A Regulatory Review Roadmap for Non-Light Water Reactors

(October 2016 Draft – Released to support public discussions)

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A contributing activity within the NRC's implementation action plan for improving its regulatory readiness for non-light water reactor (non-LWR) designs includes developing a regulatory review "roadmap" reflecting design development activities and appropriate interactions between the NRC staff and stakeholders at various stages of the reactor design process. The roadmap is 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 development of licensing project plans will be discussed in more detail under the documentation for contributing activity #6 within the implementation action plan for improving regulatory readiness.

This draft of the roadmap has been prepared and is being released to support ongoing public discussions on possible improvements to regulatory processes, in particular interactions and decisionmaking during the various stages of the design process for non-LWR technologies. This draft paper has not been subject to NRC management and legal reviews and approvals, and its contents should not be interpreted as official agency positions. Following the public discussions (including a public meeting scheduled for October 25, 2016), the staff plans to continue working on this roadmap as well as other activities defined in the agency's vision and strategies document. A final version of this paper will be issued following public discussions and appropriate internal NRC reviews and approvals.

1) Introduction

The federal government and private companies have shown an interest in the development of nuclear reactor designs that are different than the currently operating reactors, which use water for both cooling and supporting the nuclear reactions in the core by moderating or slowing neutrons generated by the fission process. Various reactor technologies are being considered and include those using coolants such as helium, liquid metal, and molten salt. These reactor technologies are referred to as non-light water reactor (non-LWR) or Generation IV designs. A desire to maintain U.S. leadership in nuclear technology, goals to reduce carbon emissions, and other energy policy considerations drive the increasing interest in non-LWR technologies.

The role of the Nuclear Regulatory Commission (NRC) is limited to ensuring that the potential design, construction, and operation of non-LWR technologies provide for the safe and secure use of radioactive materials. However, many assessments identify the NRC's licensing processes and readiness to regulate different reactor designs as a potential challenge to the development and deployment of non-LWR designs. The NRC has prepared a vision and strategy document for improving the agency's readiness to regulate non-LWR technologies, which includes developing implementation action plans (IAPs) in areas of technical readiness, regulatory readiness, and communications. The strategic objective for optimizing regulatory readiness is stated to be:

> Regulatory review processes are optimized when the resources of the NRC and potential applicants are efficiently and effectively 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.

The strategies and contributing activities necessary to achieve the strategic objectives include items binned into near-term (0-5 years), mid-term (5-10 years) and long-term (beyond ten years) timeframes. In the area of improving the NRC's regulatory readiness for possible non-LWR designs, the staff defines the near-term strategy as follows:

> Establish a flexible, risk-informed, performance-based, 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.

The NRC's IAP for improving its regulatory readiness for non-LWR designs includes the following contributing activities:

- Establish the criteria necessary to reach safety, security, or environmental findings for non-LWR technologies
- Determine appropriate licensing bases and accident sets for non-LWR technologies
- Identify and resolve gaps in current regulatory framework
- **Develop a regulatory review "roadmap" reflecting design development lifecycle and appropriate interactions**
  - Possible research and test reactors (RTRs)
- Develop prototype reactor guidance
- Engage with technology- or design-specific licensing project plans and develop regulatory approaches commensurate with the risks posed by the technology

This draft white paper describes a regulatory review "roadmap" reflecting design development activities and appropriate interactions between the NRC staff and stakeholders at various stages of the reactor design process. This preliminary roadmap is intended to support discussions between the staff and stakeholders and support the future issuance of a final version of the roadmap.

2) Background

Key safety objectives and functions for nuclear reactors are defined in various references, including NRC regulations such as Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities." The NRC's requirements in 10 CFR Part 50 were developed over the years based primarily on experience with LWR technology. The International Atomic Energy Agency (IAEA) Specific Safety Requirements SSR-2/1, "Safety of Nuclear Power Plants: Design," describes safety in design for any nuclear reactor technology as follows:

> [2.8] To achieve the highest level of safety that can reasonably be achieved in the design of a nuclear power plant, measures are required to be taken to do the following, consistent with national acceptance criteria and safety objectives:
>
> (a) To prevent accidents with harmful consequences resulting from a loss of control over the reactor core or over other sources of radiation, and to mitigate the consequences of any accidents that do occur;
> (b) To ensure that for all accidents taken into account in the design of the installation, any radiological consequences would be below the relevant limits and would be kept as low as reasonably achievable;
> (c) To ensure that the likelihood of occurrence of an accident with serious radiological consequences is extremely low and that the radiological consequences of such an accident would be mitigated to the fullest extent practicable.

IAEA SSR-2/1 goes on to define fundamental safety functions for nuclear reactors as follows:

> Fulfilment of the following **fundamental safety functions** for a nuclear power plant shall be ensured for all plant states:
>
> (i) **control of reactivity**;
> (ii) **removal of heat** from the reactor and from the fuel store; and
> (iii) **confinement of radioactive material**, shielding against radiation and control of planned radioactive releases, as well as limitation of accidental radioactive releases.

The history of LWRs includes an evolution in the designs and related regulatory requirements associated with fulfilling the fundamental safety functions. Plant designs and operating practices have been improved based on operating experience, analytical studies, and technological advancements. Regulatory requirements and associated approaches taken by reactor vendors have likewise evolved and increasingly reflect the NRC's adoption of a risk-informed performance-based regulatory framework.

The current efforts to define regulatory approaches for non-LWRs provides an opportunity to adjust the LWR framework or develop an improved framework to ensure the fundamental safety functions are fulfilled in a manner commensurate with the risks associated with specific technologies or designs. The NRC has had some experience in the regulation of non-LWR plants and has previously engaged in pre-application interactions with reactor designers and the U.S. Department of Energy (DOE). The NRC staff has developed potential approaches to the licensing and regulation of non-LWR technologies in studies such as NUREG-1860, "Feasibility Study for a Risk-Informed and Performance-Based Regulatory Structure for Future Plant Licensing," and NUREG-2150, "A Proposed Risk Management Regulatory Framework." The staff is currently working to complete development of advanced reactor design criteria. For that effort, DOE completed a report entitled, "Guidance for Developing Principal Design Criteria for Advanced (Non-Light Water) Reactors," and submitted it to the NRC in December 2014. The NRC reviewed the information in the report and published draft design criteria for advanced reactors on the NRC's public web site on April 7, 2016. The staff plans to issue a draft regulatory guide containing these criteria for comment in 2017.

The non-LWR technologies and designs currently being discussed incorporate features and characteristics consistent with the NRC's advanced reactor policy statement which states:

> Regarding advanced reactors, the Commission expects, as a minimum, at least the same degree of protection of the environment and public health and safety and the common defense and security that is required for current generation light-water reactors (LWRs). Furthermore, the Commission expects that advanced reactors will provide enhanced margins of safety and/or use simplified, inherent, passive, or other innovative means to accomplish their safety and security functions.

Consistent with this policy, preliminary interactions between the NRC staff and non-LWR designers indicate that many of the potential designs include less radioactive inventory, more stable fuel forms, higher system thermal capacities and longer thermal constants, and passive safety features that rely on natural phenomena. Inclusion of such attributes could facilitate the safety review. However, the non-LWR technologies also bring less operating experience and incorporate innovative or novel design features that could complicate the regulatory review. The potential benefits, as well as potential challenges for non-LWR designs, highlight the importance of early interactions between the NRC staff and designers to help develop regulatory approaches commensurate with risks from the technologies. The development of regulatory approaches will likely occur in parallel with the development of the designs and performance of related research and testing.

