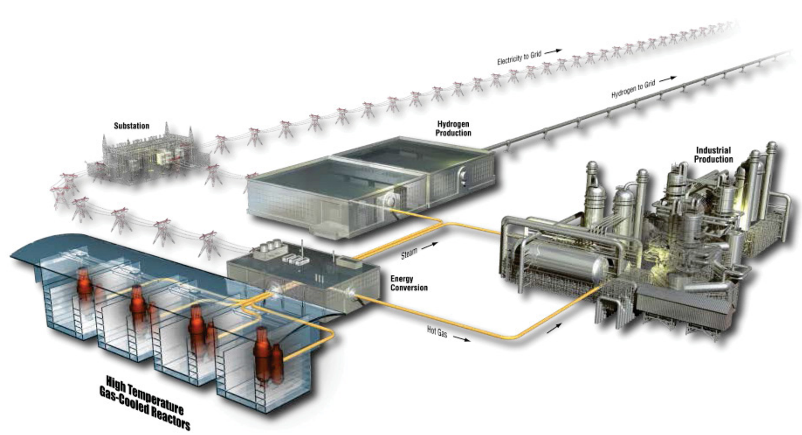
INL/EXT-16-39629
Revision 0

Regulatory Risk Reduction for Advanced Reactor Technologies – FY 2016 Status and Work Plan Summary

September 2016



The INL is a
U.S. Department of Energy
National Laboratory
operated by
Battelle Energy Alliance

Idaho National Laboratory

INL/EXT-16-39629
Revision 0

Regulatory Risk Reduction for Advanced Reactor Technologies – FY 2016 Status and Work Plan Summary

September 2016

Idaho National Laboratory
INL ART TDO Program
Idaho Falls, Idaho 83415

http://www.inl.gov

Prepared for the
U.S. Department of Energy
Office of Nuclear Energy
Under DOE Idaho Operations Office
Contract DE-AC07-05ID14517

INL ART TDO Program

Regulatory Risk Reduction for Advanced Reactor Technologies – FY 2016 Status and Work Plan Summary

INL/EXT-16-39629
Revision 0

September 2016

Author:

Wayne L. Moe Licensing Engineer, INL ART Regulatory Affairs	9/12/16 Date

Approved by:

for Jim Kinsey Jim C. Kinsey Director, INL ART Regulatory Affairs	9/12/16 Date
Michelle T. Sharp INL Quality Engineer	9/12/16 Date

FOREWORD

The regulatory framework governing commercial nuclear power plant safety reviews and licensing in the U.S. is highly oriented towards large light-water reactor (LWR) technologies. Recent design advancements in non-LWR technologies and the need for new non-fossil fuel energy resources have allowed non-LWR concepts to become a viable option in the domestic energy market. In order to realize the benefits of this energy option, however, significant efforts are needed concerning the regulatory framework if non-LWR technologies are to meet operational plant deployment schedules that are set as early as 2025.

Efforts are underway to modernize the domestic regulatory framework to accommodate advanced non-LWR technologies. This report summarizes major advanced reactor regulatory risk reduction activities and accomplishments over the past year within the Licensing portion of the Department of Energy's (DOE) Advanced Reactor Technologies (ART) Program being managed at the Idaho National Laboratory (INL).

Top-level project success criteria for this project are:

- The regulatory risk reduction (RRR) effort will generate sets of recommendations on technology-inclusive, risk-informed and performance-based technical requirements (along with their associated basis), and proposals for implementation which allow applicants and the Nuclear Regulatory Commission (NRC) to begin deployment of new regulatory processes and technical requirements within two years
- Implement a modernized regulatory structure so those recommendations and proposals can be used by applicants and regulators in licensing actions within five years following completion of the RRR project, and
- The objectives of DOE's GAIN initiative will be furthered by providing the advanced reactor community with access to the technical, regulatory, and financial support required to move innovative nuclear energy technologies towards commercialization.

This report discusses foundational activities initiated and performed during fiscal year (FY) 2016 that are designed to retire selected regulatory risks for new non-LWR designs. Additional commentary is provided concerning the approaches that will be used to retire these risks, how issues are to be prioritized, and activities planned for FY 2017 and beyond.

This report addresses DOE/INL milestone M3AT-16IN2001084, "Complete Regulatory Risk Reduction Work Plan Status Report."

CONTENTS

FIGURES

TABLE

ACRONYMS

ALWR	advanced light water reactors
ANL	Argonne National Laboratory
AR	advanced reactors
ARDC	advanced reactor design criteria
ARRTF	Advanced Reactor Regulatory Task Force
ART	Advanced Reactor Technologies
ASME/ANS	American Society of Mechanical Engineers/American Nuclear Society
AT	analytical tools
DID	defense in depth
DOE	U.S. Department of Energy
EPRI	Electric Power Research Institute
ESBWR	economic simplified boiling water reactor
FHR	fluoride high temperature reactor
FOAK	first of a kind
FY	fiscal year
GAIN	DOE's Gateway for Accelerated Innovation in Nuclear
GFR	gas fast reactor
HTGR	high temperature gas-cooled reactor
INL	Idaho National Laboratory
ISG	interim staff guidance
LBE	licensing basis event
LFR	lead fast reactor
LWR	light-water reactor
MCFR	molten salt fast reactor
MHTGR	Modular High Temperature Gas-Cooled Reactor (General Atomics design)
MSR	molten salt reactor
NEI	Nuclear Energy Institute
NGNP	Next Generation Nuclear Plant
NIA	Nuclear Innovation Alliance
NIC	Nuclear Infrastructure Council
NLWR	nuclear light-water reactor
NRC	Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratory

PB	performance-based
PRA	probabilistic risk assessment
R&D	research and development
RAW	risk assessment worth
RG	regulatory guide
RI	risk-informed
RIDM	risk-informed decision making
RIPB	risk-informed, performance-based
RRR	Regulatory Risk Reduction
RTR	research and test reactor
SC	Southern Company
SDO	standards development organizations
SFR	sodium fast reactor
SI	supporting infrastructure
SRP	standard review plan
SSC	structures, systems, and components
TI	technology inclusive
TLRC	top-level regulatory criteria
WBS	work breakdown structure

Regulatory Risk Reduction for Advanced Reactor Technologies – FY 2016 Status and Work Plan Summary

1. OVERVIEW

1.1 Purpose

Millions of public- and private-sector dollars have been invested over recent decades to realize greater efficiency, reliability, and the inherent and passive safety offered by advanced nuclear reactor technologies. However, a major challenge in experiencing those benefits exists in the U.S. regulatory framework. This framework governs domestic commercial nuclear plant construction and operations, and is oriented towards confirming safety margins for large light-water reactor (LWR) technology. The framework must be modernized to address non-LWR concepts if new designs are to be made available to the U.S. energy supply.

The U.S. Department of Energy's (DOE) Advanced Reactor Technologies (ART) Regulatory Risk Reduction (RRR) initiative is establishing a capability to systematically retire licensing risks associated with incompatibilities in the regulatory framework. This capability relies on insights of the affected regulated community (i.e., commercial advanced reactor designers/vendors and prospective owners/operators), yet remains tuned to assuring public safety and acceptability by licensing authorities. The extent to which broadly representative industry perspectives are being incorporated into the proposed framework adaptation effort makes this initiative unique and potentially beneficial to a wide range of non-LWR license applicants.

1.2 Background

Advanced reactor design safety must be fully evaluated by the U.S. Nuclear Regulatory Commission (NRC). The processes associated with this safety evaluation, and the associated licensing process itself, must be well-crafted and suited to the design. Clarifying compliance guidance is also important to these processes. Concern about existing regulatory framework capabilities with respect to non-LWR designs have led NRC to acknowledge update is essential if advanced reactors are to be licensed. [1]

The DOE is a major government agency that facilitates development of clean and efficient energy sources in the U.S. Given existing regulations, DOE also recognizes the need to modernize the regulatory environment for non-LWR technologies. Regulatory framework adaptation approaches suited to modular high-temperature gas-cooled reactor (HTGR) technology were developed under the Next Generation Nuclear Plant (NGNP) program. [2] Building on the progress and regulatory framework achievements of projects like NGNP, DOE/ART has initiated a new modernization initiative that is much more technology-inclusive than past efforts. The RRR initiative will link with companion initiatives from industry organizations to further the shared goal of amending the nuclear power regulatory environment for greater compatibility and lower regulatory risks in non-LWR deployments.

2. OBJECTIVES AND SCOPE

2.1 Objectives

Advanced reactor technologies need modernized NRC policies, regulations, licensing technical requirements, and associated implementation guidance. Figure 1 depicts the relationship of these topics to the managed retirement of regulatory risk.

