

POLICY ISSUE INFORMATION

March 28, 2010

SECY-10-0034

FOR: The Commissioners

FROM: R. W. Borchardt
Executive Director for Operations

SUBJECT: POTENTIAL POLICY, LICENSING, AND KEY TECHNICAL ISSUES FOR
SMALL MODULAR NUCLEAR REACTOR DESIGNS

PURPOSE:

To inform the Commission of potential policy, licensing, and key technical issues that may require Commission consideration to support future design and license review applications for small modular reactors (SMRs), and the staff's plans for developing plans for their resolution.¹

SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) staff has been meeting with the Department of Energy (DOE) and, as resources allowed, with individual SMR designers to discuss potential policy, licensing, and key technical issues for SMR designs. As a result of these pre-application activities and earlier work by the NRC staff and Commission, the NRC staff has identified a number of potential policy and licensing issues. The enclosure to this paper provides a summary description of these potential policy issues for Commission information. The discussions are consistent with information provided in previous Commission papers and other related agency documents. The references provided in Attachment 2 to the enclosure include these key Commission documents.

The NRC staff plans to develop proposed resolutions to these potential policy issues and will inform the Commission and other stakeholders of its activities and progress on resolving them. Although approaches to potential resolutions are described, the enclosure does not include proposed resolutions for any of the issues. As information is available and the evaluations

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¹ A design review application could involve a request for a design approval or design certification under Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR Part 52). A license review application could involve a request for a combined license, manufacturing license, or early site permit under 10 CFR Part 52 or a request for a construction permit and operating license under 10 CFR Part 50.

progress, the NRC staff will prepare future papers that propose potential resolutions or paths to resolution of policy issues to support the Next Generation Nuclear Plant (NGNP) and other SMR review activities. In addition, the staff will inform the Commission in a timely manner of additional issues when they are identified.

BACKGROUND:

As discussed in SECY-08-0019,² nuclear reactor designers are developing new nuclear reactor designs and technologies, and have notified the NRC that they may submit design and license applications for some of their SMR designs to the NRC as early as FY 2011. These include (1) a license application for construction and operation of a helium-cooled very-high-temperature reactor in connection with the NGNP project established by the Energy Policy Act of 2005; (2) a design certification (DC) application for the International Reactor Innovative and Secure pressurized-water reactor (PWR) design; (3) a DC application and possible combined license (COL) application for the NuScale Power Reactor PWR design; (4) a DC application for the mPower PWR design; (5) a design approval application for the Super-Safe, Small and Simple sodium-cooled fast reactor (SFR); and (6) prototype COL and manufacturing license applications for the Power Reactor Inherently Safe Module SFR design. Other innovative reactor design and site development activities could lead to the submission of additional design and license review applications for SMRs to the NRC within the next 10 years, but they are not addressed in this paper because of the preliminary status of their development.

The Commission's final policy statement on the regulation of advanced reactors³ states:

To provide for more timely and effective regulation of advanced reactors, the Commission encourages the earliest possible interaction of applicants, vendors, other government agencies, and the NRC to provide for early identification of regulatory requirements for advanced reactors and to provide all interested parties, including the public, with a timely, independent assessment of the safety and security characteristics of advanced reactor designs. Such licensing interaction and guidance early in the design process will contribute towards minimizing complexity and adding stability and predictability in the licensing and regulation of advanced reactors.

Furthermore, in the NGNP Licensing Strategy,⁴ the Commission stated that in order to implement the NGNP licensing strategy successfully, and meet the congressionally-mandated operation date of 2021, the NRC and DOE needed to implement a pre-application review to identify and resolve policy, regulatory, and key technical issues for the NGNP. Early resolution or identification of a clear path to resolution for issues related to SMRs will enable designers to incorporate appropriate changes during the development of their designs before submitting a design or license review application. Accordingly, the NRC staff has been interacting with DOE on the NGNP and, on a limited basis in accordance with resource availability, with the designers of new SMRs to become familiar with the new designs and technologies, and to provide feedback to DOE and pre-applicants on potential key design, technology, and licensing issues

² SECY-08-0019, "Licensing and Regulatory Research Related to Advanced Nuclear Reactors," dated February 14, 2008. (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML091130253 (publicly available), ML073370326 (non-publicly available) and ML073370532 (non-publicly available)). All documents referenced in this paper are available in ADAMS on the NRC's web page (www.nrc.gov) under the accession number provided, except where noted.

³ Policy Statement on the Regulation of Advanced Reactors: Final Policy Statement, 73 Federal Register 60,612, and 60,616 (October 14, 2008)

⁴ "Next Generation Nuclear Plant Licensing Strategy - A Report to Congress," dated August 2008 (ADAMS Accession No. ML082290017)

and on their technology development program plans. These interactions will also provide information to determine NRC infrastructure development and research needs and plans.