3) Design Stages

The NRC encourages early preapplication interactions with reactor designers. The Advanced Reactor Policy Statement states:

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

In accordance with the policy statement, the NRC has worked with designers and DOE on several non-LWR designs and provided varying degrees of feedback on designs and testing programs related to the development of non-LWR designs. Examples include the NRC staff's review and issuance of pre-application safety evaluation reports for liquid-metal and gas-cooled reactor technologies. There are also numerous examples of less-formal interactions with specific reactor designers.

The IAP for addressing regulatory readiness consists of several contributing activities in areas such developing decision criteria, selecting and categorizing licensing basis events, and improving regulatory processes to support various stages of reactor design activities. Various non-LWR technologies and specific designs based on similar technologies are at different points in the development process. A representation of design processes from the DOE Order 413.3B, "Program and Project Management for the Acquisition of Capital Assets," is shown in Figure 1[1]. This figure provides a useful distinction between different phases of project development and critical decisions, which will define the associated interactions between the NRC staff and designers.

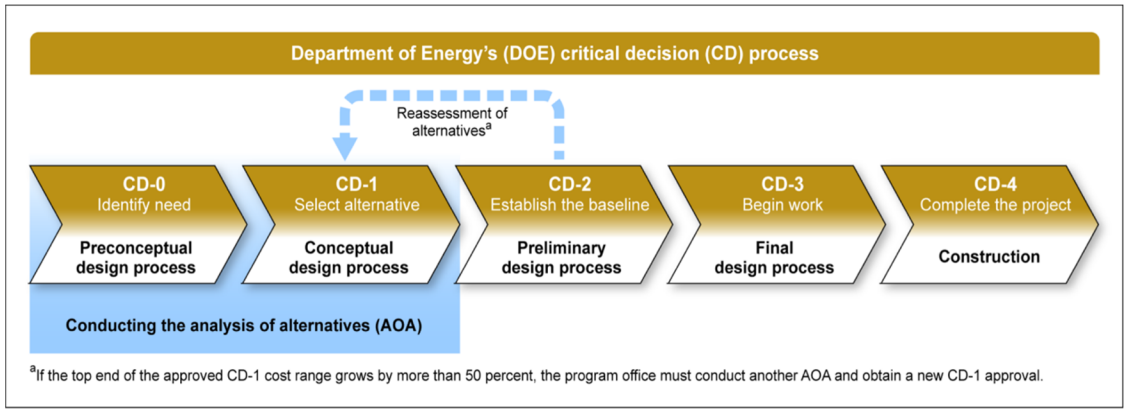

Figure 1: DOE Critical Decision Process

[1] From U.S. Government Accountability Office (GAO) Report GAO-15-37, "Analysis of Alternatives Could be Improved by Incorporating Best Practices," December 2014

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 (FOAK) large scale plants, and subsequent commercial plants. The NRC's existing processes and practices are flexible enough to support interactions related to this wide variation in design development, recognizing that the NRC staff may in some cases be providing feedback and developing regulatory positions[2] in parallel with designers assessing various alternatives during the conceptual design process. The regulatory interactions are intended to align with other related plans for developing non-LWR technologies. These related plans include plant design, research and development, finance, public policy, and fuel cycle.

The staff prepared this regulatory roadmap to help define processes and interactions for various stages of the design and licensing processes. This generic roadmap is intended to standardize terminology and expectations. Technology or design specific licensing plans can then be developed in cooperation with groups or individual designers to align the regulatory review plan with other plans, including research and development. A key aspect of aligning the design, research, and regulatory processes will be including characterization of design or technology status (e.g., technology readiness level, phenomena identification and ranking table (PIRT)). Examples of these relationships from DOE Guide 413.3-4A, "Technology Readiness Assessment Guide," are shown in Figures 2 and 3.

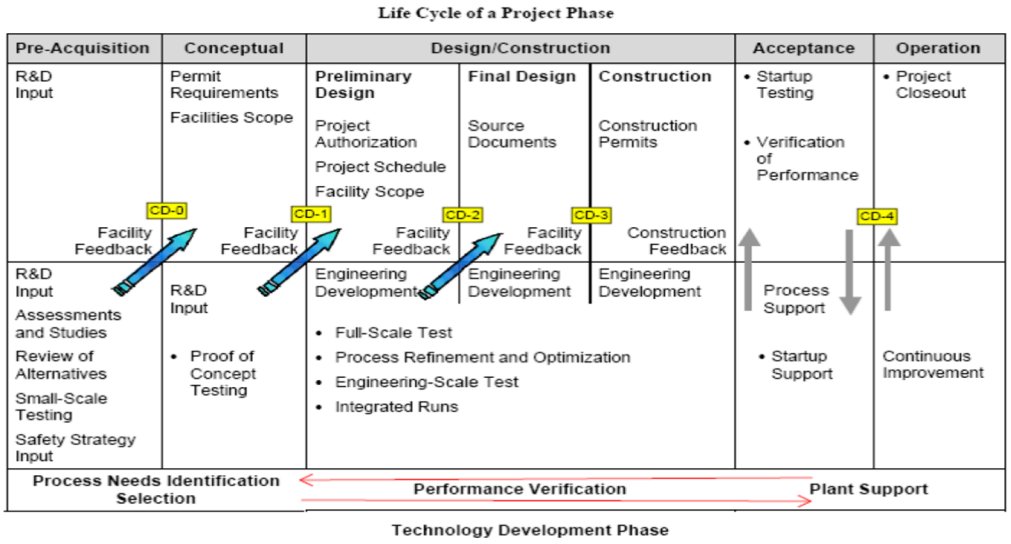

Figure 2: Technology Development Integration with Project Management

[2] In this context, "regulatory positions" may range from preliminary discussions with designers without the creation of documentation to be cited in future applications to Commission decisions (e.g., staff requirements memorandum or policy statement) or other published regulatory position (e.g., interim staff guidance, regulatory guide, or safety evaluation). See Section 4. While NRC processes can provide the needed flexibility, the interactive and iterative nature of some interactions, especially in the conceptual design phase, is not the standard operating procedure familiar to many staff members.

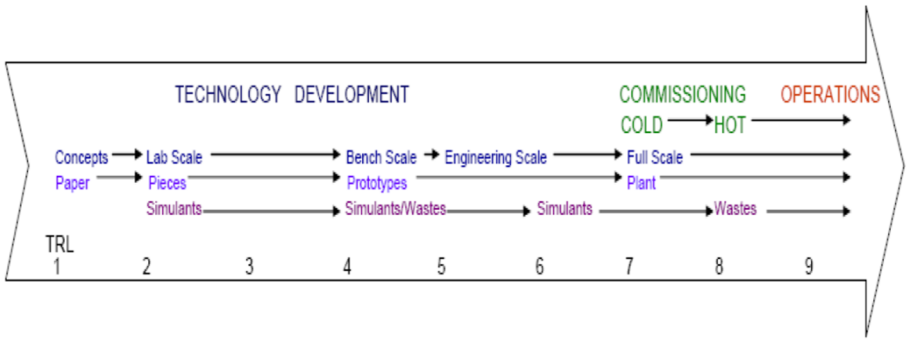

Figure 3: Schematic of DOE Office of Environmental Management Technology Readiness Levels (TRLs)

The critical decision process shown in Figure 1 and reflected in Figures 2 and 3 are useful starting points. However, the detailed discussions within the associated DOE orders and guidance support DOE projects and some aspects of those discussions may not be relevant to the development of non-LWR technologies and the related licensing project plans. The roadmap described in the following sections aligns various regulatory applications (e.g., construction permit (CP), operating license (OL), standard design approval (SDA), design certification (DC), combined license (COL)) and preapplication interactions (e.g., meetings, topical reports, white papers, conceptual design reviews) with different stages of the design process. Figure 4 provides a general summary of the various regulatory processes.