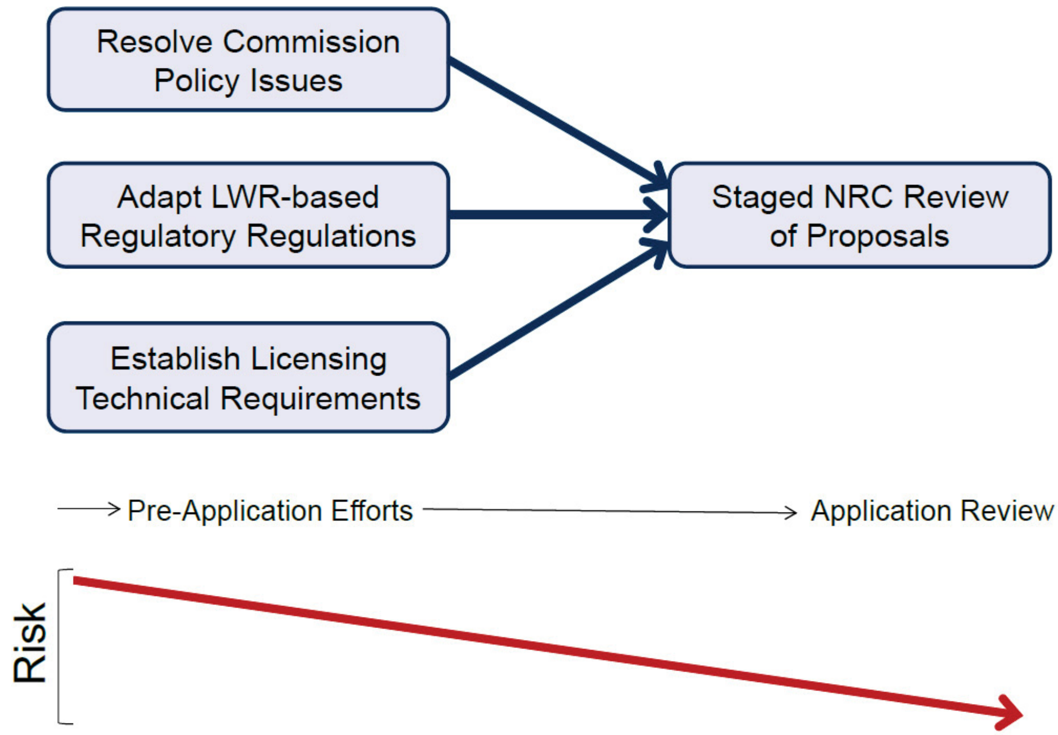


Figure 1. Managed retirement of regulatory risk.

NRC has indicated willingness to work with stakeholders to resolve incompatible policy and technical requirements concerning advanced reactor designs. Representative elements needing attention include:

- Resolving long-standing Commission policy issues for advanced technologies as discussed in:
  - SECY 93-092 - Policy Issues for CANDU, PRISM, MHTGR, PIUS, that addressed accident evaluation, source terms, and containment performance
  - SECY 15-0077 - Options for Emergency Preparedness, which broadly identified concerns when determining accidents for evaluation, accident source terms, and the effects of modularity, multi-modules, and collation with industrial facilities
- Defining a clearer approach and structure for adapting LWR-centric prescriptive requirements to non-LWR applications while meeting the underlying safety basis
- A "phased" NRC review process that can incrementally reduce regulatory uncertainties and risks as designs mature and are finalized.

Improving framework compatibility is also an objective identified the May 27, 2016 (unpublished) draft of DOE's "Vision and Strategy for the Development and Deployment of Advanced Reactors". With respect to RRR, a key strategic objective is identified as:

> ***"Support the establishment of an efficient and reliable regulatory framework for advanced reactors.*** *Industry experts consistently point to the need for an appropriate, efficient and predictable regulatory framework as a high priority for commercializing advanced reactor technologies. DOE and its stakeholders will work with the NRC as the NRC develops new regulatory processes, including efforts to develop design criteria for advanced reactors, staged licensing processes, and preapplication licensability review processes."*

Figure 2 shows how this particular objective conceptually relates to the overarching DOE vision for advanced (Generation IV) reactor technology deployment as discussed in the draft vision and strategy document.

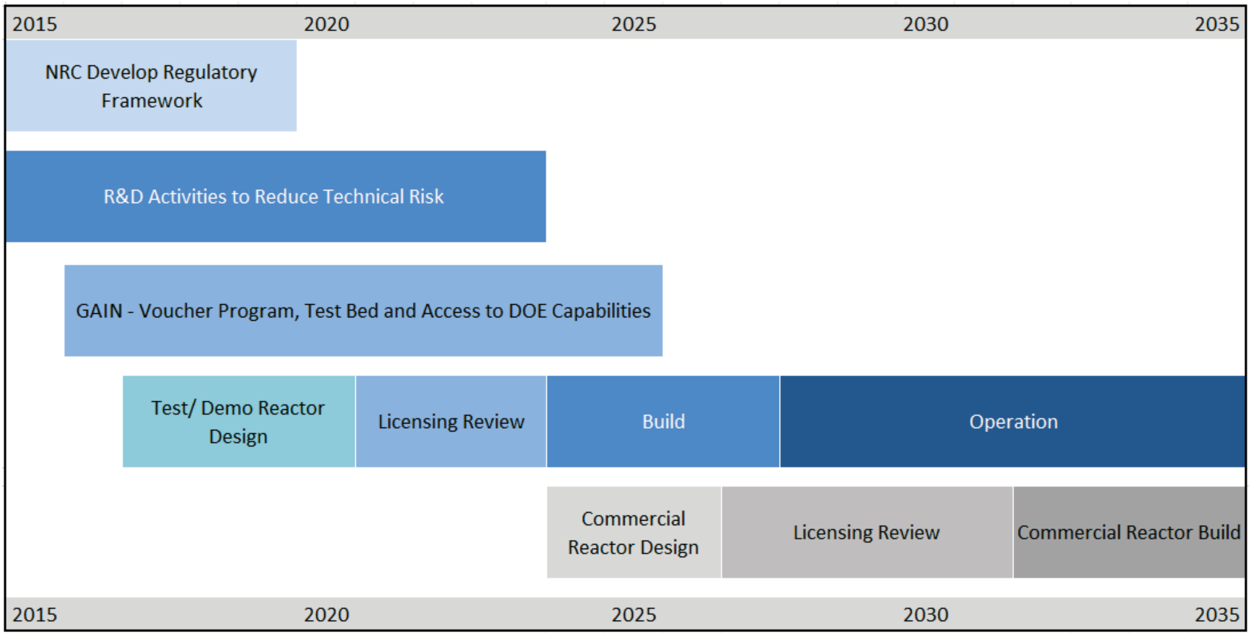


Figure 2. Notional timeline for advanced reactor deployment.

To address this element of the DOE vision and strategy document, top-level RRR objectives have been established that:

1. Develop well-informed and substantive proposals with actionable sets of recommendations suited for consideration by the regulated community and the NRC which can be eventually used in advanced reactor safety evaluations and licensing
2. Systematically implement activities that enable use of proposals and recommendations by applicants and regulators within a 5 year timeframe
3. Ensure proposals and implemented actions do not erode confidence in the methods and measures used to ensure public safety.

2.2 Scope

Achieving regulatory risk retirement objectives will be a complex and iterative endeavor requiring involvement of NRC staff, the Commission, DOE, representative cross-sections of the vendor and owners/operators community, and interested members of the public. These groups must collaborate to ensure technical requirements are established that are:

Risk-Informed (RI)

This approach to regulatory decision-making considers risk insights together with other factors to establish requirements that focus licensee and regulatory attention on design and operational issues commensurate with their importance to public health and safety. A RI approach enhances deterministic approaches (now used in the regulatory framework) by:

a. Allowing explicit consideration of a broader set of potential challenges to safety
b. Providing a logical means for prioritizing challenges based on risk significance, operating experience, and/or engineering judgment

c. Facilitating consideration of a broader set of resources to defend against challenges

d. Explicitly identifying and quantifying sources of analysis uncertainty (although such analyses do not necessarily reflect all important sources of uncertainty), and

e. Leading to better decision-making by providing a means to test result sensitivity to key assumptions.

RI methods can reduce unnecessary conservatism contained in purely deterministic approaches and help identify areas with insufficient conservatism in deterministic analyses. They can also provide a basis for additional requirements or regulatory action. The "risk-informed" approach lies between "risk-based" and "purely deterministic" approaches.

