff developed SECY-11-0152⁵. This information paper discussed “the staff’s intent to develop a technology-neutral, dose-based, consequence-oriented EP framework for SMR sites that takes into account the various designs, modularity and collocation, as well as the size of the EPZ.” It also stated that the “staff will work with stakeholders to develop general guidance on calculating the offsite dose, and is anticipating that the industry will develop and implement the detailed calculation method for review and approval by the staff.”

The Nuclear Energy Institute (NEI) submitted a white paper⁶ to the NRC in December 2013 outlining a high level approach to determining EPZ size; and in a September 11, 2014, public meeting (ADAMS Accession No. ML14272A009), the Tennessee Valley Authority (TVA) announced its forthcoming early site permit (ESP) application based on a plant parameter envelope for SMRs. The staff in SECY-10-0034 stated: “Should it be necessary, the staff will propose changes to existing regulatory requirements and guidance or develop new guidance concerning reduction of offsite emergency preparedness for SMRs in a timeframe consistent with the licensing schedule.” At this time the staff believes that key SMR EP issues must be resolved. This would generate predictability in the licensing process for the staff and potential vendors and applicants.

The concept of an EPZ size commensurate with the offsite radiological risk is not new to the NRC. The staff recently reviewed exemption requests from specific emergency planning requirements from certain reactor licensees that have permanently ceased operations (SECY-14-0066⁷ and SECY-14-0118⁸). The staff reviewed these exemption requests against the requirements in 10 CFR 50.47, “Emergency Plans,” Appendix E to 10 CFR Part 50, and 10 CFR 72.32, “Emergency Plan.” The staff considered the status of permanently shut down and defueled facilities, and the low likelihood of any credible accident resulting in radiological releases requiring offsite protective measures and based its evaluation of the requests for exemptions from EP requirements on site-specific analyses. The staff verified that conclusions based on these analyses and calculations provided reasonable assurance that in granting the requested exemptions: (1) an offsite radiological release would not exceed the EPA PAGs at the site boundary; and (2) in the unlikely event of an accident resulting in a loss of all spent fuel pool cooling, there would be sufficient time to initiate appropriate mitigating actions. Also, if a release was projected to occur, there would be sufficient time for offsite agencies to take protective actions using an existing local Comprehensive Emergency Management Plan⁹

⁵ SECY-11-0152, “Development of an Emergency Planning and Preparedness Framework for Small Modular Reactors,” dated October 28, 2011 (ADAMS Accession No. ML112570439).

⁶ “Proposed Methodology and Criteria for Establishing the Technical Basis for Small Modular Reactor Emergency Planning Zone” (ADAMS Accession No. ML13364A345).

⁷ SECY-14-0066, “Request by Dominion Energy Kewaunee, Inc. for Exemptions from Certain Emergency Planning Requirements,” dated June 27, 2014 (ADAMS Accession No. ML14072A257).

⁸ SECY-14-0118, “Request by Duke Energy Florida, Inc., for Exemptions from Certain Emergency Planning Requirements,” dated October 29, 2014 (ADAMS Accession No. ML14219A444).

⁹ The CEMP is part of FEMA’s Comprehensive Preparedness Guide (CPG) 101, “Developing and Maintaining Emergency Operations Plans.” It helps planners at all levels of government in their efforts to develop and maintain viable, all-hazards, all-threats emergency plans. A CEMP is often referred to as “all hazards planning.”

(CEMP) to protect public health and safety. In SRM-SECY-14-0118, the Commission directed the staff to proceed with rulemaking on decommissioning and address issues raised in

SECY-00-0145¹⁰, such as a graded approach to EP. Pre-application information and SMR design concepts provided by NuScale, mPowerTM, and Westinghouse indicate that SMRs could also have reduced offsite dose consequences in the unlikely event of an accident, although this has not yet been verified.

OUTREACH:

The staff has actively engaged stakeholders on several occasions since the NRC issued SECY-11-0152 to exchange key information on EP for SMRs and to fully inform next steps. As discussed below, the staff has been interacting with Federal agencies and public stakeholders over the last several years to discuss possible revision of regulations and guidance for EP for SMRs and other new technologies.

