

# POLICY ISSUE INFORMATION

December 29, 2011

SECY-11-0184

FOR: The Commissioners

FROM: James T. Wiggins, Director  
Office of Nuclear Security and Incident Response

Michael R. Johnson, Director  
Office of New Reactors

SUBJECT: SECURITY REGULATORY FRAMEWORK FOR CERTIFYING,  
APPROVING, AND LICENSING SMALL MODULAR NUCLEAR  
REACTORS (M110329)

PURPOSE:

The purpose of this paper is to inform the Commission of the results of the staff's assessment of the adequacy of the current security regulatory framework for certifying, approving, and licensing small modular nuclear reactors (SMRs). This paper focuses primarily on integral pressurized-water reactors (iPWRs), since the U.S. Nuclear Regulatory Commission (NRC) expects to receive applications for licensing this type of SMR in the near future. The paper also addresses the staff's assessment of the suitability of the current security regulatory framework for certifying, approving, and licensing for non-light-water reactor designs (non-LWRs) (e.g., high-temperature gas-cooled reactors, fast reactors, traveling wave reactors, and molten salt reactors) to the degree possible given the limited information available on the designs and operations of these SMR technologies. This paper does not address any new commitments or resource implications.

CONTACTS: Pete Lee, NSIR/DSP  
(301) 415-8111

Wesley Held, NRO/DARR  
(301) 415-1583

SUMMARY:

The staff's assessment determined that the current security regulatory framework is adequate to certify, approve, and license iPWRs, the manufacturing of iPWR fuel, the transportation of special nuclear material (SNM) and irradiated iPWR fuel, and the interim storage of irradiated nuclear fuel for proposed iPWRs and related activities under Title 10 of the *Code of Federal Regulations* (10 CFR) Parts 50, 52, 70, 71, and 72, respectively. The staff's assessment also determined that the security and material control and accounting (MC&A) requirements established in 10 CFR Parts 72, 73, and 10 CFR Part 74, respectively, are comprehensive and sufficiently robust, and therefore are adequate for iPWRs.

In the case of non-LWRs, the staff's assessment of the suitability of the current security regulatory framework for certifying, approving, and licensing these SMR technologies was based on the limited information currently available on the reactor and fuel designs and operations of these technologies, which is described in later section of this paper. Based on this information, the staff's preliminary conclusion is that the current security regulatory framework is comprehensive and sufficiently robust to certify, approve, and license non-LWRs. Sufficient provisions are available to provide flexibility for designers and applicants to meet performance-based and prescriptive security requirements and to apply methods or approaches to achieve the objective of high assurance that activities involving SNM are not inimical to the common defense and security and do not constitute an unreasonable risk to public health.

The staff is not currently aware of any area in which the existing security regulatory framework would not apply to non-LWRs, or would have to be amended in order to certify, approve, and license these technologies. However, given the limited information available on these designs, as specific designs mature and details are made available, the staff will assess the security and MC&A requirements for proposed non-LWR technologies to identify any regulatory gaps and potential or policy issues.

BACKGROUND:

Security and safeguards requirements were identified as potential policy issues in SECY-10-0034, "Potential Policy, Licensing, and Key Technical Issues for Small Modular Nuclear Reactor Design," dated March 28, 2010 (Agencywide Documents Access and Management System Accession No. ML093290245). The NRC staff has engaged in public preapplication activities on this topic with the U.S. Department of Energy, SMR designers, potential applicants, representatives of the nuclear industry, and other stakeholders to discuss potential policy, licensing, and key technical issues for SMR designs. These interactions are in support of the Commission's policy statement on the regulation of advanced reactors (73 *Federal Register* (FR) 60612; October 14, 2008), which states the following:

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.

Current designers and combined license applicants for new large LWRs have considered the Commission's policy statement and integrated security into their design processes. They have interacted with the staff through the regulatory processes for certification and licensing of new large LWRs. During preapplication interactions, SMR designers and potential applicants have indicated their intent to adhere to the Commission's policy statement and to address security during the design process.

