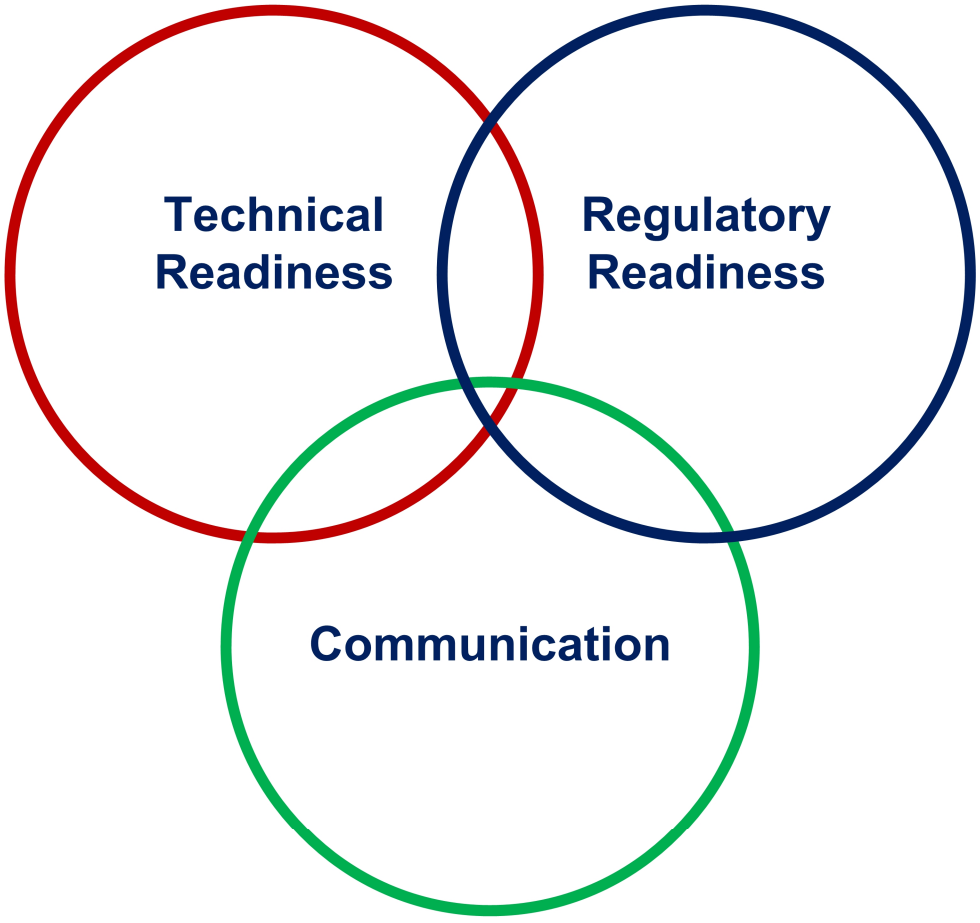
ML17165A069

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

NRC Non-Light Water Reactor Near-Term Implementation Action Plans



July 2017

EXECUTIVE SUMMARY

As the U.S. Nuclear Regulatory Commission (NRC) prepares to review and regulate a new generation of non-light water reactors (non-LWRs), the NRC developed a vision and strategy to assure NRC readiness to efficiently and effectively conduct its mission for these technologies, including fuel cycles and waste forms. "NRC Vision and Strategy: Safely Achieving Effective and Efficient Non-Light Water Mission Readiness" (non-LWR Vision and Strategy Document), published in December 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16356A670), is the overarching document that describes the objectives, strategies, and contributing activities necessary to achieve non-LWR mission readiness, and it provides the connection to the Implementation Action Plan (IAP) documents.

The project has been organized into two phases. Phase 1 was the conceptual planning phase used to lay out the vison and strategy, gather public feedback, and finalize the NRC's approach. Phase 2 includes detailed work planning efforts and task execution. Phase 2 also includes opportunities for public feedback. The NRC completed Phase 1 in December 2016 with issuance of the final non-LWR Vision and Strategy Document. The planning process for Phase 2 is broken down into three periods: near-term (0-5 years), mid-term (5-10 years), and long-term (greater than 10 years). The NRC recognizes that non-LWR developers may wish to commence pre-application activities or submit applications for review in the near-term. In these cases, the NRC will work with developers on design-specific licensing project plans and the NRC may prioritize and accelerate specific readiness activities, as needed, to support these reviews. The NRC will also continue to seek information from prospective applicants to ensure that technology-inclusive readiness activities will be supportive of the plans of near-term applicants.

The near-term actions identified in the non-LWR Vision and Strategy Document have been further developed using the IAP format and are summarized in this report. Mid-term and long-term plans have also been developed (ADAMS Accession No. ML17164A173). The purpose of the IAPs is to identify specific, actionable tasks that, once completed, will lead to accomplishment of the NRC's non-LWR Vision and Strategy objectives: enhance technical readiness, optimize regulatory readiness, and optimize communications.

