

POLICY ISSUE  
(INFORMATION)

August 12, 2011

SECY-11-0112

FOR: The Commissioners

FROM: Michael R. Johnson, Director */RA/*  
Office of New Reactors

SUBJECT: STAFF ASSESSMENT OF SELECTED SMALL MODULAR REACTOR  
ISSUES IDENTIFIED IN SECY-10-0034

PURPOSE:

This paper informs the Commission of the results of the staff's assessment of several potential licensing issues and key technical issues for small modular reactors (SMRs) that were identified 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 assessments in this paper apply to integral pressurized-water reactors (iPWRs) and nonlight water SMRs, including the Next Generation Nuclear Plant (NGNP). This paper does not address any new commitments or resource implications.

BACKGROUND:

The U.S. Nuclear Regulatory Commission (NRC) staff developed SECY-10-0034 after early interactions with the U.S. Department of Energy (DOE), SMR designers, preapplicants, representatives of the nuclear industry, and other stakeholders to describe potential issues resulting from the early review of SMRs.<sup>1</sup> The NRC staff identified topics in categories such as

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<sup>1</sup> See Attachment 1 to Enclosure 1 of SECY-10-0034 for a description of these SMRs.

licensing process issues, design issues, operational issues, and financial issues. The NRC staff identified matters that had either previously been identified as, or had the potential of being, policy issues, which would warrant Commission attention, and potential licensing and key technical matters that might develop into policy issues depending on the actual designs, associated business plans, and possible licensing options pursued by SMR designers or potential applicants. The NRC staff did not intend to designate all of the potential issues listed in SECY-10-0034 as policy issues requiring Commission attention.

The NRC staff has developed and implemented issue resolution plans for each issue discussed in SECY-10-0034 taking into account factors such as the following:

- whether the item was a potential policy, licensing, or key technical issue
- whether the resolution of the issue is critical to the development of iPWR designs or the NGNP
- 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
- the dependency of the issue on other policy, licensing, or technical issues

The NRC staff stated that it would refine the resolution plans for each issue as it received additional information from DOE, preapplicants, or other sources in fiscal years (FYs) 2010 and 2011. As discussed in SECY-10-0034, the NRC staff uses the Office of New Reactors (NRO) quarterly status reports to update the Commission on its activities and progress on resolving the policy issues. The NRC staff submitted the latest status report, "Quarterly Report on the Status of New Reactor Licensing Activities – April 1 – June 30, 2011," on July 19, 2011 (ADAMS Accession No. ML111940602). In addition, the staff has addressed activities related to several issues not discussed in this paper, but discussed in SECY-10-0034, in separate communications such as SECY-11-0024, "Use of Risk Insights to Enhance the Safety Focus of Small Modular Reactor Reviews," dated February 18, 2011 (ADAMS Accession Nos. ML110110691 and ML110110701) and SECY-11-0079, "License Structure for Multi Module Facilities Related to Small Modular Nuclear Power Reactors," dated June 12, 2011 (ADAMS Accession No. ML110620459).

DISCUSSION:

As a result of the NRC staff's development and implementation of resolution plans and discussions with representatives of the nuclear industry and other stakeholders, the NRC staff has concluded that certain issues documented in SECY-10-0034 are not expected to require rulemaking or changes to existing Commission policies for SMRs planned for near-term deployment. Specifically, the NRC staff has reached this conclusion for issues related to licensing of prototype reactors, operation programs for small or multimodule facilities, installation of reactor modules during operation for multimodule facilities, industrial facilities using nuclear-generated process heat, and aircraft impact assessments for small modular reactors. Enclosures 1-5 to this paper elaborate the basis for the staff's current assessment and conclusion.

In general, the NRC staff's current assessment is that these issues do not warrant Commission attention in the foreseeable future because they can be addressed within the existing regulatory policy and framework, or they do not apply to SMRs planned for near-term deployment (in accordance with stated business plans). Some of the issues identified in SECY-10-0034 may be policy issues for advanced nonlight-water reactors that may be deployed at a later time, but the NRC staff must receive and evaluate more detailed design information not currently available before moving forward to propose their resolution. The NRC staff will continue to pursue these matters within its licensing-related interactions with stakeholders. The NRC staff will notify the Commission if policy issues emerge after SMR designs and industry positions on these matters are further developed, issues are better defined, or nuclear industry representatives express an interest to engage in detailed discussions of these matters.