Performance-Based (PB)

A requirement can be either prescriptive or performance-based. Prescriptive requirements specify design features or actions to achieve a regulatory objective. A PB requirement relies on meeting measurable (or calculable) performance results but provides flexibility on the means used in attaining the outcome. Regulatory approaches that use performance results as the primary basis for decision-making incorporate the following attributes:

a. Measurable (or calculable) parameters can be used to calculate the parameter of interest

b. Objective criteria to assess performance are established based on risk insights, deterministic analyses and/or performance history

c. The licensee has flexibility in determining how to meet established criteria and do so in ways that encourage and reward improved outcomes, and

d. A framework exists in which failure to meet a performance criterion, while undesirable, will not in and of itself constitute or result in an immediate safety concern.

While a PB approach can be implemented without benefit of risk insights, this method would still require objective performance criteria based on deterministic safety analysis and performance history; such analysis and history may be unavailable for a radically new design.

Technology-Inclusive (TI)

To incentivize innovation across a broad spectrum of safety design ideas and reduce barriers to market entry for as many advanced reactor technologies as possible, framework elements must be adapted to be as generic and TI as possible. While design-specific attributes will still undergo analysis in a modernized regulatory environment, the issue of inclusiveness is likely best approached by broadly considering the following non-LWR reactor technology types:

a. Sodium Fast Reactors (SFRs)

b. Lead Fast Reactors (LFRs)

c. Gas-Cooled Fast Reactors (GFRs)

d. Modular High Temperature Gas-Cooled Reactors (HTGRs)

e. Fluoride High Temperature Reactors (FHRs)

f. Molten Salt Reactors (MSRs).

It should be recognized that in the near-term only modular HTGR and SFR technologies are adequately developed to provide the design details necessary to support certain regulatory interactions and "pilot testing" of key RI, PB, TI proposals. Consequently, framework modernization will likely rely more heavily on the design elements associated with these two technologies.

A work scope addressing Subsection 2.1 objectives has been drafted to guide the RRR initiative along two venues of change advocacy. These are:

1. Direct interface with and support to key nuclear industry advocacy groups, such as the Nuclear Energy Institute (NEI), Nuclear Innovation Alliance (NIA), and Nuclear Infrastructure Council (NIC). These organizations represent interests of the nuclear community (including advanced reactor developers) and are tuned to exert influence in the regulatory environment.
2. Creation of a multi-faceted industry-led regulatory framework modernization work team. This team will be led by a highly experienced large LWR utility owner/operator committed to bringing advanced reactor technology to the energy market. The team will analyze industry regulatory needs in great detail, develop specific recommendations and proposals regarding necessary change, and perform activities designed to incorporate those recommendations and proposals into an industry and regulator-accepted framework. The industry-led team also provides linkage between ART R&D planners/investigators and the advanced reactor community regarding the needs resulting from newly established licensing technical requirements. It also facilitates more effective R&D planning and increases mutual awareness about critical technology information gaps.

While nuclear advocacy groups like those mentioned above are focused on high level industry needs, the RRR initiative is being scoped to complement that capability and leverage it into a capacity that more precisely itemizes specific needs and implements actions necessary to address those needs. The RRR work scope also supports DOE's Gateway for Accelerated Innovation in Nuclear (GAIN) initiative which, among other things, seeks to improve the "licensing readiness level" of innovative nuclear technologies.

The RRR effort will provide substantive progress in framework modernization within the next 5 years. At that time, project success will yield new opportunities for advanced reactor applicants to optimize project costs, minimize scheduling constraints, and increase confidence in project planning due to clearer requirements and a more robust overall regulatory environment. These opportunities will directly translate into reduced regulatory risks, lower uncertainties in the independent safety evaluation process, and ultimately increase competitiveness in the domestic energy market.

3. FY 2016 REGULATORY RISK REDUCTION ACTIVITIES

Objectives of the RRR initiative align with other companion efforts in framework modernization. Important risk reduction activities outside of the RRR project (and not discussed in this report) include the DOE/NRC joint initiative to develop new design criteria guidance for advanced reactors [3] and a series of public workshops on non-light water reactor planning (also jointly sponsored by DOE and NRC).

The following subsections identify major RRR efforts over the past year as done under the INL/ART licensing program. Their purpose, relationship to Subsection 2.1 objectives, and current status are discussed and are effective as of August 2016.

3.1 Nuclear Energy Institute

3.1.1 Need and Purpose

The primary mission of NEI is to: (1) foster the beneficial use of nuclear technology before Congress, the White House, executive branch agencies, federal regulators, and state policy forums, (2) proactively communicate accurate and timely information, and (3) provide a unified industry voice on the global role of nuclear energy and nuclear technology.

NEI's core objective is to ensure policies are formed that promote beneficial use of nuclear energy and technologies in the U.S. and around the world. Through membership participation, NEI develops policy on legislative and regulatory issues affecting the industry and serves as a unifying voice for industry before the U.S. Congress, executive branch agencies, federal regulators, in international organizations and other venues. NEI also provides a forum to resolve technical and business issues for the nuclear industry.

Recently, NEI began coordinating industry-wide efforts to propel innovative nuclear technologies into the U.S. market. An "Advanced Reactor Working Group" was formed last year to bring greater attention to the regulatory needs of advanced reactors. To address the formidable licensing challenges facing non-LWR developers, an Advanced Reactor Regulatory Task Force (ARRTF) subgroup was established to work directly with NRC staff and establish an efficient and predictable regulatory framework. The ARRTF is chartered in four areas: (1) resolve regulatory policy issues for nonlight water advanced reactors, (2) establish a staged regulatory approach, (3) establish a technology-inclusive regulatory structure that is risk-informed and performance-based, and (4) ready the licensing process for noncommercial demonstration projects. In recognition of the shared goals addressed by this charter, the INL/ART Director of Regulatory Affairs joined the ARRTF in 2015 as a full working member.

3.1.2 Activities

Active collaborations between NEI and industry stakeholder representatives routinely occurred throughout FY 2016. Matters of shared importance concentrated on the ARRTF mission to lead various industry efforts in resolving regulatory issues and implement actions that improved the regulatory framework appropriate to commercial designs by 2030. Support from INL/ART to the ARRTF concentrated on the synthesis of background information needed to:

1. Identify and resolve regulatory gaps and implement modernization actions that support efficient and timely licensing of demonstration and commercial advanced reactor concepts
2. Interact with the NRC, DOE, and others to modify or create the requisite licensing and regulatory framework; modes of interaction include workshops, public meetings, and written position papers/comments
3. Support and coordinate efforts with other advocacy organizations and the American Nuclear Society to clarify and advance shared objectives
4. Identify and recommend resolutions to other framework-related issues that may arise within NEI membership.

3.1.3 Status

At this time, ARRTF/ART collaborations are ongoing with industry stakeholder inputs being received that identify specific regulatory policy issues of concern. Key technical information gaps that remain to be addressed are also being catalogued. Other involvements include development of a staged reactor design approval/licensing process (with a July public meeting held between NRC and NEI), how to most effectively establish a TI, RI, PB regulatory framework, and how clarification and compliance guidance related to a modernized licensing processes can be developed. Substantial attention is also being directed towards the use of advanced reactor demonstration projects as a tool in fleet-scale licensing.

INL/ART will remain actively engaged in the ARRTF and continue to contribute and glean insights on the aforementioned topics. Particular attention will be directed towards maintaining alignment between the ARRTF and the industry-led initiative discussed in Subsection 3.4 of this report.

3.2 Nuclear Innovation Alliance

3.2.1 Need and Purpose

The NIA is a recently formed industry focus group that is part of the Clean Air Task Force. Its mission is to lead advanced nuclear energy innovation by developing and advocating policies that enable efficient licensing and timely early-stage demonstrations of advanced reactor technology.

The NIA has established four priorities:

1. A more staged and technology neutral licensing process
2. Develop a test bed capability
3. Promote international cooperation
4. Encourage financial support for new and innovative technologies.

Regarding the first priority, NIA views current NRC regulations as confronting advanced reactor technology developers with two major challenges. First, NRC design certification and approval calls for an enormous front-loaded investment and a protracted development and licensing phase. Without a staged licensing structure to provide applicants with clear, early feedback on a mutually acceptable timeframe with appropriate finality, project risks are dramatically increased. Second, current regulations evolved primarily to assure light water technology safety. Those regulations are sometimes not suited to the features and performance characteristics of non-LWRs and must be adapted. Clearly, since the latter technologies often rely on substantially different fuels, cooling systems, and safety strategies, existing regulations offer significant risks due to inconsistency and confusion.