The NRC also prepared an accompanying document (i.e., Volume 2 of the near-term IAPs), which provides more information for each strategy and extensive background information, as needed, to assist staff assigned to execute these plans. This document was made available in support of public stakeholder meetings (ADAMS Accession No. ML16334A495). The NRC has considered this stakeholder feedback in this revision to the near-term IAPs and will continue to consider stakeholder feedback in executing the IAPs.

There are six individual strategies addressed in the near-term IAPs. They are:

1. Acquire/develop sufficient knowledge, technical skills, and capacity to perform non-LWR regulatory activities

2. Acquire/develop sufficient computer codes and tools to perform non-LWR regulatory reviews

3. Develop guidance for a flexible non-LWR regulatory review process within the bounds of existing regulations, including the use of conceptual design reviews and staged-review processes

4. Facilitate industry codes and standards needed to support the non-LWR life cycle (including fuels and materials)

5. Identify and resolve technology-inclusive (not specific to a particular non-LWR design or category) policy issues that impact regulatory reviews, siting, permitting, and/or licensing of non-LWR nuclear power plants

6. Develop and implement a structured, integrated strategy to communicate with internal and external stakeholders having interests in non-LWR technologies

A summary list of the near-term strategies and contributing activities is provided in Section 4.0.

Note that the strategies and contributing activities described in this report are assumed not to be constrained by budget or by other agency mission priorities. The purpose of making this foundational assumption is to facilitate the exercise of describing the activities and sequencing needed to accomplish non-LWR readiness, and to estimate the resources that will be needed to complete those activities, without fiscal prejudice. By doing so, the NRC will have a work plan that can be executed as resources become available. Resource availability will then govern the pace of achieving readiness, but will not significantly change the activities to be done or the appropriate work sequencing. This approach also provides the NRC's basis for future budget formulation and informs discussions of NRC resource needs relative to other Commission, Executive branch, and Congressional priorities.

1.0 INTRODUCTION

As the U.S. Nuclear Regulatory Commission (NRC) prepares to review and regulate a new generation of non-light water reactors (non-LWRs), the NRC developed a vision and strategy to assure NRC readiness to effectively and efficiently conduct its mission for these technologies, including fuel cycles and waste forms. "NRC Vision and Strategy: Safely Achieving Effective and Efficient Non-Light Water Mission Readiness" (non-LWR Vision and Strategy Document), published in December 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16356A670), is the overarching document that describes the objectives, strategies, and contributing activities necessary to achieve non-LWR mission readiness, and it provides the connection to the IAP documents.

The project has been organized into two phases. Phase 1 was the conceptual planning phase used to lay out the vison and strategy, gather public feedback, and finalize the NRC's approach. Phase 2 includes detailed work planning efforts and task execution. Phase 2 also includes opportunities for public feedback. The NRC completed Phase 1 in December 2016 with issuance of the non-LWR Vision and Strategy Document. The planning process for Phase 2 is broken down into three periods: near-term (0-5 years), mid-term (5-10 years), and long-term (greater than 10 years). The NRC recognizes that non-LWR developers may wish to commence pre-application activities or submit applications for review in the near-term. In these cases, the NRC will work with developers on design-specific licensing project plans and the NRC may prioritize and accelerate specific readiness activities, as needed, to support these reviews. The NRC will also continue to seek information from prospective applicants to ensure that technology-inclusive readiness activities will be supportive of the plans of near-term applicants.

The near-term IAPs discussed in this report cover actions to be taken in the first five years. These strategies and activities are expected to be initiated during the identified timeframes, and may continue into the mid- and long-term time periods, when necessary.

1.1 Achieving Mission "Readiness" for Non-LWRs

The IAPs contained in this report list the near-term actions to be completed as the NRC moves towards achieving non-LWR mission readiness. In this context, "readiness" means that the elements needed to conduct the NRC's regulatory operations to support its mission are in place and optimized. These elements are discussed below, and expressed more fully in Section 4.0 of the non-LWR Vision and Strategy Document that describes non-LWR objectives, strategies, and contributing activities.

- **People**
  The technical, support, and management staff of the NRC (and its external support resources such as Department of Energy (DOE) laboratory experts) are critical to achieving the agency's goals and mission. For non-LWRs, the staff must be familiar with a range of potential technologies, must have adequate training support in place, must have a non-LWR knowledge base available, and must have familiarity with system and integrated plant operations. The staff must also be knowledgeable of any unique waste management, environmental, safeguards or security challenges posed by a particular non-LWR technology. While many aspects of non-LWR designs may be technology-inclusive (that is, independent of the particular non-LWR technology being reviewed), subject matter expertise for technology-specific aspects of the designs is also required.

The NRC must have the right number of people with the right skills at the right time in order for the staff to conduct an effective and efficient review.