DISCUSSION:

The NRC staff has been meeting with DOE and, as resources allowed, with individual SMR designers to discuss potential policy, licensing, and key technical issues for SMR designs. The NRC staff also conducted an SMR workshop in October 2009⁵ with SMR designers, DOE, the Nuclear Energy Institute, and other stakeholders to discuss potential policy issues that are common to more than one design. The staff encouraged the participants to work together or with other organizations to generically address issues common to all nuclear designs, SMRs, or specific technology groups (i.e., integral PWRs) in order to focus the issues, propose and obtain consistent resolutions, and effectively use resources. As a result of these pre-application activities and earlier work by the NRC staff and Commission, the NRC staff has identified a number of potential policy and licensing issues based on the preliminary design information provided by pre-applicants and discussions with the designers and DOE regarding their proposed approaches to addressing key issues. The enclosure describes those potential policy issues that the staff has identified. In general, these issues result from the key differences between the new designs and current-generation pressurized-water reactors (such as size, moderator, coolant, fuel design, and projected operational parameters), but they also result from industry-proposed review approaches and industry-proposed modifications to current policies and practices. This paper addresses only those potential policy and licensing issues for which resolutions may require Commission consideration. It does not address key technical issues related to these designs unless their importance to the design and the potential impact of policy issue resolutions require such discussion. The description and references provided in the enclosure are not intended to be all inclusive. In addition, although approaches to potential resolutions are described, the enclosure does not include proposed resolutions for any of the issues.

The NRC staff plans to develop proposed resolutions to these issues by continuing to obtain information from DOE, potential design and license applicants, and other sources (both domestic and international); identifying and developing proposals for the resolution of policy issues; and where appropriate, preparing papers proposing resolutions of these issues with recommendations for consideration and approval by the Commission. Although the staff discusses a number of potential policy issues concerning SMRs in the enclosure, it has identified some key issues that it considers most important to resolve by FY 2011 or FY 2012 in order to support the design development of the NGNP and integral PWRs. The following is a brief description of these key issues. They are discussed in greater detail in the enclosure along with the other potential policy issues that may need to be addressed as the NRC staff conducts its SMR reviews.

Implementation of the Defense-In-Depth Philosophy for Advanced Reactors

The Commission has had a long-standing policy of ensuring that defense-in-depth (DID) is incorporated into the design and operation of nuclear power plants. The requirements in 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," incorporate DID measures specific to light-water reactors (LWRs). Although integral PWRs employ the more traditional DID approach of LWRs in their designs, non-LWR SMR designers propose to use

⁵ "Summary of Workshop on Small- and Medium-Sized Nuclear Reactors (SMRs)," U.S. Nuclear Regulatory Commission, October 22, 2009. (ADAMS Accession No. ML092940138)

different approaches to establish DID barriers for their designs. This can be seen in their approaches to address technical issues such as redundancy of key safety-related components and containment functional capability. The DID measures have been determined on a case-by-case basis for non-LWRs licensed in the past. Preventive or mitigative compensatory measures may need to be incorporated into the design or operation of certain SMRs to account for uncertainties in design or operational capability of the facility. In FY 2010 and FY 2011, the NRC staff will review pre-application submittals concerning DID that it receives from DOE and potential SMR applicants, discuss design-specific proposals to address this matter, consider approaches to DID proposed by the domestic and international community, and determine whether preventive or mitigative compensatory measures may be needed for SMR designs to account for uncertainties in design or operational capability of the facility. Should it be necessary, the staff will propose changes to existing regulatory guidance or new guidance concerning DID in FY 2011 to support development of the NGNP or other SMR designs.

Appropriate Source Term, Dose Calculations, and Siting for SMRs

Accident source terms are used for the assessment of the effectiveness of the containment and plant mitigation features, site suitability, and emergency planning. Other radiological source terms are used to show compliance with regulations on dose to workers and the public. Design and license applicants and the NRC will need to establish appropriate bounding source terms for high-temperature gas-cooled reactors and other SMRs. There may also be source-term issues associated with the multi-module aspect of SMRs where modules share structures, systems, and components (SSCs). For example, the Commission may have to determine when it would be appropriate to base the bounding source term on an accident in a single module and when possible sharing of SSCs require the evaluation of core damage in and potential releases from more than one module. In FY 2010 and FY 2011, the NRC staff will review pre-application submittals concerning source-term issues that it receives from DOE and potential SMR applicants, discuss design-specific proposals to address this matter, and consider research and development in this area (both by the domestic and the international community). Should it be necessary, the staff will propose changes to existing regulations or propose new regulatory guidance concerning the source term and site suitability for an SMR in FY 2011 to support development of the NGNP and other SMR designs.