The NRC staff has recently identified specific potential policy issues for the iPWRs associated with decommissioning funding, insurance and liability, and manufacturing licenses. These potential policy issues will be further developed, or a basis for their exclusion identified and reported to the Commission in subsequent papers. The staff will determine whether these potential issues require rulemaking or changes to existing Commission policy and notify the Commission of the staff's determination, and the basis for that determination, in a future paper.

COORDINATION:

The Office of the General Counsel reviewed this paper and has no legal objection.

***/RA/***

Michael R. Johnson, Director  
Office of New Reactors

Enclosures:

1. License for Prototype Reactors
2. Operational Programs for Small or Multi Module Facilities
3. Installation of Reactor Modules During Operation for Multi Module Facilities
4. Industrial Facilities Using Nuclear-Generated Process Heat
5. Aircraft Impact Assessments for Small Modular Reactors

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**SECY-012**

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# License for Prototype Reactors

## Background

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 U.S. Nuclear Regulatory Commission (NRC) staff states that the use of prototype license provisions in the Commission's regulations could involve potential policy issues requiring Commission input. Title 10 of the *Code of Federal Regulations* (10 CFR) 50.43(e) and, by reference, 10 CFR 52.79(a)(24) state in part that for proposed reactor designs that differ significantly from certain light-water reactors (LWR) designs, one way that the NRC will approve a design certification, combined license, manufacturing license, or operating license is if there has been acceptable testing of a prototype plant over a sufficient range of normal operating conditions, transient conditions, and specified accident sequences, including equilibrium core conditions. If a prototype plant is used to comply with the testing requirements, the NRC may impose additional requirements on siting, safety features, or operational conditions for the prototype plant to protect the public and the plant staff from the possible consequences of accidents during the testing period.<sup>1</sup> For example, license conditions might be imposed to limit the plant to less than full power, place restrictions on operational temperature, or require more extensive startup or operational testing.

## Assessment

During the development of the NRC staff's resolution plan for this issue, the NRC staff concluded that, although the identification of specific requirements and license conditions for prototype reactors may be challenging because applicants and the NRC have not yet used the provisions defined in 10 CFR 50.43(e), the NRC staff expects to be able to approve a design certification or develop a license for a prototype reactor using existing regulations and regulatory guidance. Therefore, the NRC staff's current assessment is that rulemaking for 10 CFR 52.47(c)(2), 10 CFR 50.43(e), and 10 CFR 52.79(a)(24) or changes to existing Commission policies will not be needed to address licensing or technical issues that may arise for prototype reactors. The NRC staff will determine requirements for acceptable testing for a prototype plant of the type described in 10 CFR 50.43(e)(2) based on the design, location, size, and other characteristics of the proposed reactor. The NRC staff has not identified any policy issues with the regulation or its implementation and believes that if the NRC receives a design certification or license application for a prototype reactor, the NRC staff will be able to determine the appropriate provisions in 10 CFR 50.43(e) to use during the design certification or licensing review.

In the responses to NRC Regulatory Issue Summary 2011-02, "Licensing Submittal Information and Design Development Activities for Small Modular Reactor Designs," dated February 2, 2011, no small modular reactor (SMR) designer or potential applicant has indicated that it intends to submit a design certification or license application in the near term that includes plans for a prototype reactor. However, in one response, a reactor designer indicated that it considers that its first reactor will be a prototype, but the designer does not specify the type of license an

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<sup>1</sup> 10 CFR 50.43(e)(2)

applicant proposing to construct and operate this reactor will actually request. Although the U.S. Department of Energy and the NRC recommend in “Next Generation Nuclear Plant Licensing Strategy”, dated August 14, 2008 (ADAMS Accession No. ML082290017), that Next Generation Nuclear Plant (NGNP) license applicant submit a license application for a prototype nuclear power plant (using 10 CFR 50.43(e)) in order to meet a fiscal year 2021 startup date, there is nothing binding in this licensing strategy. The NRC staff does not know what type of license an applicant proposing to construct and operate the Next Generation Nuclear Plant will actually request and, should the applicant submit a licensing application for a prototype nuclear power plant, whether policy issues will result.

Because the NRC staff expects to be able to approve a design certification or develop a license for a prototype reactor using existing regulations and regulatory guidance, and no potential applicant has expressed interest in engaging in detailed discussions with the NRC staff about a design certification license application for a prototype SMR planned for near-term deployment, the NRC staff does not plan to pursue this matter. Therefore, the NRC staff does not plan to address this issue in its future updates on the status of the resolution of issues identified in SECY-10-0034.