- **Processes**
  The staff must have work processes, procedures, and internal guidance established and available to conduct safety, security, and environmental reviews for non-LWRs. These processes need to reflect unique aspects of non-LWR technologies, which fundamentally differ from LWR designs.

- **Organization and Infrastructure**
  An effective and efficient organization is necessary to enable the staff to perform their work within the required timeframes. The organization must be adaptable and flexible to enable the best use of NRC resources. Examples of organizational approaches include Centers of Expertise, discipline-based organizations, and project-based matrix organizations. Adequate infrastructure, such as information technology platforms and systems, and project management systems with sufficient capacity to manage non-LWR task planning and execution, are basic requirements for readiness.

- **Analytical Tools**
  The NRC must have adequate computer models and other analytical resources to conduct its review of non-LWR designs.

- **Policies**
  The NRC must have policy decisions in place to govern the acceptability of non-LWR designs. Examples of these policy issues include emergency preparedness requirements for high-safety, low-consequence designs, and commercial concerns such as NRC fees and insurance requirements. This effort will focus on resolving policy issues for non-LWRs. In some cases, however, the resolution of these issues may be more broadly applicable. For example, current activities related to Emergency Preparedness apply to small modular light-water reactors and other new technologies, including non-LWRs.

- **Decision Criteria**
  Criteria must be established for non-LWRs that allow the NRC to reach a safety, security, and environmental finding for a particular technology and design. Processes alone will not produce a result absent appropriate decision criteria. The NRC plans to develop a regulatory framework for non-LWRs, including defining decision criteria recognizing the differences in reactor designs. To the degree possible, the NRC framework will consider previous efforts, consensus codes and standards, and international standards. The framework and decision criteria will also be developed recognizing the goals and objectives of possible non-LWR applications.

- **Transparency and Clarity of Requirements**
  Prospective non-LWR applicants and other stakeholders need to know and understand what the NRC requires from them to reach a successful safety, security, or environmental finding, as well as what requirements must be met throughout the nuclear power plant (NPP) life cycle.

- **Communication**
  The NRC must ensure that it has an effective means of exchanging information with its stakeholders, using a variety of channels and messages appropriate for target audiences. This information will range from general regulatory or industry topics of public interest, to specific guidance for potential applicants to assist in preparing and presenting non-LWR applications for review by the NRC. An example of effective communication exchange is the series of three workshops co-hosted by the NRC and DOE. The staff also conducts periodic advanced reactor public meetings and participates in industry working groups, conferences and other forums.

2.0 OVERVIEWS OF NEAR-TERM STRATEGIES

2.1 Strategy 1: Acquire/develop sufficient knowledge, technical skills, and capacity to perform non-LWR regulatory reviews

This strategy supports the non-LWR Vision and Strategy objective of enhancing non-LWR technical readiness:

> Ensuring that the staff has the requisite knowledge, expertise, tools, and processes needed to effectively and efficiently evaluate non-LWR applications, and to reach safety, security, or environmental findings.

To support accomplishment of this objective, the non-LWR Vision and Strategy Document described readiness for "people" (the staff) as follows:

> The NRC must have the right number of people with the right skills at the right time in order for the staff to conduct an effective and efficient review. For non-LWRs, the staff must be familiar with a range of potential technologies, must have adequate training support in place, must have a non-LWR knowledge base available, including non-LWR system and integrated plant operations. The staff must also be knowledgeable of any unique waste management, environmental, safeguards or security challenges posed by a particular non-LWR technology. While many aspects of non-LWR designs may be technology-inclusive (that is, independent of the particular non-LWR technology being reviewed), subject matter expertise for technology-specific aspects of the designs is also required.

The approach taken for this strategy is based on the principle of designing and maintaining the workforce consistent with the work to be accomplished, in the timeframe needed to support licensing reviews.

The near-term IAP for this strategy focuses on identification of work requirements, identification of critical skills and staff capacity requirements, assessment of the current staff's non-LWR technical readiness, and technical readiness gap closure by a variety of methods. The mid-term and long-term IAPs for this strategy address items such as long-range training and staff development for non-LWRs, mentoring programs, and attrition planning. Certain foundational activities, such as organizational assessments, knowledge capture, knowledge management, workforce competency modeling, and strategic workforce planning are continuously conducted in the near-, mid-, and long-term. The Office of the Chief Human Capital Officer is an integral partner in conducting these foundational activities. As part of the NRC's knowledge capture and management efforts, the staff will also identify historical reference materials that can be made publicly available or more easily accessible to the public. As part of this effort, the staff will also work with DOE, the national labs, and other entities to identify additional non-LWR reference materials that should be captured.

The near-term contributing activities and support tasks associated with this strategy throughout the IAPs include both technology-inclusive and technology-specific actions. The staff should be prepared and able to complete the technology-inclusive activities without specialized preparation or training. Technology-specific tasks and the associated critical skills are identified and detailed with the assistance of subject matter experts (SMEs). These SMEs will be identified and sourced from a variety of organizations, as needed.