3.2.2 Activities

During FY 2016, a representative from INL/ART Regulatory Affairs became a member of NIA's Advisory Council as well as a working member of NIA's Advanced Reactor Licensing Working Group. In that capacity, INL/ART has been able to contribute to NIA's efforts in defining industry needs in the context of the NIA mission and establish a set of viable "path forward" recommendations that address the first NIA priority, i.e., the staged and technology neutral licensing process. These efforts are documented in a report entitled "Enabling Nuclear Innovation – Strategies for Advanced Reactor Licensing". [4]

3.2.3 Status

The NIA report proposed strategies that are designed to facilitate efficient, cost-effective, and predictable licensing of advanced nuclear power plants in the U.S. More specifically, the report lays the foundation for in-depth consultations among stakeholders interested in an improved licensing process. The process would incorporate discrete stages of regulatory approval that are seen by industry as creating opportunities for better project risk management and, where appropriate, opportunities to employ risk-informed, performance-based (RIPB) strategies.

INL/ART will continue to track and participate in NIA efforts to create a staged and technologically neutral licensing process. Important coordination will also be provided to bridge NIA efforts with the RRR initiative discussed in Subsection 3.4 of this report.

3.3 Nuclear Infrastructure Council

3.3.1 Need and Purpose

The NIC is a business consortium advocate for new nuclear technology development and global promotion of the U.S. supply chain. Strategic NIC priorities include:

1. Launching the next wave of U.S. nuclear energy plants

2. Revitalizing the U.S. supply-chain infrastructure to compete in global markets
3. Resolving key “building block” issues such as a sustainable fuel cycle.

3.3.2 Activities

INL/ART Regulatory Affairs staff provided a “Lead Perspectives” presentation at the NIC-sponsored Advanced Reactor Technical Summit III held at Oak Ridge National Laboratory (ORNL) on February 10-11, 2016. This was done with parallel presentations by NRC management that engaged industry panel discussions concerning methods available for the management and retirement of extraneous regulatory risk. Interactions focused on several areas of “Moving the Licensing Paradigm Forward” and included an analysis of options like the use of NRC Draft Regulatory Guidance, DOE-NRC joint initiatives, lessons learned from small modular reactor generic issues, and barriers associated with licensing framework modernization.

3.3.3 Status

INL ART Regulatory Affairs staff will continue to engage NIC as appropriate opportunities arise to facilitate common ground discussions about how to further accelerate the maturation of advanced reactor designs, reduce impediments to deployment, and enhance safe reactor operations. In particular, interaction opportunities will be sought concerning the industry supply chain, leading-edge advanced reactor concept developers, and key thought and policy leaders whose involvement would benefit the emergence of a more efficient regulatory environment.

3.4 Industry-Led Regulatory Framework Modernization

3.4.1 Need and Purpose

Member-oriented industry advocacy groups like those identified in Subsections 3.1 through 3.3 are moving quickly to identify broad suites of issues that must be addressed to improve the regulatory environment and move deployments forward. At this time, these groups appear to be converging on a similar thread of foundational concern. However, addressing these concerns in a systematic manner at working levels requires a change management capability that exceed mere advocacy. Effective retirement of regulatory risk must also be approached with the committed involvement of credible future applicants interested in the subject technology and willing to ensure essential activities are undertaken in the appropriate sequence. They must also be capable of technically justifying those actions before regulators and the public. To address this challenge, an industry-led team is being established under the ART RRR initiative to bring a bias for action in framework modernization and better ensure a “one issue-one resolution” approach during prelicensing interactions with the NRC.

A large number of diverse activities from many sectors are required to modernize the regulatory framework. The RRR industry-led team will accept inputs from across the industry and refine those inputs into actionable recommendations and proposals for consideration by the NRC. The team will also perform many (but not all) follow-on implementation activities. The relationship of the industry-led team to major “bins” of expected activity is conceptually illustrated in Figure 3.

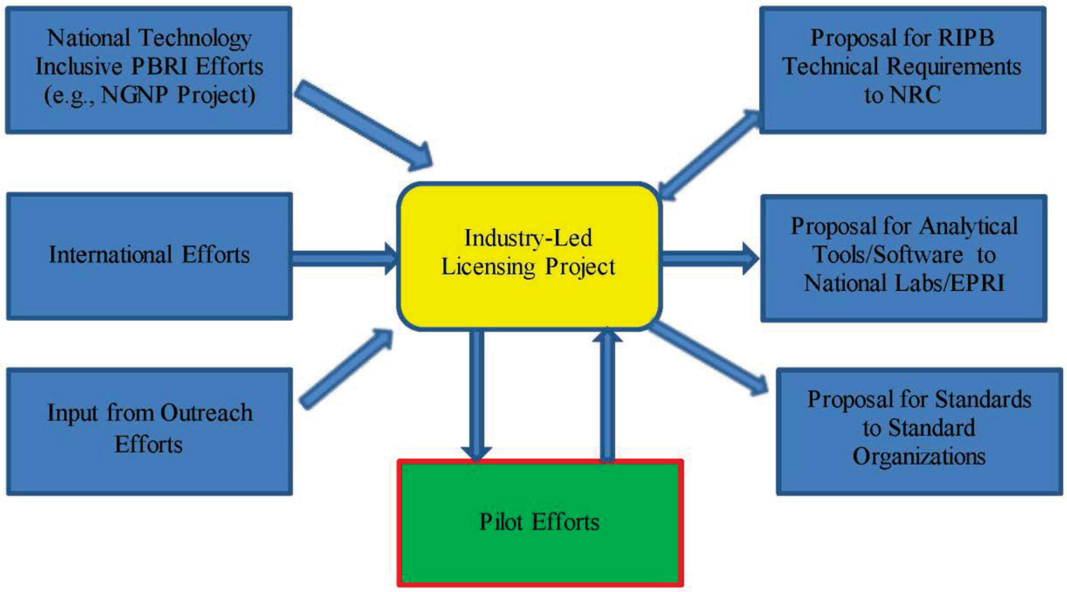


Figure 3. Example of framework team activities.

3.4.2 Activities

A statement of work has been written and appropriate contracts awarded that support the formation of an industry-led framework modernization team. The project team is being led by Southern Company Services, a wholly-owned subsidiary of Southern Company (SC). The industry-led team will operate in close coordination with the INL ART Regulatory Affairs Department to ensure project objectives and scope as identified in Section 1 are addressed.

Certain high priority activities have been identified that form the basis for near-term industry-led team planning. These include:

- Unique and Applicable Historic Reactor Licensing Precedents: Conduct a comprehensive examination of prior non-LWR licensing activities and recent advanced light water reactor (ALWR) policies. Evaluate their regulatory treatment from a technology-inclusive perspective.
- RIPB Applications: Analyze the full set of RIPB design applications along with associated regulatory decision criteria. The technical basis for decisions must be technology-inclusive and changes must lead to effective, efficient, and predictable criteria that are of value to technology developers. A clear and consistent basis for NRC staff's findings is to be established with respect to safety and environmental impacts. Key policy issues will likely need Commission-level resolution.
- Pilot Applications: Proposed recommendations may benefit from testing in pilot or trial-scale user situations. This assures efficacy before incorporation into the framework. Pilots would be done in association with the user community (e.g., developers and/or prospective applicants) and should help assure DOE technology deployment objectives are met.
- Establish Supporting Infrastructure (SI): Framework modernization requires support from external organizations in areas such as codes and standards, safety analysis models, and analytical tools. Because external organization timelines may be extended beyond the timeline now projected for the ART RRR effort (i.e., 5 years), proposals must provide for full life-cycle SI development.
- Communications: Effective information exchange with representative stakeholders is crucial. Communications must address outreach to external stakeholders (e.g., standards development organizations (SDOs), software developers, reactor designers, advocacy groups and task forces, the

Electric Power Research Institute (EPRI), NRC, and DOE) and timely internal project communications (e.g., project team members and private sector resource support, project subcontractors, and ART/INL).

3.4.2.1 Initiative Phases. The three distinct project phases have been established. They are:

Phase 1 – Project Scoping and Work Plan Development

A work plan has been developed that was scoped using a project management work breakdown structure to guide and schedule activities in subsequent proposal development (Phase 2) and implementation and demonstration (Phase 3) efforts. Communication protocols are also outlined in the work plan.

Phase 2 – Modernized Licensing Framework (Definition and Feasibility)

Activities identified in the work plan will lead to the creation of specific proposals and recommendations. Emphasis will be on developing suites of actionable steps for their incorporation into modernized technical and regulatory requirements. Phase 2 is a multi-year effort during which topical "white papers" and a final report are to be developed. These documents are meant to advise NRC and others about recommended approaches, options, and pathways for implementation. To the greatest extent practical, recommendations will address multiple non-LWR technologies and emphasize changes that support SDOs in the development of licensing tools, consensus standards, and analytical methods. Phase 2 activities will be performed largely by the core industry-led framework modernization team and expand to others as needed.