# Operational Programs for Small or MultiModule Facilities

## Background

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 U.S. Nuclear Regulatory Commission (NRC) staff states that policy issues may be identified during the development of operational programs such as inservice inspection (ISI) and inservice testing (IST) programs for small modular reactors (SMRs).<sup>1</sup> The unique design of select SMR safety-related components, such as helical steam generators, may present challenges and limitations in the ability to conduct thorough inspections and tests. Additionally, the introduction of new technologies and design features may require the development of operational programs that are new or significantly different from those of current generation large light-water reactors (LWRs). The NRC staff also indicated in SECY-10-0034 that on-line refueling and the proposed increased time period between refuelings for certain integral pressurized-water reactors and non-LWRs (from 4 to as many as 30 years between refueling outages) may introduce policy issues concerning longer time intervals between periodic inspections and tests.

NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Report for Nuclear Power Plants LWR Edition," and SECY-05-0197, "Review of Operational Programs in a Combined License Application and General Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria," dated October 28, 2005 (ADAMS Accession No. ML052770257), list operational programs to be developed for large LWR nuclear power plants. The Commission provided policy guidance related to operational programs for new large LWR plants in a series of Commission papers and staff requirements memoranda (e.g., SECY-90-016, "Evolutionary Light Water Reactor (LWR) Certification Issues and Their Relationship to Current Regulatory Requirements," dated January 12, 1990; SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs," dated April 2, 1993; SECY-94-084, "Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems in Passive Plant Designs," dated March 28, 1994; and SECY-95-132, "Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems (RTNSS) in Passive Plant Designs (SECY-94-084)," dated May 22, 1995).

## Assessment

During the development and implementation of the NRC staff's resolution plan for this issue, the NRC staff concluded that although SMR design differences will likely introduce technical issues that must be addressed through operational programs, such efforts will likely involve technical matters that can be addressed during the NRC staff's review of a license application using the guidance in NUREG-0800 or SECY-05-0197 (including the Commission direction discussed previously as appropriate). For example, where SMRs might operate for extended periods between refueling outages, new operational programs might be appropriate for the incorporation of on-line monitoring instrumentation to provide reasonable assurance that SMR equipment will

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<sup>1</sup> See attachment to Section 13.4, "Conduct of Operations," of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," March, 2007, and Table 13.4-1 of Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," June 2007, for a list of operational programs required for LWRs.



perform its design function over the long operating cycle with equipment-specific diagnostic testing, and recalibration of on-line monitoring instrumentation during maintenance and refueling outages. Therefore, the NRC staff's current assessment is that rulemaking or changes to existing Commission policy will not be needed to address the licensing or technical issues that may arise for SMRs planned for near-term deployment.

For non LWR SMRs that may be deployed at a later time, the many innovative design features and materials associated with these reactor technologies may require the development of new operational programs that are not applicable to, or needed, for LWRs. For example, matters concerning on-line refueling (e.g., for pebble bed gas-cooled reactor designs) and ISI and IST programs of unique or innovative features of advanced non-LWR designs could involve policy issues. As the NRC staff receives and evaluates more detailed information on these designs and the technical basis for the safety performance of these reactor designs and innovative technologies, the NRC staff will be able to identify any specific potential policy issues concerning operational programs for non-LWR technologies. Accordingly, at this time, the NRC staff does not plan to pursue this matter for non-LWR designs until they are further developed and more design information is available, or until SMR designers or applicants express interest in engaging in detailed discussions on this matter.

In the staff requirements memorandum to SECY-05-0197, the NRC staff was directed to inform the Commission of the addition of operational programs for combined license applications beyond those identified in SECY-05-0197 and related guidance, such as Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)." Similarly, the NRC staff will inform the Commission if the staff determines that additional operational programs are necessary for SMRs beyond those identified in RG 1.206 under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52 or those identified in NUREG-0800 under 10 CFR Part 50. At this time, the NRC staff does not foresee the need to request Commission direction on matters concerning operational programs. Therefore, the NRC staff does not plan to address this matter in its future updates on the status of the resolution of issues identified in SECY-10-0034.

# Installation of Reactor Modules During Operation for MultiModule Facilities

## Background

The multimodule aspect of certain small modular reactor (SMR) designs may allow modules to be constructed and placed into operation while other previously installed adjacent modules are operating. 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 Accession No. ML093290268), the U.S. Nuclear Regulatory Commission (NRC) staff stated that this type of evolution and possible effects on systems and structures could raise policy issues requiring Commission consideration before the agency makes final decisions regarding the acceptability of a design or issuance of a license. For example, there may be concerns regarding the movement of heavy loads near operating modules, changes in the boundary conditions associated with the seismic analysis of an existing operating module during the construction and installation of a new adjacent module, and some related common mode failures resulting from initiating events affecting more than one module.