Federal Emergency Management Agency (FEMA) and Other Agencies

The staff has discussed and coordinated review of SMR EP issues with FEMA, consistent with the June 17, 1993, Memorandum of Understanding between the NRC and FEMA, contained in Appendix A (“Memorandum of Understanding Between Federal Emergency Management Agency and Nuclear Regulatory Commission”) to 44 CFR Part 353 (“Fee for Services in Support, Review and Approval of State and Local Government or Licensee Radiological Emergency Plans and Preparedness”). NRC staff has made several presentations in 2014 to the Federal Radiological Preparedness Coordinating Committee¹¹ to discuss the issues raised in SECY-11-0152 regarding SMR EP and the sizes of the EPZs. The staff has also met separately in 2014 with FEMA technical hazards and radiological EP staff, as well as EPA staff, to discuss preliminary SMR design concepts and potential impacts on both onsite and offsite EP. The staff provided FEMA with a copy of this paper and the opportunity to interact with the staff, obtain clarification, and comment on the paper. FEMA indicated that it would like NRC to keep it informed regarding this issue and supports the staff recommendation to explore the issues surrounding SMR EP via rulemaking.

Advisory Committee on Reactor Safeguards

The staff will brief the Advisory Committee on Reactor Safeguards in the future when a concrete and specific proposal is considered.

Industry and Public Engagement

The industry appears to support the idea of revising EP requirements for SMRs. NEI submitted a white paper that provided a high-level discussion of a methodology and criteria for determining SMR plume exposure EPZ size (ADAMS Accession No. ML13364A345). NEI developed this

¹⁰ SECY-00-0145, “Integrated Rulemaking Plan for Nuclear Power Plant Decommissioning,” dated June 28, 2000 (ADAMS Accession No. ML003721626).

¹¹ Federal Radiological Preparedness Coordinating Committee is composed of 20 Federal departments, agencies, and offices that work together to assure that the United States is safe from radiological incidents involving nuclear or radioactive materials, including acts of terrorism.

white paper, in part, as an industry follow-on activity to SECY-11-0152. On April 8, 2014, the staff conducted a public meeting (ADAMS Accession No. ML14113A610) to discuss the NEI

white paper. During the meeting, the staff provided feedback to NEI representatives. The staff provided a letter to NEI on June 11, 2014, with the staff's questions regarding the white paper's proposal (ADAMS Accession No. ML14142A406). NEI subsequently provided a response to the staff's questions on November 19, 2014 (ADAMS Accession No. ML14323A476).

As mentioned above, in a public meeting on September 11, 2014, TVA announced that it is preparing an ESP application for the Clinch River site near Oak Ridge, Tennessee. The application will be based on a plant parameter envelope intended to be representative of pressurized water reactor SMR designs currently under development. Subsequently, NEI and TVA met with NRC staff on December 17, 2014 (ADAMS Accession No. ML15044A419), to discuss a proposed generic framework for SMR EP being developed by NEI. In that meeting, TVA also described its plan to use that framework in the Clinch River ESP application to propose two specific plume exposure EPZ options: 2 miles and site boundary. TVA stated a subsequent COL submittal will incorporate one of the two options when a specific SMR design is selected. TVA presently plans to submit an ESP application in early 2016.

Similar to the meetings on SMRs, the NRC held public meetings with a medical isotope production facility applicant to discuss emergency planning. Part of that discussion included the possible approach of an offsite emergency plan determination based on offsite dose and the EPA PAG guidelines.

The staff recognizes the public's interest in EP issues for nuclear power plants and subsequent to the Commission's decision on these options, will provide opportunities in public meetings for all stakeholders to make their opinions known. The staff proposes to seek public involvement early in the rulemaking process so that public comments concerning safety and issues that may affect a community can be taken into consideration, addressed, and resolved in a timely and practical manner.

DISCUSSION:

In an SRM following a March 29, 2011, Commission briefing on SMRs (ADAMS Accession No. ML110880535), the Commission directed the staff to, "...think expansively about upcoming issues and to engage the Commission early if they are uncertain whether an issue is a matter of policy. Early engagement will allow the Commission to help staff narrow a range of options, if necessary, and prevent subsequent redirection." Therefore, staff is using this paper to request early Commission direction on whether the staff should consider smaller EPZs and other possible changes in EP requirements associated with technologies such as SMRs and non-LWRs. If so, the staff is asking for clarification on whether such changes should be considered on a case-by-case basis via exemption requests, or in a more comprehensive manner (e.g. rulemaking).

