

<b>Issues with Ongoing NRC Activities for non-LWRs</b>		
Issue	Description	Plans & Status
License for Prototype Reactors	<p><a href="#">10 CFR 50.43(e)</a> requires applicants for standardized non-LWR reactor designs to demonstrate performance of safety features through a combination of analysis, testing, and experience. The rule allows the use of a prototype plant to fulfil the testing requirements. The NRC may impose additional requirements on siting, safety features, or operational conditions for the prototype plant during the testing period. The provisions in NRC regulations for use of a prototype plant have not been exercised and therefore questions have been raised regarding its use.</p>	<p>The NRC staff has prepared a white paper on the requirements in 10 CFR 50.43(e) for demonstrating the performance of safety features, and specifically on the use of a prototype plant to gather data and support the safety case for subsequent standardized units. The paper builds from previous guidance provided in SECY-91-074, "Prototype Decisions for Advanced Reactor Designs" (ADAMS Accession No. ML003707900). The staff plans to make the white paper publically available in ADAMS and discuss it in the routine public meetings being held periodically between the NRC staff and stakeholders interested in the development and licensing of non-LWR technologies.</p>
Appropriate Source Term, Dose Calculations, and Siting	<p>Non-LWR technologies may have fuel forms, coolants, power levels, and other design features that vary significantly from the LWRs assumed in the formation of current NRC requirements and guidance related to source terms, dose calculations, and related siting decisions. A discussion of the issues is provided in SECY-16-0012, "Accident Source Terms and Siting for Small Modular Reactors and Non-Light Water Reactors" (ADAMS Accession No. ML15309A319). Additional information related to the NRC staff's feedback on the use of mechanistic source term analyses for the Next Generation Nuclear Plant (NGNP) Project issued in July 2014 is available under ADAMS Accession No. ML14174A845. This issue remains a key technical and policy issue given its importance in addressing potential malfunctions and accidents and</p>	<p>Parts of this topic are being discussed within the NRC staff's interactions with the Licensing Modernization Project (LMP) and related white papers building from the NGNP Project. This issue is also a significant part of discussions related to potential changes to emergency planning requirements and questions related to the siting of advanced reactors, which is the subject of a pending Federal Register Notice on the issue of determining appropriate siting in proximity to population centers. In addition, the development and validation of source term and dose calculations is a key topic in technology- and design-specific interactions between the staff and non-LWR developers. More detailed plans to address these issues for non-LWRs and/or specific technologies will be developed based on discussions with the LMP, developers, and other stakeholders during periodic public meetings.</p>

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	the related regulatory decisions related to design, siting, and plant operations.	
Offsite Emergency Planning (EP) Requirements	Non-LWRs differ significantly from the LWRs assumed in the formation of current NRC requirements and guidance related to emergency planning (see related issue on source terms, dose calculations, and related siting decisions). Potential releases from non-LWRs may differ in both magnitude and timing in comparison to current plants. This issue remains a key technical and policy issue given its importance in addressing potential malfunctions and accidents and the related regulatory decisions related to design, siting, and plant operations.	The NRC staff has prepared a draft regulatory basis document to support the possible development of a proposed rule with a performance-based approach to emergency planning. The concept would enable light-water small modular reactors (SMRs) and non-LWRs to assess appropriate offsite emergency planning requirements based on a comparison of calculated offsite dose to established protective action guidelines. The draft regulatory basis is available on <a href="http://www.regulations.gov">www.regulations.gov</a> under docket number <a href="https://www.regulations.gov/docket/NRC-2015-0225">NRC-2015-0225</a> . This policy issue will be managed primarily through the rulemaking process and the related technical and policy issues associated with source term, licensing basis events, and other topics discussed during periodic public meetings.
Insurance and Liability	The Price-Anderson Act and related NRC regulations place requirements upon and define protections for the operators of nuclear power plants and their suppliers in the event of a reactor accident. Non-LWRs differ significantly from the LWRs that make up the current operating fleet and the associated insurance pools. Questions have therefore been raised on whether the existing requirements and protections are appropriate for non-LWR technologies and designs. In a related matter, the NRC is required to submit to the Congress by December 31, 2021, detailed reports concerning the need for continuation or modification of the provisions of the Act, taking into account the condition of the nuclear industry, availability of private insurance, and the state of knowledge concerning nuclear safety at that time, among other relevant	The NRC staff is planning to address non-LWR technologies and designs within the required report to Congress in 2021. The plan to address non-LWRs will likely require assessments of safety features and possible accident consequences for various technologies, designs, and power levels. The staff plans to include discussions of this topic in future periodic stakeholder meetings (tentative Fall 2017) and subsequently prepare input for a report to the Commission.