Appropriate Requirements for Operator Staffing for Small or Multi-Module Facilities

Some SMR designs may use multiple modules at one site, but current regulations do not address the possibility of more than two reactors being controlled from one control room. In addition, SMR designers have indicated that they are considering whether their designs can operate with a staffing complement that is less than that currently required by the Commission's regulations. Other potential SMR policy issues include the possible need for requirements on control room staffing during refueling operations, reactor staff who interact with an interconnected manufacturing plant, supervisory staff, shift work, and training. In FY 2010 and FY 2011, the NRC staff will review pre-application submittals concerning operator staffing and associated control room design that it receives from DOE and potential SMR applicants, discuss design-specific proposals to address this matter, discuss the proposed resolutions with human factors and instrument and controls experts, and consider research and development in this area (both by the domestic and the international community). Should it be necessary, the staff will propose changes to existing regulatory guidance or staff positions or propose new guidance concerning the operator staffing for an SMR in FY 2012 to support development of the NGNP and other SMR designs.

Security and Safeguards Requirements for SMRs

Because many SMRs are still in early developmental stages and the designs are not yet fixed, SMR designers have a unique opportunity to determine the appropriate design basis threat; develop emergency preparedness; and integrate physical security protection, cyber security protection, and material control and accounting (MC&A) measures with the design and operational requirements during the design process and during the development of the a license applicant's physical security and MC&A programs and systems. SMR designers are expected to integrate security into the design and will need to conduct a security assessment to evaluate the level of protection provided, including safeguards aspects of SMR-related fuel cycle and transportation activities. The DOE, SMR designers, and potential operators have raised issues regarding the appropriate number of security staff and size of the protected area. In FY 2010 and FY 2011, the NRC staff will review pre-application submittals concerning safeguards that it receives from DOE and potential SMR applicants, discuss design-specific proposals to address this matter, discuss the proposed resolutions with safeguards experts, and consider research and development in this area (both by the domestic and the international community). Should it be necessary, the staff will propose changes to existing regulatory guidance or new guidance concerning safeguards for an SMR in FY 2011 to support development of the NGNP and other SMR designs.

The staff is developing detailed resolution plans for each issue discussed in this paper, taking into account factors such as whether resolution of the issue is critical to the development of the NGNP or integral LWR designs; the number of affected technology groups and design centers; the potential effect on design decisions; the potential need for legislation, rulemaking, or policy changes; the potential need for confirmatory research; the participation and cooperation of applicants, other Government agencies, professional societies, and other stakeholders; the potential effect on the schedule for prototype plants or commercial deployment; and the dependencies on other policy or technical issues (e.g., development of source-term models). The staff will refine and implement the resolution plans for each issue as it receives additional information from DOE, pre-applicants or applicants, or other sources in FY 2010 and FY 2011, and as the staff assesses possible solutions to the technical and policy issues. The staff will address technical issues using established processes, including public participation, for issuing regulatory guidance, and will provide future papers to the Commission describing the proposed resolutions and the NRC staff positions and recommendations regarding each of the major policy issues. The staff will provide information to the Commission and other stakeholders regarding its activities and progress on resolving the policy and key technical issues using established mechanisms such as public meetings, postings on the NRC web page, and routine reporting vehicles such as the quarterly updates on the status of new reactor review activities.

RESOURCES:

The resources allocated to conduct the activities described in this paper (including those for supporting offices) are included in budgeted activities listed below related to the reviews of SMRs. There is \$14.2M, including 29.4 full time equivalents (FTEs) budgeted in FY 2010. There is \$18.8M, including 49 FTE, included in the FY 2011 Presidents Budget. The resources for FY 2012 and beyond will be requested using the planning, budgeting, and performance

management process as the staff better understands the complexity of these issues and their effect on the SMR designs.

	FY 2010			FY 2011		
	Contract \$	Total FTE	Amount	Contract \$	Total FTE	Amount
Total	\$9,756	29.4	\$14,195	\$11,430	49.0	\$18,819
NRO	3,166	12.9	5,114	5,994	26.2	9,945
NSIR	0	0.5	75	0	1.8	271
RES	6,590	16.0	9,006	5,436	21.0	8,603

CONCLUSIONS:

The NRC staff will continue its pre-application activities on the NGNP and its interactions with the designers of other SMRs to further identify and resolve policy, licensing, and key technical issues. The staff is developing detailed resolution plans for each issue. As the plans are implemented, the staff will prepare papers that propose resolutions or paths to resolution of policy issues to support the NGNP and other SMR review activities. In addition, the staff will inform the Commission in a timely manner of additional issues when they are identified.

COORDINATION:

This paper has been coordinated with the Office of the General Counsel, which has no legal objection, and with the Office of the Chief Financial Officer.

/RA by Bruce S. Mallett for/

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for Operations

Enclosure:
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Issues for Small Modular Nuclear Reactor
Designs

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Potential Policy, Licensing, and Key Technical
Issues for Small Modular Nuclear Reactor
Designs

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