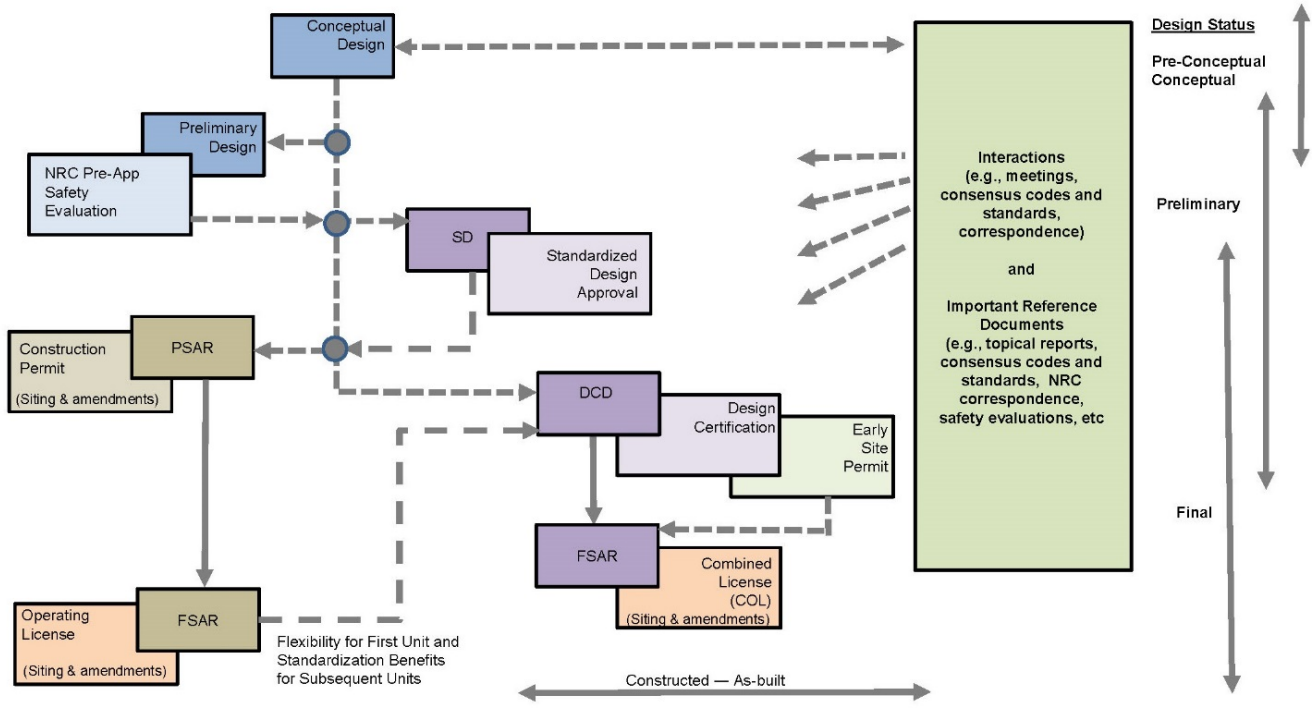

Figure 4: NRC Licensing-related processes

Previous preapplication interactions highlight the importance of regulatory feedback in areas such as fundamental safety approaches, research, qualification of materials and fuels, and plans for integral and systems tests. The staff recently included a new introductory section[3] in the standard review plans for LWRs specifically related to preapplication activities for light-water small modular reactors (SMRs). Consistent with this guidance, the staff has been engaged in significant preapplication interactions with SMR vendors on a variety of topics. Building on recent experiece with LWRs and past experience with non-LWRs, the staff has developed a roadmap for licensing project plans. As discussed further in Sections 4 and 5, the roadmap describes flexible non-LWR regulatory review processes, including interactions during the conceptual design phase, preliminary design reviews, and standard design approvals, to define possible staged-reviews for designs or parts of designs at various levels of completion or maturity (e.g., across spectrum of technology readiness levels). The alignment of regulatory interactions with the stages of development of non-LWR designs requires a technology- or design-specific licensing project plan that reflects the results of technology- or design-specific assessments such as PIRTs or technnology readiness level evaluations (at the plant and/or structure, system or component level); the status of supporting research and testing; and the prioritization of desired feedback from the NRC. The NRC staff and the requester will need to agree on the appropriate levels of review and possible forms of feedback (e.g., verbal, correspondence, safety evaluation, etc.) considering available resources (NRC and requester), schedule, and importance. Aspects of the overall project plan dealing with the business model and some public policy issues may influence the priorities and schedules proposed by a designer but are not directly related to the NRC's regulatory review and licensing processes. NRC's ability to support the non-LWR program will be determined based on broader agency budgets and priorities.

This roadmap will support the development of the technology- or design-specific licensing project plans as described in Section 5, "Licensing Project Plans to Obtain NRC Licenses, Certifications, and Approvals," regarding interactions and processes and relationships between various stages of design, research and development, and licensing. The licensing project plan and interactions with the NRC will also need to address the appropriate time for establishing and obtaining NRC approval of quality assurance plans. Designers will need to request access to safeguards information at the appropriate time, to enable them to address regulatory requirements such as 10 CFR 50.150, "Aircraft Impact Assessment," and to appropriately integrate security into the plant design consistent with the advanced reactor policy statement.

[3] NUREG-0800, Introduction - Part 2: Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: Small Modular Reactor Edition, January 2014.

4) Interactions, Reference Documents, and Applications

There are a variety of regulatory processes and tools that can support the design, construction, and operation of one or more nuclear power plants. Figure 4 shows the processes and tools that provide flexibility to address a range of possible circumstances associated with the development and deployment of non-LWR technologies. This section describes the individual interactions and applications from Figure 4. Section 5 discusses how the processes and tools can support various stages of the design process within a licensing project plan, including examples of scenarios for different combinations of processes and tools for different development and deployment models.

Interactions between the NRC staff and a requester involve exchanges of information that ultimately support a regulatory decision. Some interactions warrant preparing and archiving records of decisions for reference in formal applications. Other interactions may help manage resources and schedules, resolve process or policy issues, or otherwise support the decisionmaking process, but do not result in a record that will be referenced in an application. Given that the results of interactions can range from simple exchanges to legally binding regulatory decisions, an important part of navigating through the regulatory process is to ensure that all parties have the same understanding of the desired outcome for each interaction. The ability of the NRC staff to provide definitive responses and decisions is dependent on the availability of supporting information from research and analysis. However, early interactions can nevertheless be useful to both NRC staff and designers and can help define appropriate activities that will ultimately be included or referenced in formal applications.

Possible outcomes from regulatory interactions (from preapplication stage though the eventual licensing application stage) include the following:

- Information exchange: Some interactions between designers and the staff simply involve exchanges of information on reactor design concepts, technical information, regulatory requirements, or guidance.