#### DISCUSSION:

The scope of the staff's assessment focused on the licensing and security regulations that establish the regulatory basis for certification, approval, and licensing of iPWRs, including licensing activities for manufacturing iPWR reactor fuel, transporting SNM, and providing interim storage of irradiated nuclear fuel. The security performance and prescriptive requirements, including the preparation and submission of a physical security plan, a training and qualification plan, security contingency plans, and a cyber security plan for nuclear power reactors, are established in 10 CFR Part 73, "Physical Protection of Plants and Materials." The MC&A requirements are established in 10 CFR Part 74, "Material Control and Accounting of Special Nuclear Material." The security and MC&A requirements are incorporated by reference under the licensing regulations of 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," Part 70, "Domestic Licensing of Special Nuclear Material," Part 71, "Packaging and Transportation of Radioactive Material," and Part 72, "Licensing Requirements for Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste." The staff reviewed each of these regulations, NRC orders, and related Commission-approved ongoing rulemaking actions to assess the adequacy of the security regulatory framework necessary for licensing activities related to iPWRs.

The staff's assessment included determining whether there are any gaps in the current security regulatory framework and any potential policy issues requiring Commission decisions for the proposed iPWRs. In the case of non-LWRs, because of the limited information available on the designs and operations, the staff only assessed the overall suitability of the security regulatory framework for certifying, approving, and licensing these SMR technologies. The following sections summarize the staff's assessment of each key regulation related to the licensing activities for iPWRs. They also provide a limited assessment of the potential technical and policy security issues for non-LWR technologies.

#### Staff's Assessment of the Security Regulatory Framework for Integral Pressurized-Water Reactors

##### *Nuclear Power Reactors*

The current security regulatory framework is adequate to certify or approve standard iPWR designs, and to issue early site permits, construction permits, operating licenses, and combined licenses for iPWRs. This framework is established under 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," and 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." The security and MC&A requirements in 10 CFR Part 73

and 10 CFR Part 74, respectively, for nuclear power reactors are incorporated by reference under Parts 50 and 52. These requirements are applicable to any nuclear power reactor (i.e., utilization facility) regardless of the size or type of reactor technology (i.e., large LWRs, iPWRs, or non-LWRs).

On March 27, 2009, the NRC completed a rulemaking that revised portions of 10 CFR Part 73 to include requirements that establish the current security regulatory framework for nuclear power reactors. The revised rule incorporated the security requirements imposed on certain licensees by NRC orders after the events of September 11, 2001, and additional requirements for the protection of digital systems and networks for the operations of nuclear power reactors in the current threat environment (74 FR 13970-13991). The revisions did not amend procedures and standards governing alternative measures and exemptions in 10 CFR Part 73.

An applicant requesting a license to operate iPWRs must meet all applicable MC&A requirements in 10 CFR Part 74 for nuclear power reactors, as well as the security requirements for protecting nuclear power reactors against the design basis threat of radiological sabotage set forth in 10 CFR Part 73. The staff has determined that the current security and MC&A requirements are sufficiently comprehensive and robust, and therefore adequate for the protection of iPWRs in the current threat environment. The provisions for alternative measures, exemptions, and license conditions provide flexibility for designers and applicants to meet security requirements and apply methods or approaches to achieve the objective of high assurance that activities involving SNM are not inimical to the common defense and security and do not constitute an unreasonable risk to public health and safety. The staff has determined that the existing security framework is adequate for certifying, approving, and licensing iPWRs. The regulatory provisions for alternative measures, exemptions, and license conditions are further discussed below.

The staff did not identify any gaps in the current security regulatory framework for certifications, approvals, and licensing of iPWRs. The staff did not identify any potential policy issues.

#### *Manufacturing of iPWR Fuel*

The current regulatory framework for the issuance of material licenses for the manufacturing of iPWR fuel is established under 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material." The security and MC&A requirements for the manufacturing, receipt, and storage of fresh iPWR fuel in 10 CFR Part 73 and 10 CFR Part 74 are incorporated by reference under 10 CFR Part 70. These requirements address the possession of, use of, and activities involving SNM that range from low and moderate strategic significance (Categories II and III) to formula quantities of strategic significance (Category I). The basis for the security and MC&A requirements is a material categorization scheme that establishes the three risk categories, which depend on the types, form, enrichment (i.e., isotopic composition), and quantity of uranium and plutonium that could be used to improvise a nuclear device. The current security regulatory framework includes requirements imposed by NRC orders to enhance security at fuel manufacturing facilities after the events of September 11, 2001. The Commission has approved rulemaking actions to make the requirements, currently imposed by orders, generically applicable to the domestic licensing of SNM.