Sources of available non-LWR expertise include the Department of Energy as well as its national laboratories; commercial engineering and regulatory support firms, international regulatory bodies and their research partners; inter-governmental organizations such as the International Atomic Energy Agency, Nuclear Energy Agency of the Organization for Economic Co-operation and Development, and the Generation IV International Forum; standards development organizations (SDOs) such as the American National Standards Institute and American Society of Mechanical Engineers; and the non-LWR industry itself. Strategy 1 activities will be informed by ongoing DOE and industry technology development activities. The NRC will also monitor the plans of prospective applicants to ensure that staff readiness in technology-specific areas is prioritized appropriately.

2.2 Strategy 2: Acquire/develop sufficient computer codes and tools to perform non-LWR regulatory reviews

This strategy supports the non-LWR Vision and Strategy objective of enhancing non-LWR technical readiness and optimizing regulatory readiness. In support of those objectives, the non-LWR Vision and Strategy Document states the staff must have adequate computer models and analytical tools to conduct its review of non-LWR designs.

As part of the staff's review for design certification and licensing of a non-LWR, confirmatory calculations of some of the most important design-basis events and key structures, systems, and components will be performed. This provides the staff with a basis to examine the applicant's analysis and to confirm the margin of safety for a given design and its operating condition. To perform these calculations, the staff will either need to develop or have access to existing analytical codes suitable for use with non-LWR applications. Currently, the staff has analysis codes that are applicable to conventional and advanced LWRs. For non-LWR reactor designs, the initial tasks for this strategy will include evaluation and down-selecting the codes for use by the staff. This is especially true for design with the least regulatory experience and that have been the subject of only limited code development efforts. The non-LWR technology with the most depth of understanding is the High Temperature Gas-cooled Reactor (HTGR), resulting from operating experience in the United States, United Kingdom, Germany, Japan, Russia, and China. Liquid metal fast reactors (LMFRs), specifically sodium-cooled fast reactors(SFRs), have been constructed and operated in the United States, Russia, China, United Kingdom, Japan, France and Germany. Of note is France's Rapsodie SFR, which had a particularly long operation period from 1967 to 1983. For molten salt designs, there is far less regulatory review history. An 8 MW thermal molten salt experimental reactor was designed and operated by Oak Ridge National Laboratory (Molten Salt Reactor Experiment, 1965-1969).

The approach taken for this strategy is to: 1) identify the computer codes and supporting information and data that would be needed to support both the design of a non-LWR and the staff's review of that design; 2) evaluate the existing computer codes and supporting information and identify gaps in both analytical capabilities and supporting information and data; and 3) interact with both domestic and international organizations working on non-LWR technologies to identify opportunities to collaborate and cooperate in closing the gaps, while being mindful of the importance of avoiding conflicts of interest. The staff's goal is to leverage, to the maximum extent practical, collaboration and cooperation with the domestic and international community interested in non-LWRs with the goal of establishing a set of tools and data that are commonly understood and accepted. That community may be composed of NRC, DOE, developers, utilities, and international regulatory partners. Having a common understanding of the tools and data, rather than having to develop that understanding during each technical review, should significantly improve the efficiency of the review process. The NRC can maintain its independence by developing expertise in the codes' phenomenological modeling, numerical schemes, and verification and validation process. The NRC will also participate in the development process to the degree that resources allow. It is anticipated that NRC will use the codes to run sensitivity analyses and perform uncertainty analyses to help investigate margins in the design. In some technical areas, an applicant may be required to submit the code documentation for NRC's review and approval, such as an evaluation model used for design basis analyses. It would be the applicant's responsibility to justify that the quality assurance program used in the code development meets NRC's requirements outlined in Appendix B to Title 10 of the Code of Federal Regulations (CFR) Part 50. In cases where an applicant uses a code that has been developed by others, commercial grade dedication could be used to satisfy

the quality assurance requirements. Code development, verification and validation, collectively known as assessment, can be extremely resource and time intensive. Therefore, it might not be practical for a single organization to undertake all of the required efforts, particularly in light of current budget realities and the deployment timelines that have been suggested by DOE and the industry. Thus, collaboration and cooperation are essential to the success of the strategy.

The staff has a number of ongoing interactions and collaborative efforts with DOE, the domestic research community, and the international community related to codes and analytical tools. The approach will build on these existing interactions, developing new cooperative funded activities, as appropriate.

For the purpose of developing the IAPs for this strategy, the staff has considered high temperature gas-cooled reactors, sodium-cooled fast reactors, and molten salt reactors where the fuel may or may not be dissolved in the coolant, as the designs of interest in the near-term. This choice is made based on the NRC's experience and is not intended as a "down-select" of the potential non-LWR designs currently being explored by industry and DOE. This design set will be reviewed frequently during execution of the near-term IAPs and will be informed by the plans of prospective applicants, in order to prioritize activities and to make effective use of the NRC's resources.