- Initial feedback: Initial feedback from the NRC is usually provided from staff-level interactions in meetings or correspondence. The feedback can range from the views of individual staff members provided during meetings to more formal exchanges that might result from written exchanges. The feedback often involves insights from previous regulatory actions, operating experience, or cursory assessments of proposals or issues by the staff. Interactions resulting in initial feedback, even if provided in written correspondence, may be valuable to both the requester and staff but do not result in documents for referencing in subsequent applications or binding regulatory positions.

- Conditional staff findings: The staff may make findings and document these findings in correspondence, “preapplication” or “preliminary” safety evaluation reports, topical report safety evaluations, or other records that a proposed design feature, analysis method, or operational program conforms to regulatory requirements or is otherwise acceptable provided that testing, analyses, or other activities are completed and provide the expected results. Conditional findings are intended to improve the efficiency of the staff’s review process and supporting activities such as testing and analyses performed by applicants. Applicants can reference the conditional findings in subsequent submittals – with the requested information to satisfy the condition or in support of other proposals with the potential of creating a cascading dependency on the supporting testing or analyses.

Conditional findings are developed and documented using established agency processes (e.g., correspondence, topical reports) and include the appropriate reviews by management, the Office of General Counsel (OGC), and the Advisory Committee on Reactor Safeguards (ACRS). These findings would be technically conclusive and would not be revisited assuming any conditions of approval are met and that the design has not changed in such a way as to invalidate the staff's findings. These findings do not however have finality with respect to future Commission decision making and could be subject to hearing opportunity as part of a future licensing proceeding.

- Conclusive staff finding: The staff may find and document in correspondence, safety evaluations, or other records that an applicant has provided sufficient justification to conclude that a proposed design feature or operational program conforms to regulatory requirements or is otherwise acceptable. Conclusive staff findings are provided in safety evaluation reports for licenses, certifications, standard design approvals, and topical reports, and may also be provided in correspondence or other reference documents prepared by the staff in support of future or ongoing reviews of applications for licenses, certifications, or standard design approvals. Applicants can reference the conclusive findings in subsequent submittals provided the information remains applicable to the associated design feature or operational program. Conclusive findings are developed and documented using established agency processes and include the appropriate reviews by management, OGC, and ACRS.

- Final agency position: Final agency positions are those established in regulations, issued licenses or certifications, Commission decisions and orders, and other documents issued following the review and approval by the Commission or delegated official. The NRC usually documents final agency positions after providing opportunities for public participation (e.g., licensing hearings or rulemakings). Applicants can reference final agency positions in subsequent submittals provided the information remains applicable to the associated design feature or operational program. The NRC processes for changing final agency positions are defined by regulations such as 10 CFR 50.109, "Backfitting," and 10 CFR 52.63, "Finality of standard design certifications."

In addition to the above outcomes from some interactions with stakeholders, the staff will also prepare for non-LWR reviews by developing internal guidance documents (e.g., design specific review standards developed for SMRs), performing independent research and analyses, and completing other activities as described in the various IAPs. These activities will involve interactions with designers and other stakeholders and will ultimately support making the findings or developing positions described above. NRC's technical and regulatory readiness combined technology and design maturity will need to be considered in order to realistically assess the expected outcome of specific interactions. To the degree that a particular outcome (e.g., conditional staff finding) is needed to support the development of design, research, or business plans, the licensing project plan and associated staff review plan should be developed with that outcome in mind. The plans will also need to reflect the resource and schedule limitations facing all parties and appropriately prioritize, and in some cases adjust, the expected outcomes from interactions on a variety of topics.

The potential regulatory outcomes can be associated with various levels of available design information throughout the development of a non-LWR technology or design. This flexibility is reflected in Figure 4 by showing the spectrum of regulatory interactions available from the conceptual through the final design processes. For example, a final agency position such as rulemaking to establish requirements for risk-informed, performance-based approaches to emergency planning may be conducted, in part, to resolve questions arising in the conceptual design process for non-LWRs. On the other hand, a designer may request informal feedback on a specific detail of a system or component before submitting a supplement to an application for a design certification. The primary interactions between the staff and reactor designers, industry organizations, and other stakeholders include:

- Meetings: Meetings with the NRC staff can provide initial feedback on design options and support ongoing reviews of submitted material. The NRC staff can hold meetings with individual designers, technology or design-centered groups, industry organizations (e.g., Nuclear Energy Institute, Nuclear Infrastructure Council, Nuclear Innovation Alliance), DOE and other stakeholders. The feedback can range from preliminary questions, sharing regulatory perspectives, or finalizing needed information to complete a more formal review supporting a higher level outcome. Unless they involve discussion of sensitive information (e.g., proprietary or security-related information), meetings with the NRC staff are open to the public. Meeting summaries are prepared to document these interactions but are rarely used to document staff findings or regulatory positions.

- Correspondence, White Papers, and Technical Reports: Letters and reports outlining policy or technical positions can be used to provide information to the NRC staff and to solicit feedback in the form of initial, conditional, or conclusive regulatory positions. There are no formal guidelines or naming conventions for these interactions but general practices are described below:

    - Correspondence without an attached report is usually used for project management issues (e.g., costs and schedules), clarifying processes and procedures, and to address technical issues not needing detailed supporting information. Stakeholders may also request the NRC to provide information on regulations, including conclusive or binding interpretations in accordance with 10 CFR 50.3, “Interpretations,” and 10 CFR 52.2, “Interpretations.”

    - Documents often referred to as white papers can be used to request general feedback, to obtain preliminary regulatory responses (e.g., a submittal template could be submitted to propose reasonable format for a submittal), or a more formal regulatory decision (e.g., applicability of a regulatory requirment to the design). Note that staff responses for these types of documents are generally less specific and provide less regulatory certainty than responses for higher-level documents such as Topical Reports and formal applications.

    - Documents often referred to as technical reports can be used to provide results of research, testing or analyses that help verify or validate computer models, expected performance of components or systems, or other supporting information of an application. The NRC’s assessment of the relevance and adequacy of technical reports is usually documented in safety evaluations related to the specific topical reports or applications.

- Topical Reports - A topical report is a stand-alone report containing technical information about a reactor; structure, system or component (SSC); or safety topic that can be submitted to the NRC for its review and approval. Topical Reports improve the efficiency of the licensing process by allowing the staff to review proposed methodologies, designs, operational requirements, or other subjects for subsequent referencing in licensing applications. An NRC-approved Topical Report can provide a technical basis for a licensing action. Topical Reports have traditionally been used to obtain NRC approval for the design of key SSCs, methodologies, and computer codes and models. Topical reports have been used extensively in the review of LWR designs and are expected to be an important vehicle for obtaining NRC staff findings (conditional or conclusive) on proposed design features and analysis methodologies for non-LWR designs.

- Consensus Codes and Standards – The NRC encourages the development and use of consensus codes and standards as part of its regulatory programs and can incorporate the codes and standards into regulations and guidance documents.

- Rulemaking and Regulatory Guidance Development - Stakeholder input can be provided and is encouraged when the NRC is considering new or revised regulations or regulatory guidance documents (e.g., interim staff guidance, standard review plans, design specific review standards, and regulatory guides). Industry groups have also developed guidance documents to address technical or policy issues and these guidance documents can be referenced in NRC-issued interim staff guidance and regulatory guides.