The iPWR technologies use reactor fuels that are within the standard enrichment of large LWR fuel (i.e., less than 5 percent enrichment, Category III SNM). The security and MC&A requirements for a material license to manufacture iPWR fuel are therefore adequate to address the risks associated with the possession of, use of, and activities involving Category III SNM.

The staff did not identify any gaps in the security regulatory framework for the possession of, use of, and activities involving Category III SNM for manufacturing reactor fuel for iPWRs; the SNM and activities for iPWRs are similar to those involved in the manufacturing of large LWR fuel. The staff did not identify any potential policy issues.

#### *Transportation of Fresh and Irradiated iPWR Fuel*

The current regulatory framework for the licensing of transportation activities involving SNM associated with iPWRs is established under 10 CFR Part 71, "Packaging and Transportation of Radioactive Material." The applicable security requirements in 10 CFR Part 73 are incorporated by reference under 10 CFR Part 71. The MC&A requirements of 10 CFR 74.15 for transportation are referenced in part under 10 CFR 73.67. Transportation of SNM and irradiated nuclear fuel must meet NRC requirements and the U.S. Department of Transportation (DOT) requirements under 49 CFR Parts 107, 171 through 180, and 390 through 397, which are also incorporated by reference under 10 CFR Part 71. Carriers are granted a general license under 10 CFR Part 70 for assurance of security of transient shipments on SNM and irradiated fuel. The security regulatory framework includes requirements imposed by NRC orders to enhance security after the events of September 11, 2001. The Commission has approved rulemaking actions to make these requirements, currently imposed by orders, generically applicable for the transportation of radiological material.

The security and MC&A requirements in 10 CFR Part 73 and 10 CFR Part 74, along with supplemental security requirements imposed by NRC orders and DOT's security requirements, address the risks associated with the transportation of fresh and irradiated nuclear fuel in the current threat environment. The transportation of fresh fuel (i.e., Category III SNM) and irradiated nuclear fuel for iPWRs is not expected to differ from the transportation of fuel for current large LWRs, and thus the current security regulatory framework is therefore adequate for the licensing of transportation activities. Any new packaging designs specifically for the transportation of fresh or irradiated fuel for iPWRs must meet the requirements set forth in 10 CFR Part 71 and shippers must apply the security and MC&A requirements for transportation in accordance with 10 CFR Part 73 and 10 CFR Part 74.

The staff did not identify any gaps in the security regulatory framework for licensing activities related to the transportation of fresh fuel and irradiated nuclear fuel for iPWRs under 10 CFR Part 71. The staff did not identify any potential policy issues.

#### *Independent Storage of iPWR Irradiated Nuclear Fuel*

The current regulatory in 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste," can be used to issue licenses to receive, transfer, and possess iPWR power reactor irradiated (spent) nuclear fuel. To ensure the secure interim storage of irradiated nuclear fuel and SNM, the applicable security requirements in 10 CFR Part 73 are incorporated by reference in 10 CFR Part 72. The MC&A requirements are currently established in 10 CFR Part 72. The

security regulatory framework also includes the requirements imposed by NRC orders to enhance the security of independent spent fuel storage installations (ISFSIs) after the events of September 11, 2001. The Commission has approved rulemaking actions to make these requirements, currently imposed by orders, generically applicable for the licensing of ISFSIs as well as consolidate the MC&A requirements into 10 CFR Part 74 and resolve any policy issues (i.e., proposed dose- or design-basis threat-based approaches for security requirements).

The iPWR designs will use reactor fuel that is similar to standard large LWR fuel assemblies (i.e., less than 5 percent enrichment, 17x17 assemblies), with less than the standard length. The staff anticipates that designers will apply current knowledge and experiences from approved, certified, or licensed ISFSIs for the storage of iPWR irradiated nuclear fuel. The licensing requirements for applying a current certified or approved design or a new design for the storage of iPWR irradiated nuclear fuel will be in accordance with requirements set forth in 10 CFR Part 72. The security and MC&A requirements currently applied for the licensing and operation of ISFSIs for LWR irradiated nuclear fuel are therefore adequate to address the licensing of ISFSIs for the storage of iPWR irradiated nuclear fuel.