## Assessment

During the development and implementation of the NRC staff's resolution plan for this issue, the NRC staff concluded that, although SMR design differences will likely introduce technical issues and possibly the need to revise or develop handling procedures for heavy loads near an operating reactor that are unique to SMRs affected by this issue, such efforts will likely involve technical matters that can be addressed during the NRC staff's review of a design certification or license application. Therefore, the NRC staff's current assessment is that rulemaking or changes to existing Commission policy and past regulatory practice (e.g., handling procedures for the movement of heavy loads in the containment of current-generation large light-water reactors) will not be needed to address licensing or technical issues associated with the installation of reactor modules of SMRs planned for near term deployment. The NRC staff concludes that the matters associated with the installation of new reactor modules are expected to be issues for which an applicant will have to assess the safety impact to the operating reactor modules and associated safety-related equipment.

At this time, the NRC staff does not foresee the need to request Commission direction on matters concerning the installation of new reactor modules near an existing operating module. Therefore, the NRC staff does not plan to address this matter in its future updates on the status of the resolution of issues identified in SECY-10-0034.

# Industrial Facilities Using Nuclear-Generated Process Heat

## Background

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 Accession No. ML093290268), the Nuclear Regulatory Commission (NRC) staff states that small modular reactors (SMRs) are being considered for industrial use in remote areas to produce process heat for chemical plants, refineries, desalinization plants, hydrogen production facilities, and bitumen recovery from oil sands. The U.S. Nuclear Regulatory Commission (NRC) staff indicated that the close coupling of the nuclear and process facilities raises concerns involving interface requirements and regulatory jurisdiction issues. Effects of the reactor on the commercial product of the industrial facility during normal operation must also be considered. Resolution of these issues will require interfacing with other government agencies and the NRC staff indicated that Commission input may be needed to determine whether the design and ultimate use of the product are acceptable.

## Assessment

During development of the NRC staff's resolution plan for this issue, the NRC staff concluded that, with the possible exception of insurance and liability matters,<sup>1</sup> although SMR designs will likely introduce technical issues concerning the interface between the nuclear plant and connected industrial facility, such issues will likely involve technical matters that can be addressed during the NRC staff's review of a design certification or license application. Therefore, the staff's current assessment is that rulemaking or changes to existing Commission policies will not be needed to address licensing or technical issues that may arise. As the NRC staff receives and evaluates more detailed information on these designs, the NRC staff will be able to more firmly identify specific potential policy issues. However, until the staff knows more about the design of a connected facility and how the SMR might interface with the industrial facility, the NRC staff will not be able to identify specific issues in this matter. The applicant will have to ensure that the commercial product of the industrial facility (such as hydrogen) complies with those applicable regulations under the purview of the NRC, U.S. Environmental Protection Agency, U.S. Occupational Safety and Health Administration, the U.S. Department of Homeland Security, and possibly other agencies. Additionally, any effects of the industrial facility on the reactor will be addressed as part of the NRC staff's review, for example, as part of the offsite hazards analysis.

In their responses to NRC Regulatory Issue Summary 2011-02, no potential applicant has indicated that it intends to submit a license application for an SMR facility to produce process heat for industrial use. Although the Energy Policy Act of 2005 specifies that the Next Generation Nuclear Plant (NGNP) shall be used to generate electricity, produce hydrogen, or generate electricity and produce hydrogen, the NRC staff does not yet know with certainty what type of license an applicant to construct and operate the NGNP will actually request and, should an applicant submit a request for a license to operate a nuclear facility to generate process heat, whether policy issues will result.

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<sup>1</sup> Insurance and liability matters for nuclear facilities providing process heat for industrial facilities will be addressed in a separate Commission paper.

Because no potential applicant has expressed interest in engaging in detailed discussions with the NRC staff regarding a license for SMRs planned for near-term deployment to produce process heat for industrial use, the NRC staff does not intend to pursue this matter outside of its continuing interactions related to the NGNP. Therefore, the NRC staff does not plan to address this matter in its future updates on the status of the resolution of issues identified in SECY-10-0034.