Phase 3 – Framework Implementation and Demonstration

Phase 3 will emphasize project team collaborations with NRC, industry organizations, and future applicants as proposals and recommendations proceed to testing and implementation. Obtaining NRC endorsements will be a major priority. Active support from SI organizations will be required to stabilize the evolving framework. Activities will involve extensive public meetings with NRC, response to requests for information from NRC and others, writing position papers, developing support positions for pilot demonstrations and applicant licensing approach strategies, and data exchanges to partnered stakeholders like SDOs.

3.4.2.2 Communications. The industry-led team is expected to have extensive interaction with individual advanced reactor vendors and prospective plant owners/operators as well as key industry advocacy groups and the NRC. NEI has already been identified as a primary participant in communicating the objectives and approaches associated with the RRR effort; additional participants are being sought for involvement.

Communications with project supporters will be managed by SC in close coordination with INL ART Regulatory Affairs. Regulatory, technology, and DOE laboratory experts will be added to the project "core team" as the need for consultation arises. To better ensure the team communicates with "one voice", communication protocols are being established for three venues:

- The SC Enterprise system will enable internal project communications, document storage and revision control. Team collaborations will use the SC web-based work environment and use weekly conference calls and resource-loaded schedules to manage work allocations.
- External communications will initially concentrate on keeping key policy makers (e.g., Congressional and Administration staff) informed of progress and emerging challenges. Since Congressional and Administration involvement is a significant factor in framework modernization, these interactions will coordinate through SC Governmental Affairs in accordance with SC procedures. Coordination will also be routinely maintained with DOE and INL/ART Regulatory Affairs. NRC interactions will be subject to project external communication protocols.

- Pilot communications will be held with technology developers to secure design information and test proposed licensing approaches. Preserving proprietary and/or business sensitive information is expected to be a concern in these communications.

The dynamic nature of the project will require periodic adjustment in communication approaches. Protocol changes will be instituted based on the judgment of the SC technical lead and the SC project manager in consultation with the director of INL/ART Regulatory Affairs.

3.4.3 Status

The industry-led framework modernization project began in May 2016 with the start of Phase 1 work plan activities. Subsequent phases were developed according to the performance window provided in Figure 4.

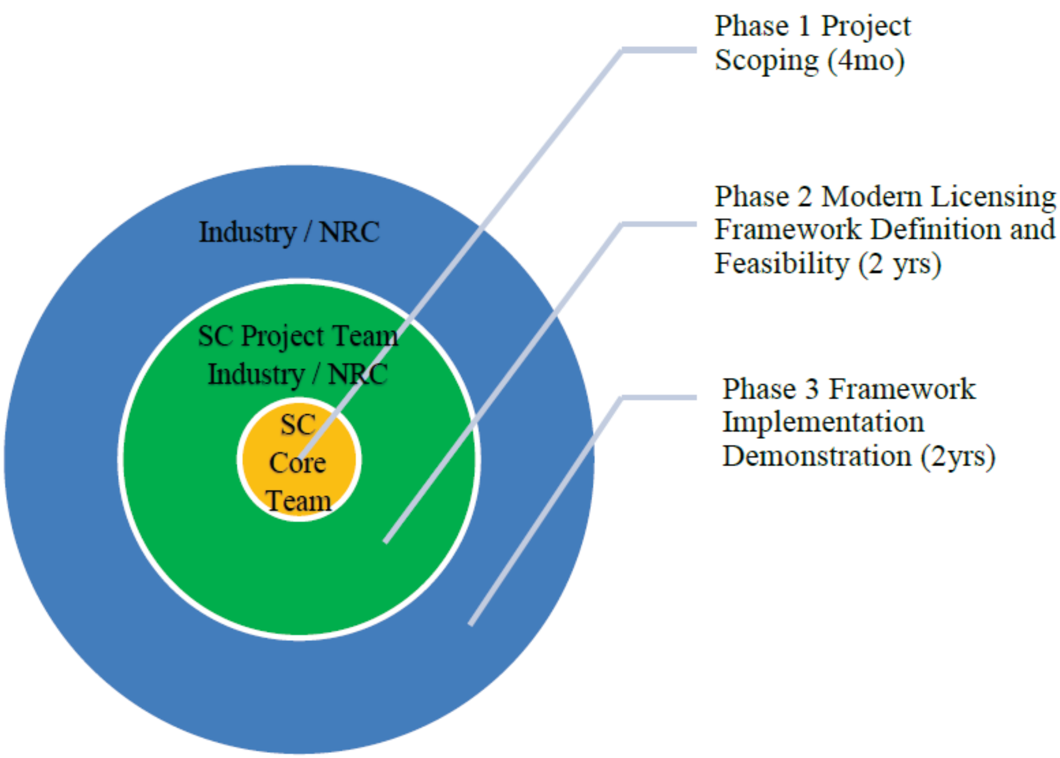


Figure 4. Industry-led framework team project phases.

The project work plan (i.e., Phase 1 work) is expected to be complete in September 2016 and is planned for public release. Phase 2 is scheduled to start in September 2016 and is planned for a two year period. Phase 3 will undergo detailed work planning as Phase 2 progresses and will nominally start as Phase 2 draws to a close. However, some pilot-scale testing normally associated with Phase 3 could start earlier, likely in the latter half of Phase 2.

4. FUTURE EFFORTS IN REGULATORY RISK REDUCTION

The following subsections discuss the RRR approach and top-tier activities anticipated for FY 2017 and beyond.

4.1 Approach

Historically significant but design-specific precedents do exist regarding development of RIPB regulatory and technical requirement sets. These precedents offer a sound basis upon which the guiding principles of the RRR effort have been built. These principles are:

- Adopt previous work directly when the precedent is applicable and appropriate
- Adapt processes to previous work where simple changes can facilitate implementation
- Advance prior work when current knowledge can (in a technology-inclusive manner) enhance existing regulatory processes and/or create more robust technical approaches.

For FY 2017 and thereafter, the RRR project will develop proposals and recommendations around these principles that accentuate TI risk profiles and non-LWR design attributes. The technical basis for a robust RIPB approach will be created that emphasizes licensing efficacy and effective decisional criteria. Supportive guidance and policies are to be eventually addressed such that:

1. Scope definitions, analysis methods, and a technical basis for safety analyses is readily available
2. Nuclear power heat source licensing is separate from secondary product licensing requirements to maximize the fungibility of nuclear island licensing results
3. Convergence is achieved on potentially conflicting jurisdictional issues associated with licensing an integrated nuclear facility in an atypical siting situation.

Prior NGNP's framework approaches will be incorporated when considering co-generation nuclear facilities in the context of a modernized licensing framework.

4.2 Activities

Specific activities scheduled over the next two years (as a function of Phase 2 efforts) are listed in Appendix A. Scheduling associated with these activities will be discussed in the industry-led team project work plan.

Figure 5 depicts how organizational interfaces will be managed in support of the various work elements identified in Appendix A.