SMR EP is a regulatory matter that can be addressed by the applicant at the ESP, operating license or COL phase. In September 2014, TVA indicated that it would submit an ESP application using a plant parameter envelope for SMRs that would ask the staff to consider a site boundary and a 2-mile plume exposure EPZ according to the case-by-case determination language in 10 CFR 50.47(c)(2).

At this time, no SMR design has been submitted to the NRC for review and approval, and design information for SMRs made available currently to NRC staff has not been sufficiently

complete to support a comprehensive evaluation of source terms and spectrum of accidents in order to inform development of an EP framework for SMR sites. However, with the submission of the white paper by NEI, and TVA's forthcoming ESP proposal to include the site boundary and a 2-mile plume exposure EPZ option, the staff believes that key SMR EP issues must be resolved. Rulemaking would provide the Commission with the broadest range of public views on the issues and would generate predictability in the licensing process for the staff and potential vendors and applicants.

OPTIONS:

Option 1: Revise regulations and guidance related to EP for SMRs and other technologies through rulemaking. The staff believes it is reasonable to consider a new EP framework because of advancements in reactor designs and their associated design features (e.g., smaller cores or passive safety systems) which are expected to have a different accident response than for large LWRs that may result in relatively smaller releases of fission products and slower release of fission products during an accident. EP regulations dedicated to SMRs or other new technologies would promote regulatory clarity, predictability, and stability. Applicants for SMR licenses would apply for approvals based on the new EP framework.

The staff anticipates that the technical basis for the EP framework would be developed as part of the rulemaking process and would include quantitative guidelines and criteria for accident selection and evaluation, specific to SMRs and other new technologies. These guidelines and criteria would then be used to derive a dose-based, consequence-oriented rationale, similar to that described in SECY-11-0152, which would be used to inform the appropriate EPZ size for a specific design and its site. In addition, the staff would use historical and regulatory experiences gained over the past decades and insights gained from the results of using probabilistic risk assessment to inform the EP rulemaking. In addition to new regulations specifically addressing EP, the staff would expect to develop guidance for applicants. There is a potential that the technical basis for the EPZ size in the dose-based, consequence-oriented EP framework could result in a plume exposure EPZ size much smaller than the 10-mile radius currently used, as described in SECY-11-0152, including an EPZ distance effectively at the site boundary. The starting point for the technical basis for the rulemaking would be in accordance with EPA guidance¹², which states that for offsite areas in which the 1 rem EPA PAG is not exceeded, a pre-planned FEMA Radiological Emergency Preparedness Program would not be needed.

Within the NRC's current EP regulatory framework, if an SMR or other applicant chooses to request to use different EP requirements or standards before the rulemaking is completed as proposed in Option 1, then applicants would have to request exemptions.

¹² Environmental Protection Agency, "Manual of Protective Action Guides and Protective Actions for Nuclear Incidents," dated May 1992.

The following are examples of some broad issues that are likely to arise while developing this EP framework, some of which may require future Commission direction:

- Determining appropriate accident source term, fission-product release, and associated dose characteristics.
- Establishing variable-distance plume exposure pathway and ingestion pathway EPZs.
- Determining the effects of modularity, multimodules, and collocation with industrial facilities.
- Determining the potential benefit of a performance-based EP regimen.¹³
- Determining appropriate accidents to be evaluated.
- Determining appropriate minimum staffing requirements for a facility.
- Incorporating lessons learned from the Fukushima Dai-ichi nuclear power plant accident in Japan into the EP framework.
- Evaluating the applicability of the planning standards set forth in 10 CFR 50.47 and regulations in Appendix E to 10 CFR Part 50.
- Providing associated guidance documents to support the EP rulemaking.

This option, if approved by the Commission, would not affect the authority that FEMA has under its regulations in Chapter I, "Federal Emergency Management Agency," of 44 CFR, "Emergency Management and Assistance," for overall emergency management and assistance to State and local response organizations. Nor would it affect the responsibilities of State and local governments to establish and maintain CEMPs. Under its role as described in the National Response Framework, the NRC remains ready to provide FEMA, and State and local governments with technical advice related to the safety and security of any proposed SMR or non-LWR facility.