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	<p>factors, and shall include recommendations as to the repeal or modification of any of the provisions of this section.</p>	
<p>Use of Probabilistic Risk Assessment (PRA) in the Licensing Process</p>	<p>PRA has been proven to be a valuable tool in the licensing and regulation of operating reactors and is expected to play an important role in the design and licensing of non-LWRs. The NRC staff issued guidance in the form of revisions to the Standard Review Plan to help increase the value of PRA in defining the scope and depth of reviews for light-water SMRs (ADAMS Accession No. ML13207A315). The requirements for and use of PRAs for non-LWRs remain a technical and potential policy issue.</p>	<p>These technical and potential policy issues will be managed primarily through the staff's initial interactions with the LMP and the subsequent development of a consolidated guidance document by the Nuclear Energy Institute (NEI). The LMP provided a draft paper on LBE selection (<a href="#">ML17104A254</a>) and the staff is preparing comments and questions related to that paper. Subsequent white papers are expected on topics such as the use of PRA and approaches to DiD. The NRC staff is working with LMP, NEI, and other stakeholders on these topics to resolve the technical and potential policy issues and these topics are discussed during periodic public meetings. The staff expects to work with LMP and NEI to reach agreement on a regulatory engagement plan related to these topics.</p>
<p>Implementation of Defense-In-Depth (DiD) Philosophy for Advanced Reactors</p>	<p>DiD is a key part of the NRC's regulatory philosophy and is expected to play an important role in the design and licensing of non-LWRs. The NRC staff issued <a href="#">NUREG/KM-009</a>, "Historical Review and Observations of Defense-in-Depth" in April 2016. The Commission decided in its Staff Requirements Memorandum (SRM) for SECY-15-0168, "Recommendations on Issues Related to Implementation of a Risk Management Regulatory Framework" (ADAMS Accession No. ML16069A370) to refrain from developing a formal agencywide definition and criteria for determining the adequacy of defense in depth. The role of DiD and how it is incorporated into the design and licensing of non-LWRs remains a technical and potential policy issue.</p>	<p>Related issues on possible surrogate measures for the NRC's quantitative health objectives (QHOs) and the treatment of multi-module risks are expected to be addressed within these activities. The NRC staff can treat these as individual policy issues if it would help with their resolution or support making progress on other issues. The staff notes that resolution of some licensing issues and identification or applicable risk metrics could also support preparation of guidance in other areas (e.g., maintenance rule).</p>
<p>Licensing Basis Event (LBE) Selection</p>	<p>The identification and analysis of LBEs is a key aspect of designing and licensing nuclear power plants. The terminology and relationships between different event categories and other parts of the design, licensing, and operation of LWRs has</p>	

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	<p>evolved over the decades. Approaches for non-LWRs have been proposed in specific pre-application activities for designs and as part of the NGNP program. The role of selection and analysis of LBEs and how they are incorporated into the design and licensing of non-LWRs remains a technical and potential policy issue.</p>	
<p>Security and Safeguards Requirements for SMRs</p>	<p>Non-LWRs differ significantly from the LWRs assumed in the formation of current NRC requirements and guidance related to physical security and safeguards (see related issue on source terms, dose calculations, and related siting decisions). Potential releases from non-LWRs may differ in both magnitude and timing in comparison to current plants. NEI has suggested that potential uncertainties related to physical security requirements for light-water SMRs and non-LWRs be addressed by rulemaking similar to the staff's actions for emergency planning. NEI has provided a possible approach in the white paper "Proposed Physical Security Requirements for Advanced Reactor Technologies" (ADAMS Accession No. ML17026A474). This issue remains a key technical and potential policy issue for non-LWRs.</p>	<p>The NRC staff issued for public comment non-LWR security design considerations (see regulations.gov docket number <a href="#">NRC-2017-0073</a>). The staff is also evaluating the approach identified in the NEI white paper on security for advanced reactors. This topic was discussed at a periodic public meeting during which the NRC staff committed to provide comments and questions to NEI by early July 2017. Following a possible iteration on the NEI white paper, the NRC staff will evaluate possible approaches, including a possible rulemaking, and make recommendations to the Commission.</p>
<p>Functional Containment Performance Requirements</p>	<p>Non-LWR technologies and designs include different fuel forms and different approaches to critical safety functions than those used for LWRs. These differences include what barriers are included in the design for retaining radioactive materials within the plant. A historical issue for high-temperature-gas reactors (HTGRs) involves defining appropriate requirements, if any, on an essentially leak tight physical structure (e.g., containment building) during and after a breach in the primary coolant system.</p>	<p>This issue was identified during periodic public meetings as being a high priority item for non-LWR developers. The topic was discussed during a periodic public meeting in May 2017. The NRC staff is developing a white paper for discussion at future meetings (tentative Fall 2017) and expects to subsequently provide recommendations to the Commission to resolve issues related to functional containment and related performance requirements.</p>