The near-term activities that support this strategy involve stakeholder interactions to better understand and assess existing computer codes, information and data, and of the gaps between the current state and what is needed. From those assessments, the staff will further engage the technical community to identify mutual interests and the potential for collaborative and cooperatively funded activities to close the identified gaps.

Based on a preliminary assessment of the gaps, the staff developed a set of contributing activities. The following functional areas will be addressed in the near-term: Reactor Kinetics and Criticality; Fuel Performance; Thermal-Fluid Phenomena; Severe Accident Phenomena; Offsite Consequence Analysis; Materials and Component Integrity; and Probabilistic Risk Assessment. This IAP includes a general assessment of the magnitude of the effort that will be required of the non-LWR technical community.

2.3 Strategy 3: Develop guidance for a flexible non-LWR regulatory review process within the bounds of existing regulations, including the use of conceptual design reviews and staged-review processes

This strategy supports the non-LWR Vision and Strategy objective of optimizing non-LWR regulatory readiness:

> Regulatory review processes are optimized when the resources of the NRC and potential applicants are effectively and efficiently used in a way that meets NRC requirements in a manner commensurate with the risks posed by the technology, that maximizes regulatory certainty, and that considers the business needs of potential non-LWR applicants. Additional options for long-range changes for non-LWR regulatory reviews and oversight that would require rulemaking will also be considered. Regulatory readiness includes the clear identification of NRC requirements and the effective and timely communication of those requirements to potential applicants in a manner that can be understood by stakeholders with a range of regulatory maturity.

One of the objectives of Strategy 3 is to develop guidance for a flexible non-LWR regulatory review process within the bounds of existing regulations, including the use of conceptual design reviews and staged-review processes. This flexibility will accommodate potential applicants having a range of financial, technical, and regulatory maturity, and a range of application readiness.

Current interactions between designers and the NRC range from activities in the preconceptual design process to designs in or nearly in the final design process. In addition, plans for the overall deployment of non-LWR designs might include multiple projects involving critical decisions for related research and test reactors, first-of-a-kind large scale plants, and subsequent commercial plants. The NRC's processes and practices need to be flexible enough to support interactions related to this wide variation in design development, recognizing that in some cases the NRC staff may be providing feedback and developing regulatory positions in parallel with designers assessing various alternatives during the conceptual design process. The timing and scope associated with these regulatory interactions are intended to align with other related plans developed by external stakeholders working on non-LWR technologies. These related plans include plant design, research and development, finance, public policy, and fuel cycle.

The NRC has developed draft guidance for conceptual design reviews and staged review-processes in the draft document "A Regulatory Review Roadmap for Non-Light Water Reactors," dated October 2016 (ADAMS Accession No. ML16291A248). The "roadmap" is also intended to help designers prepare technology- or design-specific licensing project plans. Licensing project plans define desired outcomes from various interactions between the designer and NRC considering factors such as the resources available to the designer and NRC and the coordination of the regulatory issues with other aspects of the overall program for developing and deploying non-LWR designs.

The near-term activities described in this strategy can be used to support longer-term efforts to develop, as needed, a new non-LWR regulatory framework that is risk-informed, performance-based, and that features staff review efforts commensurate with the demonstrated safety performance of non-LWR technologies.

Strategy 3 also includes activities in support of the following areas:

1. Establish criteria, as necessary, to reach a safety, security, or environmental finding for non-LWR technologies

2. Determine appropriate licensing bases and accident sets for non-LWR technologies

3. Identify and resolve gaps in current regulatory framework associated with non-LWR reactors and the associated fuel cycle

4. Develop a regulatory review “roadmap” reflecting design development lifecycle and appropriate interactions, including potential research and test reactor interactions

5. Update prototype reactor guidance

6. Engage on technology- or design-specific licensing project plans and develop regulatory approaches commensurate with the risks posed by the technology

7. Support longer-term efforts to develop, as needed, a new non-LWR regulatory framework that is risk-informed and performance-based, and that feature staff review efforts commensurate with the demonstrated safety performance of the non-LWR NPP design being considered

Several of these activities (e.g., decision criteria, licensing bases, and gap analyses) collectively establish a regulatory framework for a specific non-LWR technology and will be closely coordinated.

2.4 Strategy 4: Facilitate industry codes and standards needed to support the non-LWR life cycle (including fuels and materials)

This strategy supports the non-LWR Vision and Strategy objective of enhancing non-LWR technical readiness and optimizing regulatory readiness.

It is necessary for the NRC to consider adapting its regulatory framework to continue to ensure that new and innovative non-LWR designs are constructed and operated to protect public health and safety and the environment. In line with current practice, it is expected that the use of codes and standards will be an integral part of the NRC's strategy to improve its readiness to regulate non-LWR technologies.