# Aircraft Impact Assessments for Small Modular Reactors

## Background

In accordance with the aircraft impact assessment rule, “Consideration of Aircraft Impacts for New Nuclear Power Reactors,” dated June 12, 2009 (74 FR 28112), all future nuclear power plants will need aircraft impact assessments. This regulation (Title 10 of the *Code of Federal Regulations* (10 CFR) 50.150, “Aircraft impact assessment”) requires design and license applicants for new nuclear power reactors to perform a realistic design-specific assessment of their designs to identify design features and functional capabilities that could provide additional inherent protection to avoid or mitigate the effects of the impact of a large commercial aircraft.

Using realistic analyses, new power reactor design and license applicants are required to identify and incorporate into the design those design features and functional capabilities that avoid or mitigate, with reduced reliance on operator actions, the effects of an aircraft impact on key safety functions described in 10 CFR 50.150. Specifically, the applicant must show that, with reduced operator actions, the reactor core remains cooled or the containment remains intact, and spent fuel pool cooling or spent fuel pool integrity is maintained. These acceptance criteria focus on the functions of core cooling capability, containment, spent fuel pool capability, and spent fuel pool integrity following the aircraft impact (74 FR 28130–28131). In the statement of considerations for the aircraft impact assessment rule, the Commission stated that these four functions are applicable to light-water reactors (LWRs), and each may not be applicable to non-LWR designs, or may have to be supplemented by other key functions for non-LWR designs (74 FR 28131). The Commission also stated that its regulatory approach for reviewing non-LWR designs will begin with the U.S. Nuclear Regulatory Commission’s (NRC) evaluation of the applicability of the acceptance criteria in the aircraft impact assessment rule, and the possible need for other acceptance criteria for non-LWR designs. The Commission stated that it may issue exemptions or impose additional acceptance criteria to be used in the aircraft impact assessment for non-LWR designs, in order to ensure that non-LWR designs will also be designed against large, commercial aircraft impacts.

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 Accession No. ML093290268), the U.S. Nuclear Regulatory Commission (NRC) staff stated that additional aircraft impact assessment issues may have to be addressed for industrial facilities that are using nuclear-generated process heat. The staff also noted that proposed resolutions of aircraft impact assessment issues for small modular reactor (SMR) designs may require Commission input to determine whether the design approach is in keeping with Commission policy on this issue.

## Assessment

During the development and implementation of the NRC staff’s resolution plan for this issue, the NRC staff did not identify any policy issues. The staff’s current assessment is that, although design differences among integral pressurized-water reactor SMRs and the current-generation large LWRs may introduce technical issues concerning the effect of an aircraft impact on the reactor, the containment, and spent fuel pool cooling or spent fuel pool integrity, the staff’s

review efforts are expected to only involve licensing and technical matters that can be resolved as part of the design certification and licensing reviews.

For non-LWR SMR designs (which may be deployed at a later time), as discussed in SECY-10-0034, acceptance criteria that focus on the functions of core cooling capability, containment, spent fuel pool capability, and spent fuel pool integrity following the aircraft impact may not be applicable, or may have to be supplemented by other acceptance criteria or key functions. However, at this time, the staff has insufficient information on these non-LWR designs to support the near-term identification of potential policy, licensing, and key technical issues concerning aircraft impact assessments. When reviewing non-LWR designs, the NRC staff will evaluate the applicability of the acceptance criteria set forth in the aircraft impact assessment rule and the possible need for other criteria. If necessary, the NRC may issue exemptions and impose supplemental criteria in to be used in the aircraft impact assessment. The NRC staff will pursue these matters for non-LWR designs when they are further developed and more design information is available, or until SMR designers or applicants express interest in engaging in detailed discussions on this matter.

Additionally, while the primary focus of 10 CFR 50.150 is to assess the effects of an aircraft impact on a nuclear facility, the NRC staff's review of a design certification or license application for an SMR facility to produce process heat for industrial use will include the impacts resulting from events at the industrial facility associated with the SMR, including aircraft impacts, as part of the external hazards analysis and the siting evaluation. As discussed in the preceding section, no potential applicant has indicated that it intends to submit a license application for an SMR facility to produce process heat for industrial use. Until the staff knows more about the design of a connected facility and how the SMR might interface with the industrial facility, the NRC staff will not be able to identify specific licensing, technical or policy issues concerning aircraft impact assessments for SMRs used in industrial applications.

The NRC staff does not plan to address aircraft impact assessments in its future updates on the status of the resolution of issues identified in SECY-10-0034.