

May 30, 2013

MEMORANDUM TO: Chairman Macfarlane
Commissioner Svinicki
Commissioner Apostolakis
Commissioner Magwood
Commissioner Ostendorff

FROM: Glenn M. Tracy, Director */RA/*
Office of New Reactors

SUBJECT: CURRENT STATUS OF THE SOURCE TERM AND
EMERGENCY PREPAREDNESS POLICY ISSUES FOR SMALL
MODULAR REACTORS

The purpose of this memorandum is to inform the Commission of recent activities and the current status of the source term and emergency preparedness (EP) issues for small modular reactors (SMRs). The staff is addressing both topics in this memorandum because of the interrelated aspect of the two issues. The U.S. Nuclear Regulatory Commission (NRC) staff first described these issues in SECY-10-0034, "Potential Policy, Licensing, and Key Technical Issues for Small Modular Nuclear Reactor Designs," dated March 28, 2010 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML093290268). The staff subsequently issued SECY-11-0152, "Development of an Emergency Planning and Preparedness Framework for Small Modular Reactors," dated October 28, 2011 (ADAMS Accession No. ML112570439) to inform the Commission of staff actions to develop an emergency planning and preparedness framework for SMR sites. Most recently, the staff issued a Commission memo, "Status of Staff Activities To Address Mechanistic Source Term Methodology and Its Application to Small Modular Reactors," dated December 29, 2011 (ADAMS Accession No. ML113410366), to inform the Commission of ongoing and planned activities to address methods for determining a mechanistic source term (MST) and to describe the applications in which use of a source term determined by such methods would be appropriate.

SECY-10-0034 identified the need for design and license applicants and the NRC to establish appropriate source terms for high-temperature gas-cooled reactors and other SMR designs. The paper included discussion on whether the site-boundary dose-acceptance criteria and associated dose calculations for use in evaluation of site suitability and EP planning for SMR designs should be updated or amended, or whether new requirements should be established for SMRs. Since that time, the staff and external stakeholders have continued work to address these issues. These activities, as discussed below, include hosting a number of public and closed meetings on the topic and the submittal and review of several papers from industry groups and potential SMR applicants.

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Source Term

The December 2011 memo highlighted staff activities to address methods for determining an MST¹ and noted that MST could contribute to the staff's evaluation in a number of areas including siting, control room habitability, EP, and security considerations. The staff committed to remain engaged with SMR stakeholders regarding applications of a MST, review preapplication white papers and topical reports concerning source term issues that it receives from potential SMR applicants, discuss design-specific proposals to address this matter, and consider research and development in this area.

The Nuclear Energy Institute (NEI) submitted a position paper, "Small Modular Reactor Source Terms," in December 2012 (ADAMS Accession No. ML13004A390). The paper discussed the NEI Licensing Task Force's positions on radiological source terms issues with the premise that SMRs can be licensed within the existing regulatory framework. The paper highlights three potential options for approaching source terms for SMRs. The first approach would use the current guidance in Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors" (ADAMS Accession No. ML003731665), which provides guidance on acceptable applications of design-basis accident source terms for light-water reactors. A second approach would use an MST, and the third approach presented consisted of a hybrid of the first two approaches. The paper identified and proposed a resolution path for several regulatory issues, including the selection of a surrogate design-basis accident, multimodule accident scenarios, and source term uncertainty analysis. The paper also identified a number of areas of potential study to further the understanding of important phenomena. The staff held public meetings in December 2012 and April 2013 to discuss the paper and provide feedback to NEI. (Meeting summaries are available as ADAMS Accession Nos. ML13079A205 and ML13115A038.) The staff stated that the position paper provided a good overview of options for the development of design-specific source terms, but noted that subsequent papers or technical reports would need to provide details or research plans to validate design-specific evaluations. The staff also indicated that for designs that plan to utilize the current licensing framework, additional details would be necessary to confirm that use of the existing framework is appropriate for those designs. At the April 2013 public meeting, NEI stated that it is working with the Electric Power Research Institute and the U.S. Department of Energy (DOE) to identify potential areas for future study to advance the understanding of the effects of several unique SMR design features. The areas currently identified include small containment aerosol deposition, small piping fission product deposition, small containment penetration leak rate testing, reactor building fission product dilution and deposition, and submerged containment leakage aerosol removal.

The staff has also had interactions with a number of potential SMR design applicants, including the DOE/Idaho National Lab's (INL's) Next Generation Nuclear Plant (NGNP) project, Babcock

¹ SECY-93-0092, "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), and SECY-03-0047, "Policy Issues Related to Licensing Non-Light-Water Reactor Designs," dated March 28, 2003 (ADAMS Accession No. ML030160002), defined MST as the result of an analysis of fission product release based on the amount of cladding damage, fuel damage, and core damage resulting from the specific accident sequences being evaluated. It is developed using best-estimate phenomenological models of the transport of the fission products from the fuel through the reactor coolant system, through all holdup volumes and barriers (taking into account mitigation features), and finally into the environs.

and Wilcox mPower Inc. (B&W mPower), and NuScale Power (NuScale) to discuss source term activities. While the NEI position paper was generally intended to be applicable to all SMR designs, the interactions with these potential applicants have been focused on design-specific activities.