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	<p>The issue was partially resolved with the Commission's SRM for SECY-93-092 and SECY-03-047 but performance requirements need to be developed. In addition, non-LWR technologies such as molten salt reactors (MSRs) may include similar issues for functional containment performance requirements since they may involve significantly different barriers to fission product release.</p>	
Fuel qualification	<p>Technical and potential policy issues related to fuel qualification vary by fuel type and reactor technology. The Department of Energy (DOE) and Idaho National Laboratory (INL) have been performing irradiation and related fuel qualification activities for TRISO fuel and plans to submit a topical report for NRC review and approval. DOE performed various tests during the 1980s on metal fuel expected to be used in liquid-metal cooled fast reactors. The results from those tests are included in legacy data being reviewed by DOE, Argonne National Laboratory (ANL), and non-LWR developers. Possible approaches to the qualification of fuel for MSRs is being explored by DOE and Oak Ridge National Laboratory (ORNL). The use of data from international activities is sometimes raised as a possible technical or policy issue.</p>	<p>The NRC is assessing potential insights related to the general topic of fuel qualification but is largely addressing this as a technology-specific technical issue. The staff is having discussions with DOE, national laboratories, technology-groups, and individual developers and formulating plans to address technical issues and to identify, and as needed resolve, potential policy issues.</p>
Materials qualification	<p>Technical and potential policy issues related to the qualification of non-fuel materials vary by reactor technology. Material qualification programs have been supported by DOE, national laboratories, reactor developers, Electric Power Research Institute (EPRI), and within programs sponsored in other countries. Materials qualification programs are also related to development of consensus codes and standards being developed by the American Society</p>	<p>The NRC staff is primarily addressing materials qualification issues via participation in consensus codes and standards development by ASME and other SDOs. The staff is having discussions with DOE, national laboratories, technology-groups, and individual developers and formulating plans to address technical issues and to identify, and as needed resolve, potential policy issues.</p>

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	of Mechanical Engineers (ASME) and other standards developing organizations (SDOs).	
Increased enrichments	Many non-LWR technologies and specific designs plan to use low-enriched uranium with enrichments higher than currently operating LWRs. The use of enrichments greater than 5% U-235 but less than 20 % U-235 has been identified as a potential issue by NEI, Nuclear Infrastructure Council (NIC), and other stakeholders. The issue relates to the need to coordinate reactor development with fuel cycle issues to ensure a source of fuel is available when needed. Possible regulatory issues associated with licensing of fuel cycle facilities, transportation packages, and reactor facilities is also raised as a concern.	The NRC staff has not identified any significant policy issues related to higher enrichments but acknowledges the challenges associated with coordinating reactor design and the related fuel cycle infrastructure. The staff is currently waiting for white paper(s) being developed by NEI and NIC.
<b>Open Issues for non-LWRs but no current activities</b>		
Annual Fees	The NRC issued in May 2016 a final rule revising 10 CFR Part 171 (Annual fees) to allow a bundled unit concept for SMRs. The definition of SMR for the purposes of calculating fees is limited to the class of LWRs having a power rating less than 1,000 MWt per module.	The NRC staff expects that non-LWR developers or potential owner/operators will at some point identify this as a policy issue. Many non-LWR designs have power ratings less than 1,000MWt and support bundling multiple modules per plant. The NRC acknowledged in the final rule that the agency may consider the inclusion of non-light water SMRs in a future rulemaking once the agency has an increased understanding of the designs.
Manufacturing License Requirements	The potential use of the provisions of 10 CFR Part 52 related to manufacturing licenses has been included as a potential issue in assessments such as SECY-10-0034, "Potential Policy, Licensing, and Key Technical Issues for Small Modular Reactor Designs." The staff states in SECY-14-0095, "Status of Office of New Reactors Readiness to Review Small Modular Reactor Applications," that no interest in obtaining a manufacturing license from near-term	The NRC staff is aware of questions and possible interest in using the manufacturing license provisions for some non-LWR designs. The staff expects that non-LWR developers will at some point express an interest in at least exploring the options of using this approach to deploying advanced reactor technologies.