The staff did not identify any gaps in the security regulatory framework for the licensing of the interim storage of iPWR irradiated nuclear fuel or for the licensing of the receipt, transfer, or possession of power reactor irradiated nuclear fuel related to iPWRs under 10 CFR Part 72. The staff did not identify any potential policy issues.

#### Staff's Assessment of the Security Regulatory Framework for Non-LWRs

Because of the limited information available on non-LWR SMR technologies, the staff could only make a limited assessment as to whether the current security and MC&A requirements are suitable to address the risks associated with the unique characteristics and activities involving SNM for the operations of non-LWRs. As specific designs mature and details are made available, the staff will assess the security and MC&A requirements for proposed non-LWR technologies to identify any regulatory gaps and potential technical or policy issues. The discussions below summarize the staff's limited assessment of the security regulatory framework for licensing activities for non-LWRs.

#### *Nuclear Power Reactors*

The staff's assessment of the suitability of the security framework for certifying, approving, and licensing non-LWRs, is based on the limited information currently available for these designs, which includes certain characteristics unique to non-LWR technologies. Some of the shared characteristics of proposed non-LWRs that are different from iPWR or large LWR technologies include (1) reactor fuel with higher uranium enrichment (i.e., between 5 percent and nearly 20 percent), (2) significantly smaller physical size and reduced weight of fuel assemblies, (3) a different material form or isotopic composition of enriched SNM, and (4) a significantly smaller quantity or inventory of SNM.

Although the overall security and MC&A requirements for nuclear power reactors are comprehensive and robust for the current threat environment (i.e., bounding requirements to protect against a design-basis threat for radiological sabotage, defense in depth, and a comprehensive security program) the unique characteristics of non-LWRs stated above will need to be considered in future staff assessments as more design information becomes

available. For example, the current MC&A method (i.e., accounting of items) that is adequate for large LWR or iPWR technologies may need to be enhanced with other methods or approaches currently described in 10 CFR Part 74 to appropriately address MC&A for the unique characteristics of reactor fuels associated with some non-LWR technologies. In addition, the significantly smaller physical size and reduced weight and SNM inventory of fuel assemblies, along with higher uranium enrichment, may require the reconsideration of the risks for theft of SNM. As more detailed information becomes available on specific non-LWR designs, the staff will fully characterize the impact of the unique characteristics of these technologies on the adequacy of current security and MC&A requirements, and identify any regulatory gaps and potential technical or policy issues that arise.

#### *Manufacturing of Non-LWR Fuel*

The manufacturing of non-LWR fuel will involve higher uranium enrichment and types and forms of SNM that are different from large LWR or iPWR fuel. Examples of non-LWR fuel include fuel compacts or kernels composed of low-enriched (10–19.9 percent) uranium oxide with fission-retaining tristructural isotropic fuel particle coating, uranium nitrate with less than 20 percent enrichment, and uranium-plutonium-zirconium alloy with 2 percent plutonium or 11.5 percent plutonium. A common theme among proposed non-LWR fuel designs is that the uranium enrichment will be less than 20 percent, which is within the upper boundary of enrichment for Category III SNM. The potential applicants for material licenses to non-LWR fuels would have to meet the security and MC&A requirements applicable for Category III SNM or Category II SNM (i.e., where SNM quantities are greater than 10 kilograms with enrichment between 10 and 20 percent). The security and MC&A requirements for a material license to manufacture non-LWR fuel are adequately captured in 10 CFR Part 73 and 10 CFR Part 74 to address the risks associated with the possession of, use of, and activities involving Category III SNM. Should the fuel manufacturing activities for non-LWRs involve Category I or II SNM, the appropriate security and MC&A requirements in 10 CFR Part 73 and 10 CFR Part 74 would be applied for licensing.

#### *Transportation of Fresh and Irradiated Non-LWR Fuel*

For transportation activities related to fuels for non-LWR that will involve higher than the typical uranium enrichment for large LWRs but that are still within the definition of Category III SNM (i.e., less than 20 percent enrichment), the same security and MC&A requirements for the current licensing of transportation activities for large LWR fresh and irradiated fuels (in 10 CFR Part 73 and 10 CFR Part 74) will be applied for licensing. However, if the transportation activities related to non-LWRs involve SNM of quantities, enrichment, or material that are not within the definition of Category III SNM, the applicable security and MC&A requirements for Category I or II SNM in 10 CFR Part 73 and 10 CFR Part 74 will be applied for licensing. As stated previously, any new transportation packaging specifically for the transportation of fresh or irradiated fuel for non-LWRs must meet the requirements set forth in 10 CFR Part 71. The transportation of fresh fuel (i.e., Category III SNM) and irradiated nuclear fuel for non-LWRs is adequately addressed within the current security regulatory framework.