As part of the NGNP project, DOE/INL submitted a white paper on MST in July 2010 that summarized their recent activities and outlined their event-specific mechanistic approach to the development of an MST (ADAMS Accession No. ML102040260). In response to the paper, the staff provided formal feedback, held several public meetings with DOE/INL between September 2010 and December 2012 in part to discuss various aspects of the MST issue, and issued a draft assessment document in March 2013 (ADAMS Accession No. ML13002A168). The staff found that the proposed approach to NGNP MSTs is generally reasonable, subject to further consideration and resolution of details and issues noted in the assessment document. The staff found no fundamental shortcomings that would preclude successful implementation of the high-level approaches presented by DOE/INL. The feedback provided in the assessment document reflects the views of the staff and does not provide a final regulatory decision on any aspect of the licensing approach for the NGNP design.

B&W mPower submitted a proprietary position paper on radiological source term methodology for the B&W mPowerTM Reactor in July 2012. (The proprietary version is archived as ADAMS Accession No. ML12192A586; the nonproprietary version is available as ADAMS Accession No. ML12192A585.) The paper discussed B&W mPower's methodology for crediting the features in the B&W mPower reactor in meeting the current regulatory expectations expressed in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 100, 10 CFR 50.34(a)(1), 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants", and NRC guidance documents relating to design-basis accident radiological consequence analyses and siting dose criteria. During a meeting held in September 2012 that was closed to the public due to the proprietary material discussed, the NRC staff provided preliminary feedback to B&W mPower on the position paper. The staff stated that the paper appeared to be adequate, with a few portions requiring additional clarification. (The meeting summary is publicly available as ADAMS Accession No. ML13099A241.)

NuScale presented information on its methodology regarding MST to the staff at meetings in October 2011 and October 2012. During these meetings, NuScale discussed its approach to MST for evaluation of design-basis accidents, discussed its analysis methods and tools, and presented its design-specific scoping of licensing basis accident dose results. The staff did not identify any shortcomings in the high-level approach presented during these meetings that would preclude its use in evaluating design-basis accidents, but noted that additional details would be necessary to further evaluate the implementation of the approach. (Meeting summaries are available as ADAMS Accession Nos. ML113330187 and ML13018A085.) NuScale plans to submit a MST white paper in early fiscal year 2014.

Emergency Preparedness

SECY-10-0034 also discussed possible deviations from EP requirements for SMRs. In SECY-11-0152, the staff indicated a willingness to consider alternative EP requirements and frameworks for SMRs and described a dose-distance scalable approach that could be implemented for determining an emergency planning zone (EPZ). The staff has continued its engagement with industry stakeholders on these areas, as described below.

In October 2010, the NGNP project submitted a white paper, "Determining the Appropriate Emergency Planning Zone Size and Emergency Planning Attributes for an [sic] High Temperature Gas Reactor," which summarized an approach for establishing plume exposure and ingestion pathway EPZs for the high temperature gas-cooled reactor (ADAMS Accession No. ML103050268). In March 2013, the staff issued an assessment document that discussed a number of NGNP issues, including emergency preparedness (ADAMS Accession No. ML13002A157). The assessment document, in response to DOE/INL requests to propose or revise regulations and guidance, restates the message in SECY-11-0152 that the staff is willing to consider alternatives, but it will not propose or revise regulations absent a specific proposal. The staff briefed the Advisory Committee on Reactor Safeguards (ACRS) sub-committee on Future Plant Designs on NGNP EP issues on April 9, 2013, and the full ACRS committee on the same topic on May 9, 2013.

At the December 2012 public meeting with NEI discussed above, NEI also gave a presentation on a proposed methodology and criteria for establishing a technical basis for SMR EPZ sizing. During its presentation, NEI stated its intention to submit a position paper on this topic in the near future. NEI plans to incorporate elements from its source-term position paper in the EPZ sizing paper.

Although no applicants have formally indicated to the staff that they plan to use an alternative EP approach, the NRC staff will continue to work with external stakeholders to address these issues further, as resources allow, but it will not go further in proposing new policy or revising guidance for specific changes to EP requirements absent specific proposals from an applicant or nuclear-industry group. The staff will continue to engage interested stakeholders in activities related to source term. The staff will update the Commission, as appropriate, when it receives new and significant information on these topics. The staff will also notify the Commission if any policy issues are identified that may warrant Commission review.

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