The staff intends to enhance the NRC's technical readiness for possible non-LWR designs by applying its established process for incorporating codes and standards into its regulatory framework. This process is described fully in NRC Management Directive (MD) 6.5, "NRC Participation in the Development and Use of Consensus Standards," and consists of three primary steps: 1) Identifying and Prioritizing the Need for New and Revised Technical Standards; 2) Participation in Codes and Standards Development; and 3) Endorsement of Codes and Standards.

The NRC will work with SDOs, non-LWR designers, DOE, and other stakeholders to identify and facilitate new codes needed for non-LWR development. The NRC maintains its independence during participation with SDOs by reserving the right to apply conditions on codes and standards used in its regulatory process to ensure that they will meet the NRC's requirements to protect the public health and safety and the environment. The need to impose conditions may, however, be reduced by attempts to resolve outstanding issues through meetings with SDOs and other stakeholders, and NRC's active participation during the codes and standards development process.

Codes and standards that could be applied to a range of non-LWR designs are likely to be identified beginning in the near-term (0-5 years) as candidates for facilitation and development. One example is the need for codes for high-temperature materials for operating conditions well above the temperatures encountered in LWR operating conditions. Technology-specific codes and standards required by individual developers will likely be identified in the mid-term (5-10 years) or long-term (>10 years) as the designs mature. If technology-specific codes are identified by designers planning to commence pre-application or application reviews in the near-term, then the NRC will prioritize its efforts accordingly.

2.5 Strategy 5: Identify and resolve technology-inclusive policy issues that impact the regulatory reviews, siting, permitting, and/or licensing of non-LWR nuclear power plants (NPPs)

The identification and resolution of policy issues within the purview of the NRC contribute directly to regulatory predictability, effectiveness, and efficiency. Additionally, early identification and resolution of policy issues help to achieve the non-LWR Vision and Strategy objectives: enhanced technical readiness, optimized regulatory readiness, and optimized communications.

Technology-inclusive issues (i.e., those issues that apply widely to non-LWR designs independent of the specific technologies used) have the broadest applicability for the non-LWR regulatory framework. Technology-specific non-LWR policy issues may be identified in the near-term and will be addressed through design-specific licensing project plans, as appropriate.

Issues for non-LWRs can range from strictly technical issues that can be resolved in accordance with existing policy, to technical issues that involve policy implications, to issues that are primarily matters of policy. The Commission is the ultimate decision maker on matters related to NRC policy. The actionable steps outlined in this strategy will assist the staff and stakeholders in determining which past policies apply to non LWRs, whether there are new potential policy issues for non-LWRs to be examined, and will create/apply a more formal policy evaluation approach.

2.6 Strategy 6: Develop and implement a structured, integrated strategy to communicate with internal and external stakeholders having interests in non-LWR technologies

This strategy supports the non-LWR Vision and Strategy objective for optimizing communications:

> The NRC will optimize its communication with non-LWR stakeholders by disseminating clear expectations and requirements for non-LWR regulatory reviews and oversight. These expectations and requirements will be expressed using multiple channels of communication appropriate to different stakeholder interests. The NRC messaging will be consistent and tailored to audiences for maximum communications effectiveness. Stakeholder feedback paths to the NRC will also be optimized to ensure that feedback is received, considered, and addressed in a timely manner, as appropriate.

Further, in the area of optimizing the NRC's communications, the near-term strategy is defined as follows:

> Develop and implement a structured, integrated strategy to communicate with internal and external stakeholders having interests in non-LWR technologies.

The IAP for addressing communications consists of several contributing activities. These include:

- Provide timely, clear, and consistent communication of the NRC requirements, guidance, processes, and other regulatory topics, and provide multiple paths for external feedback to the NRC
- Develop consistent NRC messaging suitable to a range of audiences
- Promote the exchange of non-LWR technical and regulatory experience with the NRC international counterparts and industry organizations

These contributing activities have begun and will continue throughout the process of implementing the non-LWR Vision and Strategy Document in all three areas of readiness for non-LWR activities.

3.0 NEAR-TERM TASK PRIORITIZATION

The strategies and contributing activities described in this report are assumed not to be constrained by budget or by other agency mission priorities. The purpose of making this foundational assumption is to facilitate the exercise of describing the activities and sequencing needed to accomplish non-LWR readiness, and to estimate the resources that will be needed to complete those activities, without fiscal prejudice. By doing so, the NRC will have in place a work plan that can be executed as resources become available. Resource availability will then govern the pace of achieving readiness, but will not significantly change the activities to be done or the appropriate work sequencing. This approach also provides the NRC's basis for future budget formulation and informs discussions of NRC resource needs relative to other Commission, Executive branch, and Congressional priorities.