Advantages: An EP framework for SMRs and other new technologies would: (1) promote regulatory stability, predictability, and clarity; (2) eliminate the current regulatory need to request exemptions from EP requirements; (3) recognize technology advancements embedded in design features; (4) credit safety enhancements existing in evolutionary and passive systems; and (5) assess small size reactor core issues associated with postulated accidents, slower transient response times, and relatively small and slow release of fission products.

¹³ SRM to SECY-14-0038, "Performance-Based Framework for Nuclear Power Plant Emergency Preparedness Oversight," dated September 16, 2014 (ADAMS Accession No. ML14259A589).

An important aspect of rulemaking is the opportunity for public engagement on the issues related to EP. Public notice and comment during rulemaking would provide the widest range of viewpoints for Commission consideration in the development of the proposed rule.

Disadvantages: This option requires rulemaking and creation of new guidance for the revised EP framework for SMRs and other technologies, which would require resource and time expenditures as estimated in the enclosure. Because this rulemaking, if authorized, would not be completed before the planned TVA ESP application submission date in early 2016, at least one applicant would likely request exemptions from the current EP requirements even if rulemaking is authorized.

Option 2: No change to the current EP regulations. Applicants for licenses can currently, and in the future, request exemptions in accordance with 10 CFR 50.12, "Specific Exemptions," or determination of EPZs on a case-by-case basis in accordance with 10 CFR 50.47(c)(2).

This option maintains the existing EP requirements, such as those defined in 44 CFR 350.7, "Application by State for Review and Approval," 10 CFR 50.47, and Appendix E to 10 CFR Part 50. This option also establishes that the regulations are applicable to SMR designs as given. Current regulations establish EP for plume exposure pathway and ingestion pathway EPZs for existing and future nuclear power plants. This option retains the same current obligations and mandated licensing basis for SMRs as for large LWRs, thereby maintaining the status quo for licensees.

Advantages: Agency resources will not be spent on rulemaking. Applications for exemptions will follow the protocols and guidance already in existence, as well as protocols to obtain resources to support exemptions from current EP regulations.

Disadvantages: This option, if approved by the Commission, may create: (1) an unnecessary burden on all stakeholders, (2) regulatory uncertainty caused by granting EPZ exemptions from regulations or determining EPZs on a case-by-case basis, (3) inefficient use of staff and agency resources, and (4) deviation from the Commission direction to not engage in repeated exemptions.

The Commission has previously discouraged regulating by exemption for many reasons, including the fact that "exemptions can serve as warning signals that a particular rule may need to be revised[.]"¹⁴ In addition, the exemption process is a closed staff process that does not include public engagement. As a result, the Commission is not offered the opportunity to hear from all stakeholders.

This option is not recommended by the staff in addressing EP for SMRs and other new technologies.

¹⁴

"Specific Exemptions; Clarification of Standards," 50 FR 50764 (December 12, 1985).

RECOMMENDATION:

The staff recommends that the Commission:

1. Approve Option 1—Revise regulations and guidance related to EP for SMRs and other new technologies such as non-LWRs.

The staff would develop an EP framework containing regulations and guidance for SMRs and other technologies such as non-LWR designs separate from the existing EP regulations for the current operating fleet of large LWRs. Should the staff be directed to pursue Option 1, the details of the staff's plans would be presented to the Commission at a later date. Examples of key elements that would be included in the planning are public meetings and presentations to support stakeholder awareness and participation; periodic coordination and planning with affected local, Tribal, State, and Federal organizations; and Commission updates, as needed.

This option would provide the staff with a reasonable path forward to determine a general EP framework for SMRs and other technologies. This option would continue to provide protection for public health and safety, as well as clear and predictable regulatory stability for all stakeholders. It would also conform with the Commission's 2008 Advanced Reactor Policy Statement which states that "the Commission expects that the safety features of these advanced reactor designs will be complemented by the operational program for Emergency Planning (EP)" (73 FR 60612).

2. If the Commission approves Option 2, provide direction on considerations the staff should take into account when considering case-by-case determinations or exemptions for EP requirements for SMRs and other new technologies.

RESOURCES:

Resources required for each option are discussed in the enclosure, which is not publicly available.

COORDINATION:

The Office of the General Counsel has reviewed this paper and has no legal objection. The Office of the Chief Financial Officer has reviewed this Commission paper for resource implications and has no objection.

/RA Michael R. Johnson Acting for/

Mark A. Satorius
Executive Director
for Operations

Enclosure:
Resources