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	SMR applicants was expressed and the issue was effectively closed for LWR SMRs.	
Industrial Facilities Using Nuclear-Generated Process Heat	A possible use of non-LWRs is for process heat applications that could take advantage of the higher coolant temperatures associated with these technologies. The NGNP Project developed papers related to the use of an HGTR for hydrogen generation and other process heat applications. The staff states in SECY-11-0112, "Staff Assessment of Selected Small Modular Reactor Issues Identified in SECY-10-0034," that the issue was effectively closed due to potential applicants not expressing an intent to submit applications including a supply of process heat to nearby industrial facilities.	The NRC staff is aware of questions and possible interest in developing non-LWR deployment strategies that include the possible supply of process heat to industrial facilities. The staff expects that non-LWR developers or potential owner/operators will at some point express an interest in at least exploring the possible technical and regulatory issues associated with process heat applications. This issue may also be tied to siting and emergency planning issues.
Key Component and System Design Issues	SECY-10-0034 included item 3.4, "Key Component and System Design Issues for SMRs," as a potential policy, licensing, and key technical issue facing advanced reactor developers. This issue includes consideration of ongoing activities such as accident (LBE) selection, safety classification of structures, systems, and components (SSCs), and functional containment capabilities. Other possible topics include redundancy requirements for passive safety systems, expected duration of system functionality following a loss of power, and consideration of additional mitigation capabilities.	Some issues associated with the design of SSCs are being addressed within the planned activities of the LMP and subsequent NEI consolidated guidance document for a licensing framework for non-LWRs. To the degree that those efforts include the identification and resolution of broader design issues for SSCs, this item might be considered captured by those efforts. The staff plans to keep this item open for non-LWRs pending a future assessment to ensure generic design issues have been addressed.
Fuel cycle facilities (front end)	The use of higher enrichments and different fuel forms in non-LWR technologies as compared to LWRs raises issues and needed coordination of reactor design and developing fuel cycle facilities to provide needed services. NEI and NIC have proposed to prepare white papers on enrichment issues and possibly addressing technical and regulatory issues for fuel cycle facilities.	The NRC staff generally deferred significant activities related to fuel cycle facilities supporting non-LWR deployment to the mid-term implementation action plans (IAPs). The staff is prepared to interact with stakeholders on matters related to requirements for or licensing of fuel cycle facilities and may consider revising action plans and priorities as needed for a specific application for a license, certification, or approval.

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<p>Waste Issues (back end)</p>	<p>The possible deployment of non-LWRs will, at some point, require the development of plans, technologies, and strategies for the handling of high-level radioactive wastes. Some non-LWR technologies include reprocessing or other systems related to the handling and separation of radioactive materials.</p>	<p>The NRC staff generally deferred significant activities related to waste issues supporting non-LWR deployment to the mid-term implementation action plans (IAPs). The staff is prepared to interact with stakeholders on matters related to requirements for or licensing of reprocessing facilities, separation systems, and waste storage systems. The staff may consider revising action plans and priorities as needed for a specific application for a license, certification, or approval.</p>
<p>Transportation</p>	<p>The possible deployment of non-LWRs will, at some point, require the development of plans, technologies, and strategies for transporting fresh fuel at the higher end of the range for low-enriched uranium and for transporting radioactive wastes.</p>	<p>The NRC staff generally deferred significant activities related to transportation of fuel or waste supporting non-LWR deployment to the mid-term implementation action plans (IAPs). The staff is prepared to interact with stakeholders on matters related to requirements for or licensing of transportation packages. The staff may consider revising action plans and priorities as needed for a specific application for a license, certification, or approval.</p>
<p>Rulemaking for Risk-Informed, Performance-Based, Technology Inclusive Regulatory Framework</p>	<p>The possible benefits of a new regulation (often referred to as Part 53) for non-LWR technologies has been the subject of discussion for many years.</p>	<p>The staff has included in the IAPs an ongoing assessment of the possible need for a rulemaking throughout the near-term activities. A decision point is defined as part of the mid-term activities and a rulemaking, if pursued, is described within the long term IAPs. The staff will accelerate the process if some urgency is identified by stakeholders or if directed to do so by the Commission in response to legislation or other factors.</p>