The IAPs support the NRC's goal of assuring NRC readiness to effectively, efficiently, and predictably review non-LWR applications by 2025. This timeframe was selected to align with the Department of Energy (DOE) non-LWR vison and strategy which sets forth a goal of having at least two non-LWR concepts ready for construction in the early 2030s. The NRC recognizes that non-LWR developers may wish to commence pre-application activities or submit applications for review in the near-term, in advance of DOE's deployment goal. In those cases, the NRC will work developers on design-specific licensing project plans as discussed in Strategy 3, and the NRC may prioritize or accelerate specific contributing activities in this IAP, as needed. The NRC will also continue to seek information from prospective applicants to ensure that technology-inclusive readiness activities will be supportive of the plans of near-term applicants.

Based on stakeholder feedback on the draft near-term IAPs and recommendations of the Advisory Committee on Reactor Safeguards, the NRC will prioritize its execution of Strategies 3 and 5 in the near-term, however activities have commenced and are ongoing in support of all 6 strategies.

4.0 SUMMARY – NEAR-TERM STRATEGIES AND CONTRIBUTING ACTIVITIES

This list summarizes the strategies and associated near-term contributing activities found in this report.

Strategy 1: Acquire/develop sufficient knowledge, technical skills, and capacity to perform non-LWR regulatory reviews

- Contributing Activity No. 1.1: Identify Non-LWR Task and Technical Skill Requirements (Work Design Activities)

- Contributing Activity No. 1.2: Determine and Establish the Necessary Workforce Skills and Capacities (Workforce Design & Establishment)

Strategy 2: Acquire/develop sufficient computer codes and tools to perform non-LWR regulatory reviews

Functional Area: Reactor Kinetics and Criticality

- Contributing Activity No. 2.1: Upgrade/revise nuclear-analysis capabilities that are capable of predicting core-operating power and flux in the following operating HTGR modes (start-up; quasi-steady state cycle-specific operation; and transient analysis from a limiting point in cycle or equilibrium cycle)

- Contributing Activity No. 2.2: Identify experimental data needs and begin code assessment

- Contributing Activity No. 2.3: Upgrade/revise nuclear-analysis capabilities that are capable of predicting core-operating power and flux in the following operating LMFRs modes (start-up; quasi-steady state cycle-specific operation; and transient analysis from a limiting point in cycle or equilibrium cycle)

- Contributing Activity No. 2.4: Identify experimental data needs and begin code assessment

- Contributing Activity No. 2.5: Upgrade/revise nuclear-analysis capabilities that are capable of predicting core-operating power and flux in an operating Molten Salt Reactor (MSR), for steady state and transient analysis

- Contributing Activity No. 2.6: Identify experimental data needs and begin code assessment

Functional Area: Fuel Performance

- Contributing Activity No. 2.7: Develop knowledge of fuel design, fuel functional requirements, and fuel characteristics critical to safety and accident performance of HTGRs

- Contributing Activity No. 2.8: Develop or adopt/update existing fuel analysis code applicable to HTGRs

- Contributing Activity No. 2.9: Identify experimental data needs and begin code assessment for HTGRs

- Contributing Activity No. 2.10: Develop knowledge of fuel design, fuel functional requirements and fuel characteristics critical to safety and accident performance of LMFRs

- Contributing Activity No. 2.11: Develop or adopt/update existing fuel analysis code applicable to LMFRs

- Contributing Activity No. 2.12: Identify experimental data needs and begin code assessment of LMFRs

- Contributing Activity No. 2.13: Develop knowledge of fuel design, fuel functional requirements and fuel characteristics critical to safety and accident performance for MSRs

- Contributing Activity No. 2.14: Develop fuel analysis code applicable to MSRs

Functional Area: Thermal-Fluid Phenomena

- Contributing Activity No. 2.15: Develop thermal-fluid analysis code applicable to HTGRs

- Contributing Activity No. 2.16: Identify experimental data needs and begin code assessment

- Contributing Activity No. 2.17: Develop thermal-fluid analysis code applicable to LMFRs

- Contributing Activity No. 2.18: Identify experimental data needs and begin code assessment

- Contributing Activity No. 2.19: Develop thermal-fluid analysis code applicable to MSRs

- Contributing Activity No. 2.20: Identify experimental data needs and begin code assessment

Functional Area: Severe Accident Phenomena

- Contributing Activity No. 2.21: Develop severe accident analysis code applicable to HTGRs

- Contributing Activity No. 2.22: Identify experimental data needs and begin code assessment

- Contributing Activity No. 2.23: Develop severe accident analysis code applicable to LMFRs

.