- Research and Development Plans – Entities may submit research and development plans supporting reactor technologies or designs. This information is useful for the NRC to be aware of what data may become available for verification and validation of computer models, what test facilities may need to be inspected for quality assurance, which tests the NRC may wish to observe and also to help determine what related independent research the NRC may wish to conduct. The results from the R&D programs can be provided in technical reports or within applications, including topical reports.

- Other Supporting Documents/Programs – The design and licensing of non-LWRs are expected to introduce topics such as the use of historical Atomic Energy Commission (AEC) or DOE research programs, operating experience outside of the U.S., and increased use of advanced computer simulation tools. Designers may identify other available supporting documents that may be submitted to the NRC within their licensing project plan and discuss the desired outcomes with the NRC staff.

The above interactions can be used to exchange information between designers and the NRC and can result in the NRC providing varying degrees of feedback for use in the design process and application development for licenses, certifications, or design approvals. A discussion of how the design process and licensing project plan for non-LWRs can use these interactions and the formal application processes defined in NRC regulation follows.

Conceptual Design

Recent discussions regarding non-LWR technology development have stressed the importance of better coordinating the licensing process with other aspects of project plans, including design, funding, research, and public policy considerations. The NRC's issuance of conceptual design approvals has been introduced as a possible way to provide early feedback to reactor designers

to help better coordinate the licensing and design processes.[4] The Advanced Reactor Policy Statement acknowledges the importance of early interactions between the staff and reactor designers, including what is referred to as the conceptual design process as depicted in Figure 1. Although all parties have a general agreement on the need for regulatory interactions during the design process, defining terms and establishing common expectations is important to ensure mutual understanding of the purpose and conduct of such interactions and associated outcomes.

This roadmap uses the term "conceptual design process" to refer to early consideration and selection of various key alternatives that will define the fundamental design features and general principles of operation. These decisions involve matters such as basic approaches to the safety functions of control of reactivity, removal of heat from the reactor and from the fuel store, and limiting the release of radioactive material. The selection of these design features helps define the research and testing programs, the appropriate safety analyses, associated fuel cycle and public policy issues, and other matters to be resolved in later phases of the design. The conceptual design phase supports the development of a licensing project plan, including identifying those matters needing early regulatory interactions to support coordination with other aspects of the overall project. The licensing project plan and associated NRC review plan should define the expected outcomes from early interactions (e.g., initial, conditional, conclusive, or final) and related matters such costs, schedules, and research plans.

The NRC has previously interacted with non-LWR designers during the conceptual design process and provided initial feedback on possible design approaches to fulfill fundamental safety functions. During these interactions the NRC has also identified technical and policy issues and worked to develop and issue final agency positions providing non-LWR designers additional confidence in selecting design alternatives. The NRC's ongoing assessment of possible changes to emergency planning requirements for light-water SMRs and other nuclear technologies, including non-LWRs, is an example of such activities. The staff has typically not provided conditional or conclusive findings related to an overall design during the conceptual design process because of the level of design detail available at the conceptual design phase and changing nature of the design during this phase of a project would not support such regulatory decision-making. However, the staff can and has provided conditional findings and conclusive findings on more specific issues in response to submittals of white papers and topical reports. The staff foresees maintaining this approach for future interactions with non-LWR designers such that the NRC review plans will identify key topics, associated interactions and outcome goals. These interactions support the designers' ability to assess alternatives and progress to the preliminary design process. As previously discussed, the ability of designers and the staff to develop and execute plans during the conceptual design process may be limited by available resources and may therefore require prioritization of key topics and could impact expected regulatory outcomes.

[4] This roadmap does not use the phrases "conceptual design approval" or "preliminary design approval" in order to avoid confusion with the formal processes for licensing, certifications, and approvals defined in NRC regulations.

Preliminary Design (Preapplication Submittals)

Research, analyses and other activities performed during the preliminary design process support more detailed design decisions and verification of the design performance in terms of commercial targets and safety requirements. Preliminary or preapplication design documents can be provided to the NRC for information or to solicit feedback on testing programs, safety analysis approaches, or the overall feasibility of licensing a design. The preliminary design documents and related NRC reviews in the late 1980s and early 1990s involved essentially complete plant designs with regard to the scope of the design and the level of design detail available. Some recent non-LWR preapplication submittals have focused more on specific design features or portions of the design (e.g., fuel design).

The preapplication safety evaluation reports prepared in the 1990s for liquid-metal and gas-cooled reactor designs helped the NRC identify and develop the regulatory framework to review non-LWR designs as well as provided confidence to designers in the feasibility of licensing the specific designs. Although circumstances led to those projects being deferred, the NRC's interactions with DOE and the designers identified valuable insights on safety features, research and development programs, and proposed testing needs. The NRC reviews did not result in an approval of the designs due to project termination; however, it was expected that the preapplication efforts would help inform future licensing submittals. The NRC staff was able to conclude at that time that no obvious impediments to licensing the designs had been identified during the reviews. The appropriate use of the various interactions and tools described above can support a long-term program for the design and deployment of a non-LWR reactor while potentially minimizing the additional review efforts needed to reach conclusive findings or final agency positions during different parts of the subsequent review and approval process.

Preliminary design reviews and other tools may help designers, DOE, and other stakeholders determine whether or not design and testing programs for a non-LWR will support the eventual approval, certification, or licensing of a plant. The scope of the NRC's review findings will be dependent on the design maturity and completeness of the submittals provided. Business case considerations such as operation economics and investment factors must be evaluated by the applicants and are outside of the NRC's responsibilities. NUREG-1226, "Development and Utilization of the NRC Policy Statement on the Regulation of Advanced Nuclear Power Plants," identifies various potential benefits of preapplication interactions during the preliminary design process. These include sharing design information; assessing licensing feasibility; gaining insights on key design features; refining licensing plans including defining scope, cost, schedules; advancing principal design criteria and other acceptance criteria; reporting on research and testing programs; assessing technology readiness levels and phenomenological issues; and identifying possible prototype testing for FOAK non-LWR plants.

Frequently asked questions about the preapplication review process relate to the costs of NRC reviews and ability to provide timely regulatory feedback for consideration within a broader project plan. The potential range of potential applicants, designs, and degrees of design completeness limits the ability to define a single product cost and schedule for the review of a preliminary design. Instead, the NRC will work with a designer to establish a mutually agreeable review plan for a specific preliminary design that includes a defined scope and level of review, desired outcome in terms of regulatory observations, particular areas of focus, review costs, and review schedules. The NRC staff will arrange meetings during the process to support the review, ensure the goals of the review plan are being met, and to monitor costs and

schedules. The scope and level of detail of preapplication submittals that will be necessary to achieve the desired regulatory outcomes should be determined as part of a licensing project plan.

For preapplication design reviews where there is a high degree of design completeness, such as the preapplication safety analysis reports previously reviewed by the NRC, a preliminary design review could result in a statement from the NRC similar to that in the preapplication safety evaluation reports prepared in the 1990s – that is, that the NRC has identified no obvious impediments to the licensing of the subject non-LWR design or major parts of the design provided for review. For preliminary designs with a lesser degree of design maturity, the staff findings would have a commensurate, and likely lesser degree of regulatory certainty. If the NRC does identify impediments to licensing during the preliminary design review, that feedback will be also valuable to the potential applicant.