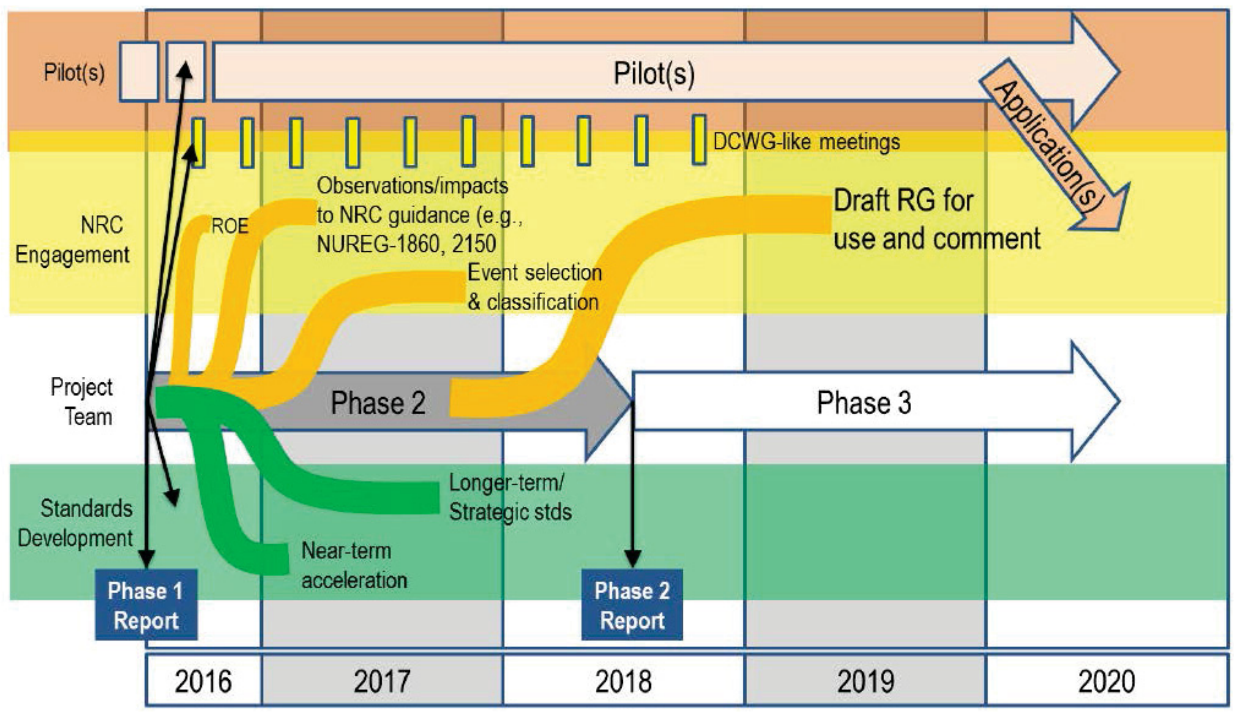


Figure 5. Organizational interfaces.

For the next two years RRR project personnel, in conjunction with DOE lab staff, advocacy groups, SDOs, NRC, and additional governmental, industry, and public stakeholders, will implement Appendix A activities to lay the groundwork needed to:

- Provide key insights on past and current non-LWR pre-licensing experience (notably NGNP and PRISM)
- Provide advanced reactor technology familiarization
- Ensure RRR efforts remain coordinated with the priorities and goals of DOE
- Solicit review and comment on proposed approaches, recommendations and pilot tests
- Address priority policy and technical issues
- Identify and define core issues in the licensing framework modernization effort
- Facilitate access to national laboratory resources (e.g., via the GAIN Initiative)
- Establish memorandums of understanding or inter-agency agreements as necessary.

4.3 Additional Considerations

4.3.1 Conflict of Interest

A review was conducted concerning how the RRR industry-led framework modernization work scope will complement, but not repeat, the work scope awarded to SC by DOE under the Funding Opportunity Announcement (FOA) to develop a molten salt fast reactor (MCFR) concept. [5]. A scope review of the FOA contract (i.e., DE-NE0008473, the "MCFR FOA Project") indicated that while a potential does exist for synergy between the two projects, work scope overlaps do not currently exist. The SC technical lead and SC project manager for both projects will monitor future project activities and if redundancies should develop, the SC project manager will report the concern to the ART/INL RRR project contract point of contact and work to resolve conflicts as appropriate.

4.3.2 Schedule

The timeline for the industry-led framework modernization team has been established and is discussed in Subsection 3.4.3. Accordingly, the industry-led framework project is planned to the following schedule:

Phase 1 – Complete September 2016

Phase 2 – Complete August 2018

Phase 3 – Complete August 2020.

Supplemental RRR work dealing with advocacy group collaborations will also be attuned to the industry-led team project timeline. However, it should be noted that because Phase 3 and, to a much lesser extent, Phase 2 schedules are contingent on the willingness and ability of supporting organizations and NRC staff to become involved in framework modernization efforts, this schedule is subject to change in response to emerging circumstances.

4.3.3 Success Criteria

Detailed RRR project success criteria for Phase 2 work are now being formulated. These criteria will be discrete and quantifiable. Phase 3 success criteria will be developed as Phase 2 work is accomplished. In the interim, top-level RRR success criteria (as developed during Phase 1 work) are summarized as:

1. Recommend sets of deployable technology-inclusive RIPB technical requirements (along with their associated basis), and propose courses of action that enable prospective applicants and the NRC to deploy process and technical requirements within two years of proposal issuance (i.e., NRC guidance preparation can be started on the basis of recommendation issued in Phase 2)
2. Facilitate implementation of a modernized regulatory structure that can be used by future applicants and regulators within five years following completion of the project.

Additionally, as the INL/ART RRR project continues to establish and refine lower-level success criteria, compatibility will be maintained with the objectives and activities established under DOE's GAIN initiative. The mission of GAIN is to advance nuclear power as a resource in meeting the nation's energy, environmental, and national security needs by engaging DOE in the often lengthy and expensive programs needed to address cost, safety, proliferation resistance, and security barriers associated with new nuclear energy options. Often, these programs rely on highly specialized R&D capabilities and unique demonstration platforms that are largely beyond the capabilities of individual private sector entities.

GAIN provides the nuclear community with access to the technical, regulatory, and financial support required to move innovative nuclear energy technologies towards commercialization while ensuring those technologies are safe, reliable, and economically viable. To better understand current industry needs, public workshops have been held to collect insights and priorities from the non-LWR development community. Through these workshops and supplemental follow-on interactions, it's clear that industry now views regulatory uncertainties and the lack of timely and efficient licensing processes as a formidable market entry barrier and thus a priority concern. As details of the safety and licensing approaches proposed by technology developers become known through GAIN and similar venues, the RRR effort will incorporate those insights into a change strategy that complements the objectives of GAIN.

5. REFERENCES

[1] NRC 2012, “Report to Congress: Advanced Reactor Licensing”, U.S. Nuclear Regulatory Commission, August 22, 2012

[2] INL 2014, “NRC Licensing Status Summary Report for NGNP”, INL/EXT-12-28205, Rev 1, Idaho National Laboratory, November 2014

[3] INL 2014, “Guidance for Developing Principal Design Criteria for Advanced (Non-Light Water) Reactors”, INL/EXT-14-31179, Rev 1, Idaho National Laboratory, December 2014

[4] NIC 2016, “Enabling Nuclear Innovation – Strategies for Advanced Reactor Licensing”, Nuclear Innovation Alliance, April 2016

[5] Southern Company Services, Inc., Domestic Utility, Advanced Reactor Industry Competition for Concept Development, DE-FOA-0001313

Appendix A

Phase 2 Activities

Appendix A

Phase 2 Activities

The following list (Table A-1) is taken from the work breakdown structure (WBS) task dictionary that will be used to guide Phase 2 industry-led team project efforts. This list is current as of August 2016 and is subject to future adjustments.

Table A-1. Forthcoming regulatory risk reduction activities.

WBS	Task Name	Task Descriptions
1	Regulatory Needs	Define the essential changes to technical licensing requirements for advanced reactors to safely, efficiently, and effectively conduct regulatory reviews and propose actions to achieve a technology-inclusive, performance-based, risk-informed framework commensurate with advanced reactor development timelines.
1.1	Background Info	Review the extensive background on advanced reactor licensing for precedents, approaches, and potentially new requirements that differ from existing LWR-centric requirements as a baseline for building a modernized TI licensing framework.
1.1.1	Identify Applicable Precedents	Identify the useful precedents that can be part of the strategy for developing a modernized technology-inclusive regulatory framework for non-LWRs.
1.1.1.1	MHTGR	Examine history on RI treatments, severe accident determination, containment performance, and other useful precedents for advanced reactors.
1.1.1.2	Exelon PBMR	Examine history on gap analysis process, legal and RIPB white papers.
1.1.1.3	EPAct05 and NGNP	Examine NGNP Licensing Plan agreed upon with NRC, results of topical white papers for RI and other useful issues.
1.1.1.4	NUREG-1860	Examine background and interim findings for technology neutral RIPB approach to a new Part 53, including event selection framework, risk applications, regulatory framework change challenges, and PB issues such as functional containment.
1.1.1.5	NUREG-2150	Examine conclusions for design development using RIPB practices, examine RI decisional framework, safety goal applications.
1.1.1.6	SRP Intro Part 2	Examine the approach to RIPB licensing, use of design specific review standards and other small modular reactor precedents useful to advanced rectors.
1.1.1.7	NIA Paper - Strategies for Advanced Reactor Licensing	Examine challenges and strategies to use the existing administrative framework in a staged manner to progressively retire risk.

Table A-1. (continued).