- Contributing Activity No. 2.24: Identify experimental data needs and begin code assessment

- Contributing Activity No. 2.25: Develop severe accident analysis code applicable to MSRs

- Contributing Activity No. 2.26: Identify experimental data needs and begin code assessment

Functional Area: Offsite Consequence Analysis

- Contributing Activity No. 2.27: Perform an initial scoping study identifying and prioritizing potentially relevant modeling needs

- Contributing Activity No. 2.28: Based on the initial scoping study and design information available to date, implement needed modeling enhancements to be able to analyze offsite consequences for non-LWRs

Functional Area: Materials and Component Integrity

- Contributing Activity No. 2.29: Assess the performance needs and issues for structural materials to be used in non-LWRs, such as HTGR, LMFR, MSR. The assessment will include the state-of-the-knowledge, ongoing domestic and international research, applicable international Operational Experience (OpE), codes and standards activities, gaps in knowledge, data, and assessment tools

- Contributing Activity No. 2.30: Conduct research activities to develop technical bases to resolve major materials related issues. Collaborate with domestic (Department of Energy (DOE), Electric Power Research Institute (EPRI), developers) and international regulatory partners [based on the recommendations from the assessment report from contributing Activity No. 2.29]

- Contributing Activity No. 2.31: Support the development of a draft regulatory framework for materials-related issues (relevant Standard Review Plan (SRP) chapters, guidance, etc.) for non-light water reactors

Functional Area: Probabilistic Risk Assessment

- Contributing Activity No. 2.32: Investigate what previous work has been done in PRA for non-LWR designs

- Contributing Activity No. 2.33: Perform scoping study to understand if any work identified above can be used again or if gaps still exist, including looking at operating experience

- Contributing Activity No. 2.34: Evaluate if new PRA policy will be needed to support non-LWR designs, including risk surrogates

- Contributing Activity No. 2.35: Identify any other technological trends in PRA methods, models, tools, or data collection

- Contributing Activity No. 2.36: Identify guidance documents that would need to be updated to support the reviews

- Contributing Activity No. 2.37: Develop a gap closure plan

Strategy 3: Develop guidance for a flexible non-LWR regulatory review process within the bounds of existing regulations, including the use of conceptual design reviews and staged-review processes

- Contributing Activity No. 3.1: Establish and document the criteria necessary to reach a safety, security, or environmental finding for non-LWR applicant submissions. The criteria and associated regulatory guidance are available to all internal and external stakeholders.

- Contributing Activity No. 3.2: Determine and document appropriate non-LWR licensing bases and accident sets for highly prioritized non-LWR technologies.

- Contributing Activity No. 3.3: Identify, document and resolve (or develop plan to resolve) current regulatory framework gaps for non-LWRs.

- Contributing Activity No. 3.4: Develop and document a regulatory review "roadmap" that reflects the design development lifecycle and appropriate points of interaction with the NRC, and references appropriate guidance to staff reviewers and applicants.

- Contributing Activity No. 3.5: Prepare and document updated guidance for prototype testing, research and test reactors.

- Contributing Activity No. 3.6: Engage reactor designers and other stakeholders regarding technology- and design-specific licensing project plans and develop regulatory approaches commensurate with the risks posed by the technology.

- Contributing Activity No. 3.7: Support longer-term efforts to develop, as needed, a new non-LWR regulatory framework that is risk-informed, performance-based, and that features staff review efforts commensurate with the demonstrated safety performance of the non-LWR NPP design being considered.

Strategy 4: Facilitate industry codes and standards needed to support the non-LWR life cycle (including fuels and materials)

- Contributing Activity No. 4.1 - Work with stakeholders to determine the currently available codes and standards that are applicable to non-LWRs and their associated fuels and waste, and to identify the technical areas currently supported by codes and standards (e.g., instrumentation and control, civil/structural, inservice inspection and testing, materials, equipment qualification, quality assurance) where gaps may exist.

- Contributing Activity No. 4.2 - Participate with the Standards Development Organizations that are actively involved in developing codes and standards for non-LWRs

- Contributing Activity No. 4.3 - Review codes and standards for endorsement

Strategy 5: Identify and resolve technology-inclusive policy issues that impact the regulatory reviews, siting, permitting, and/or licensing of non-LWR nuclear power plants (NPPs)

- Contributing Activity No. 5.1: Determine the applicability of previously identified policy issues to non-LWRs

- Contributing Activity No. 5.2: Identify additional technology-inclusive policy issues for non-LWRs

- Contributing Activity No. 5.3: Analyze and resolve technology-inclusive non-LWR policy issues identified in Contributing Activity Nos. 5.1 and 5.2

Note: Technology-specific non-LWR policy issues may be identified in the near-term and will be addressed through design-specific licensing project plans, as appropriate.

Strategy 6: Develop and implement a structured, integrated strategy to communicate with internal and external stakeholders having interests in non-LWR technologies

- Contributing Activity No. 6.1: Provide timely, clear, and consistent communication of the NRC's non-LWR requirements, guidance, processes, and other regulatory topics, and provide multiple paths for external feedback to the NRC

- Contributing Activity No. 6.2: Develop consistent NRC non-LWR messaging suitable to a range of audiences

- Contributing Activity No. 6.3: Promote the exchange of non-LWR technical and regulatory experience with the DOE, NRC international counterparts and industry organizations