Prior to submitting the preapplication design documents, it is expected that meetings have been held with the staff to provide a description of the design and the licensing strategy being pursued. The licensing project plan and preliminary design information should describe the design; relationships to previously submitted or planned white papers, topical reports, consensus standards, and other activities supporting the design; research and development and confirmatory testing programs; historical and foreign operating experience; and other relevant information. The preliminary design can be used to describe the principal design criteria being proposed and the acceptance criteria being established for the plant structures, systems and components for normal and abnormal operation, and for a range of possible transients and accidents. Past NRC interactions with non-LWR vendors have included early submittal of white papers on key licensing matters such as licensing-basis event selection and classification of SSCs. The use of such white papers or adoption of related consensus codes and standards can allow the preliminary design review to be focused on the technical issues related to the safety of the design.

During the preliminary design process, as shown in Figure 4, preapplication reports can be submitted in support of applications for an SDA, design certification, or construction permit. The licensing project plan can reflect the use of preapplication submittals to support these subsequent applications. A preapplication submittal early in the preliminary design process may help the applicant and NRC staff resolve possible licensing issues and prepare for the formal application. A preliminary design sufficiently developed to support preparing a preliminary safety analysis report (PSAR) can support an application for a construction permit when combined with submittal of required siting evaluations. A preapplication submittal might also be used to support an SDA when focused only on a major portion or portions of a design versus an essentially complete design (in scope) as required for a license or design certification application. Submittal of preapplication reports while research and testing is still underway will likely result in conditional findings, but such interactions can provide additional confidence to proceed with other parts of a project and licensing plan.

Licenses, Certifications, and Approvals

The above discussions on preapplication interactions and preparation of supporting reference documents are intended to help potential applications for licenses, certifications, and approvals in accordance with NRC's regulations. In addition to the flexibility provided to potential applicants during preapplication interactions, the NRC's regulations for licenses, certifications, and approvals, as described in the 10 CFR Part 50 and Part 52 licensing processes and as

shown in Figure 4, provide several options for licensing non-LWR technologies. Plans for the overall deployment of non-LWR designs might include multiple projects involving critical decisions and different licensing approaches for related research and test reactors, FOAK large scale plants, and subsequent commercial plants.

The regulatory processes associated with issuing licenses, certifications, and approvals are described in various regulations and guidance documents. A summary is provided in NUREG/BR-0298, "Nuclear Power Plant Licensing Process." The major elements shown in Figure 4 are summarized below. The nuclear Industry and the DOE use the term "demonstration reactor" in the context of a facility that could be used demonstrate a technology or design as part of the development lifecycle. The term has been used to describe small-scale research reactors, larger-scale test reactors, or full-scale FOAK commercial reactors. This paper uses the terms "research and test reactor" for Class 104 facilities and "prototype plant" for Class 103 facilities where special testing is needed to demonstrate a technology or design.

Construction Permit

Under 10 CFR Part 50, a construction permit from the NRC authorizes construction of a nuclear power plant. The NRC focuses on the preliminary design of a nuclear plant and the suitability of the site before authorizing construction of the plant. The NRC reviews the application and documents its findings on site safety characteristics and emergency planning in a safety evaluation report. The NRC also conducts an environmental review, in accordance with the National Environmental Policy Act (NEPA), to evaluate the potential environmental impacts and benefits of the proposed plant. The ACRS reviews each construction permit application and the NRC's related safety evaluation and reports its findings and recommendations to the Commission. A mandatory public hearing is conducted by the Atomic Safety and Licensing Board (ASLB).

The NRC may authorize an applicant to do some work at a site before a construction permit is issued. This "limited work authorization" can only be granted after the Atomic Safety and Licensing Board has made all of the environmental findings required for a construction permit and determined that the proposed site is a suitable location for a nuclear power plant of the general size and type proposed.

The development of advanced reactor applications could include using the 10 CFR Part 50 licensing process to apply for a construction permit instead of using the processes in 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." An advantage of the Part 50 process is that it supports beginning the licensing process and, if the applicant wishes, starting construction earlier in the design process (at the preliminary design stage) than would be required by Part 52. While offering some advantages, the "design-as-you-build" approach introduces some project risks in the regulatory arena if the NRC imposes additional requirements as a condition of receiving an operating license. This approach also provides less finality prior to significant financial investment in plant construction.

An overall licensing plan for a non-LWR technology might include multiple reactors (e.g., test reactor, FOAK large scale, and subsequent commercial units) and include a construction permit application within the licensing project plan for the test and/or FOAK reactor. As shown in Figure 4, a construction permit application may benefit from preapplication interactions during the conceptual and preliminary design processes. Interactions, staff findings and final agency positions, and preapplication submittals can help prepare the NRC for receipt and review of the

construction permit application. The construction permit application may reference an SDA or cite staff reports which document existing conclusive staff findings associated with the application. The application may also reference an ESP, which represents a final agency position provided the proposed plant remains bounded by the parameters defined in the ESP.

Operating License

Under the Part 50 licensing process, final design information and plans for operation are developed during the construction of the nuclear plant. The applicant then submits an application to the NRC for an operating license. The application contains a final safety analysis report and an updated environmental report in accordance with the requirements of NEPA. The safety analysis report describes the plant's final design, operational limits, anticipated response of the plant to postulated accidents, and plans for coping with emergencies. The ACRS reviews each operating license application and the NRC's related final safety evaluation report and offers findings and recommendations to the Commission. The NRC provides an opportunity for any person whose interests might be affected by the proceeding to petition the NRC for a hearing. If a public hearing is held, it is conducted by the ASLB as described in NUREG/BR-0249, "The Atomic Safety and Licensing Board Panel."

Design Certification

The NRC can certify a reactor design for 15 years through the rulemaking process, independent of a specific site. A certified design as defined by 10 CFR 52.41 is to consist of an essentially complete nuclear power plant design. The application must also contain a level of design information sufficient to enable the Commission to reach a final conclusion on all safety questions associated with the design before the certification is granted. The ACRS reviews each application for a standard design certification, together with the NRC staff's safety evaluation report. If the design is found to be acceptable, the NRC staff certifies it through a rulemaking. Under this process, the NRC publishes a public notice of the proposed rule in the Federal Register seeking public comments. The NRC reviews the comments and makes any changes to the final rule, which is then published in the Federal Register and becomes an appendix to 10 CFR Part 52 of the regulations. The rulemaking process and related Commission decisions establish final agency positions on the certified design, which can then be referenced in future combined license applications.

Early Site Permits

Under the NRC's regulations in 10 CFR Part 52 and NEPA, the agency can issue an early site permit (ESP) for approval of one or more sites separate from an application for a construction permit or combined license. Issuance of an ESP includes ACRS reviews and a mandatory ASLB hearing and results in a final agency position suitable for referencing in subsequent applications for a construction permit or combined license. Such permits are good for 10 to 20 years and can be renewed for an additional 10 to 20 years. They address site safety and environmental protection issues, and can address complete plans for coping with emergencies or major features of such plans, independent of the review of a specific nuclear plant design.

Combined License

Under the NRC's regulations in 10 CFR Part 52 and NEPA, the NRC may issue a combined license to authorize construction and conditional operation of a nuclear power plant. The application for a combined license must contain essentially the same information required in an

application for an operating license issued under 10 CFR Part 50. An application for a combined license may reference a standard design certification, an ESP, both, or neither. The ACRS reviews each application for a combined license. A hearing opportunity also provides the public an opportunity to participate in the licensing process. The ASLB conducts hearings on any contested matters, while the Commission conducts a mandatory hearing prior to issuance of every combined license. After issuing a combined license, the NRC verifies that the licensee has completed the required inspections, tests, and analyses, and that the acceptance criteria have been met before the plant can operate. The NRC publishes a notice providing an opportunity for members of the public to participate in a hearing conducted by the ASLB related to satisfaction of the inspections, tests, analyses and acceptance criteria (ITAAC) prior to plant operation.