#### *Independent Storage of Non-LWR Irradiated Nuclear Fuel*

Given the limited information currently available on non-LWRs, the staff can make only a limited assessment as to whether the current security and MC&A requirements are commensurate with

the risks associated with the potential scaling of ISFSIs to the significantly smaller size and different material form for non-LWR fuels. If the storage systems are significantly smaller in size, the NRC may need to consider risks not previously thought credible (e.g., based on portability, self-protection, and the potential for theft). Currently, the designers and applicants are focusing on establishing the specifics of the design and operations of SMRs, and details are not yet available for the NRC to assess the plans or proposed designs for the interim storage of irradiated nuclear fuel for non-LWRs.

### Regulatory Provisions for Exemptions, Alternative Measures, and License Conditions

The current regulations allow SMR designers and potential applicants to propose alternative methods or approaches to meet the performance-based and prescriptive security and MC&A requirements. These alternative methods or approaches may include increased reliance on engineered systems or reduced reliance on operational requirements and staffing, to meet the intent of the regulatory requirements. The following summarizes the provisions that are a part of the current security regulatory framework for licensing.

#### *Alternative Measures*

The regulation in 10 CFR 73.55(r) provides for alternative measures that applicants may propose to offer equivalent protection and meet the same high-assurance performance objectives for requirements specified in 10 CFR 73.55(b). The approval of alternative measures under the provisions of 10 CFR 73.55(r) does not constitute an exemption (i.e., dispensation from compliance with applicable requirements) and does not refer to or incorporate the standards for the granting of exemptions. This specific provision provides flexibility for SMR designers and potential applicants to apply alternative methods or approaches that are equivalent in performance and meet the intended functions of the performance-based and prescriptive security and MC&A requirements, based on the unique characteristics of a particular SMR design.

#### *License Conditions*

In addition to exemptions and alternative measures, the NRC regulations also establish license conditions that applicants may propose voluntarily or that the Commission may impose on its own initiative to address specific unique characteristics of the design and operation of a particular SMR technology or related activities to ensure public health and safety, security, and protection of the environment. Applicants may voluntarily propose license conditions that address the specific and unique characteristics of the operations of SMRs so long as the conditions are also deemed appropriate for adequate protection.

#### *Exemptions*

Provisions within NRC regulations (i.e., 10 CFR Parts 50, 52, 70, 71, and 72) permit applicants to submit requests for exemptions from regulatory requirements to the Commission for consideration. Those exemption requests will have to be considered by the staff on a case-by-case basis. The Commission may grant the requests for exemption if it determines that they are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest.

CONCLUSIONS:

The staff's assessment determined that the current security regulatory framework is adequate to certify, approve, and license iPWRs, the manufacturing of iPWR fuel, the transportation of SNM and irradiated iPWR nuclear fuel, and the interim storage of irradiated nuclear fuel for proposed iPWRs and related activities under 10 CFR Parts 50, 52, 70, 71, and 72, respectively. The staff's assessment also determined that the security and MC&A requirements established in 10 CFR Part 73 and 10 CFR Part 74, respectively, are comprehensive and sufficiently robust, and therefore adequate for iPWRs.

In the case of non-LWRs, the staff's assessment of the suitability of the current security regulatory framework was based on the limited information available on the reactor and fuel designs and operations of these technologies as described earlier in this paper. Based on this information, the staff is not currently aware of any area in which the existing security regulatory framework would not apply to non-LWRs. As specific designs mature and details are made available, the staff will continue to assess the suitability and adequacy of the security and MC&A requirements for proposed non-LWRs technologies, in order to identify any regulatory gaps and potential technical or policy issues pertaining to certifying, approving, or licensing non-LWR technologies.

COORDINATION:

This paper has been reviewed by the Office of the General Counsel, which has no legal objection.

*/RA/*

James T. Wiggins, Director  
Office of Nuclear Security and  
Incident Response

*/RA/*

Michael R. Johnson, Director  
Office of New Reactors