WBS	Task Name	Task Descriptions
1.1.1.8	DOE ARDC Initiative	Examine the potential for technology neutral RI and additional PB adjustments beyond the current NRC-DOE initiative. Precedents used to also examine technical regulations outside the general design criteria population for similar treatments.
1.1.1.9	Existing NRC Policies for Future Reactors	Examine safety goal, risk goal, others for permissives important to advanced reactors.
1.1.1.10	Scope of Current NRC RI Guidance	Summarize existing regulations, RG or other guidance in NUREG 800, etc. for using RI and PB practices.
1.1.1.11	NRC Strategic Plan	Examine NRC Strategic Plan intentions for RIPB, advanced reactor licensing, other issues of use to AR.
1.1.1.12	Existing and Planned Standards for PB-RI processes and non-LWR AR use	Identify current and upcoming SDO plans for RI or PB standards or advanced reactors.
1.1.1.13	NRC Performance Based Licensing Initiative (NUREG and BR-303)	Examine the extent of PB precedents and practice guidelines for application to design and licensing.
1.1.1.14	PRISM/AP1000/ESBWR	Consider earlier advanced LWR or other non-LWR precedents of use to non-LWR designs for licensing purposes.
1.1.1.14.1	Examine Trial Uses/Pilot Studies of RIPB Standards on PRISM, X-Energy, etc.	Summarize current trial use experience for RIPB processes for applicability to non-LWR designs
1.1.1.14.2	AP1000 Precedents on PB Criteria	Examine AP1000 use of PB approaches to design and licensing approved by NRC.
1.1.1.14.3	ESBWR Treatment of RAW in SSC Classification	Examine ESBWR use of risk metrics, such as RAW, in SSC Classification and special treatment; examine NuScale approach to RI SSC Classification.
1.1.1.14.4	NRC Draft Vision and Strategy: Safely Achieving Effective and Efficient Non-LWR Mission Readiness	Examine NRC planning for nuclear light-water reactor (NLWR) licensing for AR as it evolves.
1.1.2	Summarize Usefulness for Future Non-LWR Licensing and Needs	Summarize the findings (precedents, gaps, open TI issues, conflicts) with implications for developing a modernized technology-inclusive regulatory framework for non-LWRs.
1.2	Define Performance-Based Technical Requirements	Define the ultimate potential reach of performance-based technical requirements for ARs.
1.2.1	Define Rationale	Define rationale for technology-inclusive vs. technology- specific requirements use.
1.2.2	Define PRA Use	Define the use of PRA to inform PB regulatory requirements.
1.3	Conduct Non-LWR Gap Analysis	Define the synergy and use of PRA to inform TI PB regulatory requirements.
1.3.1	Review ARDC Results	Review results of DOE ARDC for suitability in RIPB framework and identify potential technology neutral and technology specific changes.
1.3.2	Summarize Potential Additional Changes to All Technical Regulatory Framework (Part 50 only)	Review all technical regulations in Part 50 for applicability to non-LWRs and summarize additional potential RIPB changes to TLRC in regulations.
1.4	Define Risk-Informed Decision Making (RIDM) for Non-LWR's	Establish a practical framework for effective and efficient RIDM.

Table A-1. (continued).

WBS	Task Name	Task Descriptions
1.4.1	Select/Develop RIDM methodology	Examine nuclear industry and other industries for established RIPB practices; summarize best practices and possible gaps as input to proposed methodology.
1.4.1.1	Review Current Standards, Practices, and Guidelines within Industry	Develop composite proposed methodology for pilot use.
1.4.1.2	Develop Composite Proposed Methodology	Conduct pilot examples of different kinds of RI decisions to validate a broad spectrum of applications using the developed process. Modify the methodology based on pilot uses.
1.4.1.3	Conduct Pilot use of Proposed Methodology	Conduct pilot examples of different kinds of RIDM to validate a broad spectrum of applicability using the developed process. Modify the methodology based on pilot uses.
1.4.1.4	Recommend Viable Strategy for Implementing Standardization of RIDM Processes	Develop and recommend a viable strategy for implementing standardization of RIDM processes with inputs from industry and NRC.
1.4.2	Develop Definitions for RIDM Acceptance Considerations	Propose the safety framework criteria for RIDM to answer the question “How good is good enough?”
1.4.2.1	Propose/Reference Top-Level Safety Criteria for RIDM	Evaluate the use of RIDM on different types of decisions impacting different parts of the licensing basis and determine if RIDM can be grouped logically based on different, appropriate acceptance criteria.
1.4.2.2	Establish Ranges of Decision Criteria for Different Licensing Basis Event Categories	Determine the need to apply special treatment (programmatic capability) to support RIDM and establish a comprehensive list of types of special treatments that will enhance confidence in process; define any boundaries of applicability and acceptance criteria for RIDM.
1.4.2.3	Develop Role and Extent of Special Treatment Application in RIDM	Confirm whether reactor technology differences will require different RIDM acceptance criteria or whether technology neutral criteria are sufficient.
1.4.2.4	Evaluate the Need for Reactor Type- Specific Requirements for RIDM	Confirm whether reactor technology differences will require different RIDM acceptance criteria or whether T-N criteria are sufficient.
1.4.2.5	Propose Definition for Considering Adequate Defense-in-Depth in RIDM	Establish a definition for adequate defense in depth (DID) and propose a framework for concluding DID adequacy on a plant or functional level and a generic strategy to remedy any shortcomings in DID.
1.5	Identify Policy Issues	Based on the background reviews and specific RIPB topics, identify any Commission-level policy gaps and NRC staff practice gaps that should be addressed and propose a path forward on each topic.
1.5.1	Identify Issues for Commission Action	Draft policy issue summary for consideration of developing new or modified policy statements.
1.5.1.1	Defense-in-Depth Approach	Review historic DID definitions. Formulate a RIPB TI definition of adequate defense-in-depth and propose new definition to NRC.
1.5.1.2	Containment Plan	Develop a technology neutral plan to complete the functional vs. conventional containment PB definition and achieve regulatory closure for NLWRs.

Table A-1. (continued).

WBS	Task Name	Task Descriptions
1.5.1.3	NGNP TLRC Elaboration	Develop and propose a plan that completes the NGNP approach TLRC (frequency vs. dose limits) for different event regions.
1.5.1.4	Multi-Unit Risk Plan	Identify the policy and technical issues that arise when considering multi-unit plant configurations.
1.5.1.5	RTR/Prototype Issues	Identify and propose solutions for research and test reactor (RTR) demonstration and prototype licensing issues for non-LWR first of a kind (FOAK) plants including definition changes.
1.5.1.5.1	Prototype Definition	Explore latitude in size and capability for prototypes for commercial FOAK reactors and potential path to more effective and timely use of RTRs as part of AR development.
1.5.1.5.2	RTR Definition Review	Examine existing NUREG and Interim Staff Guidance (ISG) guidance for RTR definition and use and determine potential conditions for broader use advanced RTRs and more efficient licensing; propose path forward to implement identified changes.
1.5.1.5.3	Regulatory Precedent Review	Explore regulatory precedents for RTR revenue and benefits of broadening RTR revenue opportunities up to "break-even" that would encourage greater private development funding; propose changes or clarifications needed to implement.
1.5.2	Identify Issues for Staff Management Action	Identify changes that can be executed within existing NRC management practices at the staff level, such as RGs, SRP requirements, ISGs and an engagement path forward.
1.5.2.1	Additional PRA Uses	Work with NRC and industry organizations to develop working list of new, valuable PRA applications and the value propositions and identify the associated regulatory infrastructure changes needed at the guidance level.
1.5.2.2	Application of Functional Reliability Criteria	Evaluate how to apply functional reliability criteria in RIPB approach vs. single failure criterion use and propose regulatory way forward.
1.5.2.3	Uses of Mechanistic Source Term	Identify all of the potential uses of mechanistic source terms and propose a regulatory path forward for each application.
1.5.2.4	List of Industry Codes	Develop a complete list of existing or new industry codes and standards beneficial to implementing a TI RIPB approach to non-LWR licensing and propose an implementation strategy and timeline for NRC and SDO pursuit.
2	Industry Outreach and Communications	
3	Analytical Tools (AT)	
3.1	Develop Requirements	Research and define scope and technical requirements for AT tools.
3.1.1	Define Roles of AT in RIPB Design and Licensing	Define the scope and role of AT in a RIPB process through collaboration with full project team.

Table A-1. (continued).