Standard Design Approval

A designer may submit a proposed preliminary or final standard design for a major portion of a nuclear power plant to the NRC for review. Unlike a standard design certification, the SDA documents staff conclusive findings but does not prevent issues resolved by the design review process from being reconsidered during a rulemaking for a design certification or during hearings associated with a construction permit or combined license application. An SDA can nevertheless be a useful tool within a licensing project plan in combination with preapplication interactions held during the conceptual and preliminary design processes. The SDA and related safety evaluation report documents staff findings, involves ACRS reviews, and provides a reference for subsequent applications. As such, the SDA can provide incremental progress towards the licensing or certification of a non-LWR design in what can be referred to as a staged-licensing process.

A potential useful feature of an SDA is that its scope is defined in 10 CFR 52.131, “Scope of subpart,” to include the design of a nuclear power plant or major portion thereof. This differs from the scope of a design certification, which is defined by 10 CFR 52.41, “Scope of subpart,” to consist of an essentially complete nuclear power plant design. The ability to limit the scope of an SDA to major portions of a design provides an opportunity for regulatory interactions to focus on those plant features most related to controlling the risks to public health and safety. Power conversion systems or other plant features either may remain in a conceptual or preliminary design process or are not included in information provided for NRC staff review. Defining a major portion of a design for the purpose of an SDA may be challenging given the relationships between various plant systems and the contributions of safety and non-safety systems to plant risk. Licensing project plans and other interactions between a designer and the staff will need to include a rationale for which parts of a plant will be included in the application and which portion(s) can be excluded from the review or addressed though concepts similar to the “conceptual design information” or “design acceptance criteria” used for some design certifications.

An applicant for a construction permit or combined license may reference an SDA for those portions of the plant included in the scope of the SDA.

As in preapplication interactions, the licensing project plan and associated NRC review plans should establish expectations in terms of outcomes, resources, and schedules. Periodic project management meetings will be conducted during the SDA review process to monitor project progress and costs.

Research and Test Reactors and Prototype Plants

An overall or integrated plan for developing non-LWR technologies and specific designs may include the construction and operation of research and test reactors or prototype plants. The development of such reactors and potential NRC licensing of these facilities are major activities in and of themselves. The staff is addressing this challenge under another activity for later incorporation into this roadmap. However, the importance of such facilities warrants a mention and emphasis early in the development of this roadmap and any technology- or design-specific licensing project plan.

The potential use of a test reactor or FOAK larger scale unit for prototype testing or other validations is another topic being addressed by a separate activity for later incorporation into this roadmap.

Other Activities

This roadmap is part of a larger NRC effort to improve its readiness for possible applications related to non-LWR reactors. IAPs are being developed or pursued related to a variety of topics. For example, supporting activities related to regulatory readiness include assessing technical acceptance criteria for non-LWR designs in parallel with this roadmap focusing on the processes by which the NRC staff interacts with potential applicants. Longer term activities could include revising NRC regulations to facilitate licensing, certifying, and approving non-LWR designs. While the current focus of the longer term activities and possible rulemaking is related to technical requirements, process changes could also be explored as part of the assessment and development of new or revised regulations.[5]

[5] Subpart F to 10 CFR Part 52 defines processes for manufacturing licenses but is not discussed within this roadmap. Adjusting the current requirements for manufacturing licenses to reflect possible approaches for SMRs or non-LWR technologies could be included in the longer term activities if new or revised regulations are developed.

5) Licensing Project Plans to Obtain NRC Licenses, Certifications, and Approvals

The various interactions and processes discussed in the previous sections provide general directions and vehicles to use when engaging the NRC about licensing non-LWR designs. The appropriate use of these tools is dependent on various factors and interrelationships. Interacting with the NRC on licensing questions is but one of a number of plans and strategies that face a reactor designer. As depicted in Figure 5, the challenges include funding, public policy, research and development, and infrastructure issues (e.g., fuel cycle). The project and related licensing project plan would be even more complex than shown when including siting and construction considerations.

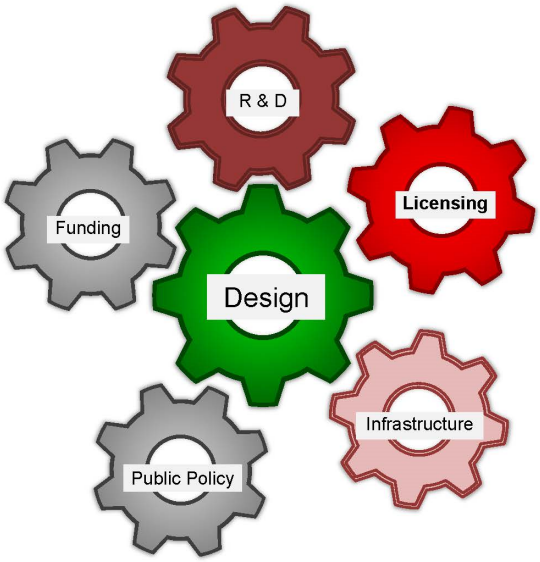

Figure 5 – Interrelated Technology Development Plans

Reactor designers need to consider the various factors as they develop a technology- or design-specific licensing project plan. While public policy matters such as whether or not nuclear power plants benefit from taxes on carbon are outside of the NRC's responsibility, such questions would likely influence the pace of design efforts, the availability of funding for research and testing, and other topics included in a licensing project plan. The purpose of this roadmap is to prepare the NRC for interactions related to non-LWR designs and to provide sufficient clarity of requirements for non-LWR designers to support other aspects of the product development process (e.g., design process, research and development, financial plan).

A key factor in developing the licensing project plan and other design-related plans and strategies is the current maturity or level of technological readiness of the proposed reactor concept and related SSCs. The roadmap includes optional steps for interactions such as preapplication reviews and standard design approvals. The various paths provide flexibility to address non-LWR designs in various stages of development. As mentioned in previous sections, designers should address any planned research or test reactors within the licensing project plan and would likely develop a separate licensing project plan for such reactors. The added complexity of the longer term plans that are likely to include a test reactor as a key part of research and development is represented in Figure 6.

Other plans or sub-plans could be shown for developing the design and licensing of associated fuel cycle facilities, FOAK reactors, and other areas needed to introduce a new technology. The interplay and dependencies between the various activities should be reflected in the licensing project plan through realistic schedules, resource estimates, capabilities, and outcomes from specific interactions.