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<b>I Issues with no current plans to undertake activities (resolved or need input from stakeholders)</b>		
License Structure for Multi-Module Facilities	The NRC staff assessed possible format for licenses in SECY-11-0079, "License Structure for Multi-Module Facilities Related to Small Modular Nuclear Power Reactors." The staff found that the best alternative was to issue a license for each reactor module and committed to provide a specific recommendation to the Commission. The staff stated in SECY-14-0095 that the first SMR application would be used to gain practical insights.	The structure of licenses for multi-module SMRs is not dependent on the reactor technology and so the staff plans no additional activities in this area unless stakeholders identify an issue.
Operator Staffing for Small or Multi-Module Facilities	The staff provided the Commission with a proposed approach to resolve the issue of appropriate staffing for SMRs in SECY-11-0098, "Operator Staff for Small or Multi-Module Nuclear Power Plant Facilities." The staff established guidance for the review of requests for exemptions from the requirements defined in NRC regulations. An update provided in SECY-14-0095 mentions the possible longer term solution of undertaking a rulemaking.	The general approach to determining the appropriate staffing levels for multi-module SMRs is not dependent on the reactor technology and so the staff plans no additional activities in this area unless stakeholders identify an issue.
Operational Programs for Small or Multi-Module Facilities	The staff provided the Commission with an assessment of the handling of operational programs for SMRs in SECY-11-0112. The staff found that operational programs for LWR SMRs could be defined and implemented using the flexibility provided in existing policies and guidance. The staff did note that non-LWR technologies could require new and innovative operational programs but deferred investigating the matter pending discussions with developers or applicants. The staff reiterated this position in SECY-14-0095.	While the Commission would need to be informed of new operational programs developed for non-LWRs, the staff has not identified significant policy issues with identifying or implementing such programs. If work in other areas identifies the need for an operational program that raises policy issues, it can be addressed as part of resolving another issue or will be added to the list of policy issues needing Commission decisions.

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<p>Installation of Reactor Modules During Operation of Multi-Module Facilities</p>	<p>The staff provided the Commission with an assessment of installing reactor modules during operation of multi-module facilities in SECY-11-0112. The staff found that the process may involve technical challenges but could be addressed using the flexibility provided in existing regulations and guidance. The staff reiterated this position in SECY-14-0095.</p>	<p>Coordinating site activities to install a module in a multi-module facility is not dependent on the reactor technology and so the staff plans no additional activities in this area unless stakeholders identify an issue.</p>
<p>Decommissioning Funding Assurance</p>	<p>The staff provided the Commission with an assessment of decommissioning issues for SMRs in SECY-11-0181, "Decommissioning Funding Assurance for Small Modular Nuclear Reactors." The staff noted that future licensees could, as necessary, address this issue by requesting exemptions from NRC regulations. The staff noted that experience gained through the exemption process could help with a longer-term approach of revising regulations to specifically address SMRs. The staff reiterated this position in SECY-14-0095.</p>	<p>The staff's plan continues to be to wait to gain lessons from exemption requests before deciding upon any rulemaking activity. The staff does not expect to revisit this issue in the near term unless stakeholders identify an issue.</p>
<p>Aircraft impact assessments</p>	<p>The NRC issued 10 CFR 50.150, "Aircraft impact assessment," and related guidance in 2009. The rule is applicable to any reactor technology for which a license, certification, or approval is sought under Parts 50 or 52. The staff states in SECY-11-0112 and SECY-14-0095 that the issue can be addressed with existing guidance and without rulemaking or policy changes.</p> <p>In previous SECY papers, the staff stated that "for non-LWR designs, 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,</p>	<p>The staff does not expect to revisit this issue in the near term unless stakeholders identify this as a higher priority issue.</p>

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	<p>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.”</p>	
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