WBS	Task Name	Task Descriptions
3.1.2	Identify Standards Governing RIPB AT for Licensing	Determine the required codes and standards that would apply to AT tools, including defining applicable exiting standards and recommend modifications and/or the need for new standards.
3.1.3	Perform Initial Needs Analysis with Users	Collect requirements from potential users and stakeholders to understand their needs and wants.
3.1.3.1	Develop Needs Analysis Questions and Identify Interviewees	Develop interview and communication plan for working with vendors and regulator.
3.1.3.2	Interview Vendors	Perform individual interviews with advanced reactor vendors.
3.1.3.3	Interview NRC	Perform interview with relevant NRC representatives.
3.1.4	Write Scope/Requirements Document for ATs	Develop scope/requirements document, review with project stakeholders prior to distribution.
3.2	Assess Current State of ATs and Availability of Validations Data	Research available R&D resources, data, and technology to support the AT needs defined in the scope and requirements document. This information will need to be pulled from the various labs and industry groups, meaning traveling to the site and tracking down what is available.
3.2.1	Identify Relevant Sources of AT and Data	Identify and coordinate visits with potential data sources.
3.2.2	Visit Labs and Research Organizations	Perform site visits to identified sources (e.g., INL, ANL, and ORNL) with possible application to non-light water reactors. Determine tool capability, development status, ownership, availability to for use, etc.
3.2.2.1	Interview Tool Developers and Custodians	
3.2.2.2	Collect History of Relevant Experimentation	
3.2.2.3	Identify Location of Data	
3.2.3	Requirements for Use of the Tools and Data	Determine the use restriction and resources identified in research.
3.3	Write Gap Analysis Report for ATs	Develop an AT Gap Analysis Report based on the Requirements Document and the AT research results.
3.4	Write a Development Plan for Gap Closure	Develop and plan for the experimental and theoretical research and the software development needed to develop, validate, and/or implement AT with the quality and within a timeline required by the stakeholders.
3.4.1	National Lab Coordination	Coordinate with national labs and EPRI for R&D resources.
3.4.2	NRC/DOE Coordination	Coordinate with NRC and DOE for Potential Funding Plan.
3.4.3	Commercial Provider Coordination	Identify commercial providers to accelerate development.
4	PRA Development	Describe how PRA will be developed and applied to support different decisions in the risk-informed aspects of the licensing approach.
4.1	Define PRA Scope/Objectives for PBRI Licensing Applications	Explain how PRA is done in stages, scope and level of detail is consistent with available design information, expectation for PRA upgrades and revisiting decisions supported by earlier phases of PRA.

Table A-1. (continued).

WBS	Task Name	Task Descriptions
4.2	PRA Utilization in Design and Licensing	PRA role in defining safety functions, role of SSCs in the prevention and mitigation of accidents, evaluating design options, supporting trade studies, and key inputs to establishing the licensing basis.
4.3	Summarize Examples of PRAs that Support Risk-Informed Designs	MHTGR, NGNP, Yucca Mountain, PRAs on DOE non-reactor facilities will be summarized and their relevance to the licensing approach explained.
4.4	Define PRA Technical Adequacy Requirements for Design, Safety, Licensing, and Operations Activities	Reference to ASME/ANS RA-S-1.4-2013, ongoing PRA standard pilot studies, need for NRC review and endorsement of standard to be developed in 2017.
4.5	Define Use of PRA to Support PBRI Licensing Approach	Describe how PRA information will be used with deterministic inputs to select licensing basis events (LBE), safety classification of SSCs, special treatment requirements, and risk-informed evaluation of defense-in-depth.
4.5.1	Use of PRA to Inform Licensing-Basis Events Selection	Describe how event sequences defined in the PRA are classified into LBE categories and how the frequencies, consequences, and uncertainties are compared against top level selection criteria and the process for selecting the deterministically analyzed design basis accidents.
4.5.2	Use of PRA to Inform SSC Safety Classification	Describe PRA use to establish requirements for SSC reliability and capabilities to prevent and mitigate accidents. Consider the merits of setting numerical reliability.
4.5.3	Use of PRA to Inform Special Treatment Requirements	Tie in to ASME Section XI Reliability and Integrity Management and System Based Code; both of these initiatives involve the allocation of numerical reliability targets within the design specifications for systems and structures and lead to designer accountability.
4.5.4	Use of PRA to Inform Evaluation of Defense-in-Depth Adequacy	Tie into the selected approach for defining and evaluating defense-in-depth; NGNP white paper on DID calls for an evaluation that includes input from the PRA, evaluation of uncertainties, and feedback to design and programmatic elements.
4.5.5	Determine Additional PRA Applications	Summarize additional applications and decisions supported by the PRA, include input in the design to define the required and supportive safety functions of SSCs, risk-input to evaluation of design options.
4.6	Define Technical Issues for Non-LWRs PRAs in Support of PBRI Licensing	The purpose of this part of the WBS is to identify the unique issues for application of PRA for advanced non-LWRs and set forth strategies for resolution.
4.6.1	Technology Neutral Risk Metrics for Non-LWR PRAs	Explain why core damage frequency and large early release frequency are not workable for non-LWR designs. Describe approach to risk metrics in non-LWR PRA standard. Discuss need for multi-unit risk metrics.
4.6.2	Treatment of Multi-Unit/Multi-Module and Multi-Radiological Sources	Explain approach to multi-unit and multi-sources in non-LWR standard.
4.6.3	Treatment of Non-Radiological Hazards	This topic includes investment protection risk and risk of worker exposure to toxic hazards.

Table A-1. (continued).

WBS	Task Name	Task Descriptions
4.6.4	Lack of Non-LWR Service Experience to Inform Data Parameters	Explain how generic data will be used to address lack of non-LWR service experience; use of components common to LWRs.
4.6.5	Treatment of Uncertainty and Margin Management	Explain approach to quantify uncertainties, perform sensitivity analyses, and tie-in to defense-in-depth approach.
4.6.6	Other Technical Issues	This is a placeholder to address other issues that arise in the course of the project.
4.7	Independent Technical Review of Intended Use of PRA	The purpose of this part of the WBS is to have an independent party such as the John Garrick Risk Institute conduct an independent review of the proposed uses of PRA, identify or suggest improvements, and provide recommendations on how the approach can be improved for future applications.
5	Pilot Projects	
5.1	Regulatory Pilots	
5.1.1	Develop List of Potential Regulatory Pilots	Identify additional regulatory pilot activities as a result of defined work and insights gained from Regulatory, PRA and AT work.
5.1.2	Assemble Lessons Learned from Existing Regulatory Pilots	Compile all pilot results; identify follow-on expanded pilots; and, refine implementation strategies proposed for beyond Phase 2 work.
5.1.3	Establish Plan/Schedule for Follow-On Pilot Activities	Based on potential topics and lessons learned, select specific topics and establish detailed schedule/scope; activity includes outreach to prospective pilot candidates (reactor developers and/or site licensees).
5.1.4	Execute Regulatory Pilot(s)	
5.1.4.1	Typical Pilot	
5.1.5	Document Conclusions	Pilot activities will overlap Phase 2 and Phase 3 as implementation extends beyond completion of Phase 2 deliverable. This activity captures progress/status of pilot activity as input to Phase 2 report.
5.2	PRA Pilots	
5.2.1	Develop List of Potential PRA Pilots	Identify pilots for the non-LWR standard and prospective users of the RIPB licensing approach.
5.2.2	Assemble Lessons Learned from Existing PRA Pilots	Tie-in to the ASME/ANS working group on advanced non-LWRs.
5.2.3	Establish Plan/Schedule for Follow-On Pilot Activities	Based on potential topics and lessons learned, select specific topics and establish detailed schedule/scope; activity includes outreach to prospective pilot candidates (reactor developers and/or site licensees).
5.2.4	Execute PRA Pilot(s)	
5.2.4.1	Typical Pilot	
5.2.5	Document Conclusions	Pilot activities will overlap Phase 2 and Phase 3 as implementation extends beyond completion of Phase 2 deliverable. This activity captures progress/status of pilot activity as input to Phase 2 report.

Table A-1. (continued).

WBS	Task Name	Task Descriptions
6	Project Management and Controls	
6.1	Program Oversight	
6.2	Monitor and Control Phase 2 Scope	Control project scope through activity forecasting, regular schedule reviews, and project team meetings to ensure that the activities to be performed are consistent with the project plan.
6.3	Monitor and Control Phase 2 Budget and Schedule	Monitor work scheduled and performed, actual costs, project performance indices, and planned performance against Phase 2 milestones.
6.4	Monitor Phase 2 Risks	Identify and regularly review project risks, risk/impact matrix, and risk responses.
6.5	Legal	
6.5.1	Collaborative Agreements	
6.5.2	Regulatory Council	
7	Phase 2 Project Reporting	Monthly and quarterly reporting as required to keep contracting office informed of technical project status, communications status, and budget/schedule/earned value measurement status.
7.1	Define Approach	Define the approach to developing the licensing framework including the breadth of review, precedents, progress from other groups in RIPB development.
7.2	Assembly/Integration of Deliverables	Assemble and unify the deliverable documents into a cohesive and complete report.
7.3	Final Narrative Report Development	Draft final report and ensure continuity and agreement of concepts throughout. Verify that report meets outline of objectives.
7.4	Integrated Team Review	Multi-discipline review of final report by project team and third-party reviewers for correction, comment, and revision as necessary.
7.5	Presentation and Training Material Development	