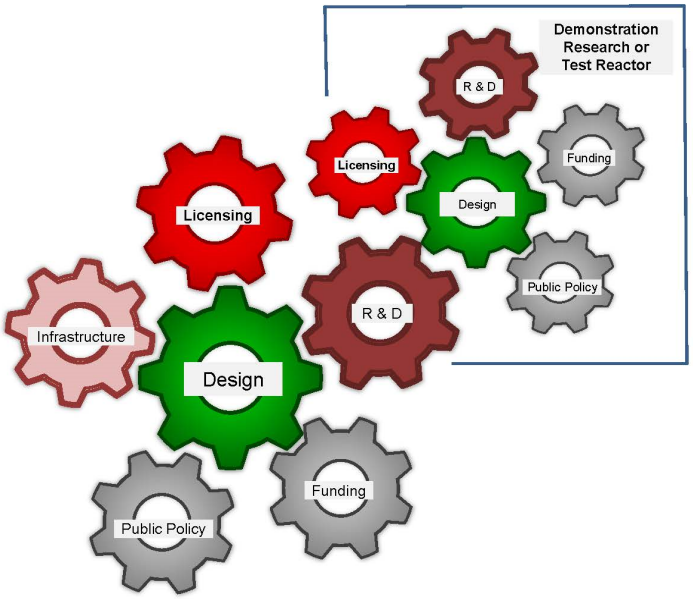

Figure 6 - Interrelated Plans with Test Reactor

There are numerous possible plans and combinations of interactions and submittals that could be included in a licensing project plan during the conceptual or preliminary design processes. Interactions with the NRC on proposed licensing project plans would include consideration of the agency's capabilities and resource availability recognizing the allocations for supporting non-LWR activities and the potential need to support multiple non-LWR technologies. The development of a licensing project plan would allow the designer and NRC staff to prioritize issues and optimize interactions to address design alternatives or address issues most important to the overall project plan.

A brief discussion of licensing project plans and possible combinations of interactions and applications to support the development and licensing of non-LWRs is provided below. The development of licensing project plans will be discussed in more detail under the documentation for contributing activity #6 within the implementation action plan for improving regulatory readiness. Several examples are provided to illustrate possible plans and the use of the various combinations of the previously discussed reference documents and applications for licenses, certifications, and approvals.

As discussed in previous sections, those parties designing non-LWRs or wishing to construct and operate a non-LWR are expected to prepare a licensing project plan as an early step in the overall program to develop and deploy a new reactor technology. The licensing project plan will reflect the technology readiness level of the reactor design, including innovative features, and

the related research and development activities. The development of the licensing project plan will include interactions with the NRC staff to reach mutual agreement on the desired outcomes of defined interactions and estimated costs and schedules for defined reviews. The licensing project plans should pay particular attention to near-term activities needed to support the critical decision process (see Figure 1) and the development of submittals and NRC review plans. Longer-term licensing and construction strategies for commercial units can be useful to include in the licensing project plan to align the licensing processes with research and development activities, business models, and resolution of associated public policy matters. Uncertainties in these areas need not prevent interactions and progress on near-term activities related to selection of key design alternatives and development of a preliminary design.

The first interactions between a designer and the NRC staff are usually intended to familiarize the staff with the design concepts or preliminary design and familiarize the designer with NRC's regulatory processes. Initial meetings include the designer providing presentations and available design documents. The NRC staff may identify available guidance documents or other references to support future discussions. These initial familiarization interactions will be followed by more specific discussions leading to the development of licensing project plans and related NRC review plans. The plans and related discussions should identify the expected meetings, correspondence, and submittal of documents for review and issuance of staff findings or final agency positions. The discussions between the designer and NRC staff and the development of coupled licensing and review plans should address expected outcomes, priorities, resources, and schedules. Where available resources or other constraints on the NRC staff or designer limit the scope or possible outcomes related to submittals and reviews, the designer should determine which topics are most important to making critical project decisions. Routine interactions between the designer and NRC staff should ensure the goals of the licensing and review plans are being met, monitor the costs and schedules, and identify and implement appropriate changes to the plans.

The licensing project plan will identify the important reference documents that are expected to be submitted and reviewed to support future applications. As discussed in the previous section, these reference documents can include correspondence (including white papers), topical reports, consensus codes and standards, industry guidance documents, research plans, and other supporting material. The submittal and review of these reference documents not only support potential future applications but are also expected to play a role in critical project decisions and influence plans and strategies related to research and development, funding, infrastructure development, and possibly even the overall direction of the program. The topical reports or other submittals will provide a starting point for the design of the overall plant and specific SSCs; possible future research and testing (including potential prototype plant testing); operating limits; and surveillance, testing and monitoring requirements during construction and operations. The assessments performed during the conceptual design process are expected to support the evaluation and selection of design alternatives and will likely deal with general approaches to key safety functions or specific topics related to critical project decisions. NRC staff review of reference documents during the preliminary design process is expected to include more detailed topics related to overall plant design, system interactions, accident analyses, and other topics needed to support future applications for licenses, certifications, and approvals. Designers, potential licensees, and industry groups may find it useful to submit additional reference documents during the final design process and even following plant operation if needed to address issues related to plant design, construction, or operation.

Licensing project plans for non-LWRs progressing into the preliminary design process have a number of options for applying for licenses, certifications, and approvals to support the design processes and potential commercial deployment of a non-LWR design. In addition to the submittal of important reference documents for future applications, designers may submit information on the preliminary design of a plant or key systems prior to a formal application. This type of preliminary design review by the staff and issuance of preapplication safety evaluation reports was used for design documents submitted by DOE following the issuance of the NRC's advanced reactor policy statement. Designers may also elect to submit an application for standard design approval as a means of progressing in the regulatory area as design decisions are made and the overall program advances. A standard design approval can then be used, in combination with other reference documents, to support a license or certification under either Part 50 or Part 52. The use of the available combinations of preapplication interactions, creation of reference documents, and standard design approval is sometimes referred to as a staged licensing process. The use of a staged licensing process can reduce the degree to which regulatory risks are not addressed until late in the preliminary or final design processes. Several examples of possible interactions and applications are provided below.

A list of possible examples is included below and may be expanded based on discussions with stakeholders

Example	Design Status	Licensing Project Plan Activity
1	Conceptual	Familiarization with reactor concept Conceptual Design Critical Decision Interactions (a) White Papers (b) Topical Reports (c) SECY papers[6]
	Preliminary	Preapplication design review
	Final (key systems)	SDA
	Final (no site selected)	DC

[6] SECY papers are written issues papers the NRC staff submits to the Commission to inform them about policy, rulemaking, and adjudicatory matters. Staff requirements memorandum document the Commission's decisions on a staff written issue paper and any related tasks assigned to the staff with the date due.

Example	Design Status	Licensing Project Plan Activity
2	Conceptual	Familiarization with reactor concept Conceptual Design Critical Decision Interactions (a) White Papers (b) Topical Reports (c) SECY papers
	Preliminary	Preapplication design review
	Final (key systems)	SDA
	Final (key systems)	CP
	Final	OL

Example	Design Status	Licensing Project Plan Activity
3	Conceptual	Familiarization with reactor concept Conceptual Design Critical Decision Interactions (a) White Papers (b) Topical Reports (c) SECY papers
	Preliminary	Preapplication design review
	Preliminary	CP
	Final	OL

Example	Design Status	Licensing Project Plan Activity
4 (multiple unit plan)	RTR Conceptual	Preapplication interactions Familiarization with reactor concept
	RTR Preliminary	RTR CP
	RTR Final	RTR OL
	FOAK conceptual	Familiarization with reactor concept Conceptual Design Critical Decision Interactions (a) White Papers (b) Topical Reports (c) SECY papers
	FOAK preliminary	Preapplication design review
	FOAK Final (key systems)	SDA
	FOAK Final (key systems)	CP (FOAK)
	FOAK Final	OL (FOAK)
	NthOAK Final	DC
	NthOAK Final	COLs

Example	Design Status	Licensing Project Plan Activity
5	Final (but pending other plans)	Incremental Progress (a) Topical Reports (b) SECY papers
	Final (but pending other plans)	SDA
	Decision Point	DC or CP