

A FRAMEWORK FOR NUCLEAR REGULATORY MODERNIZATION



Prepared By :
**Hamm Institute for
American Energy**

Framework for Nuclear Regulatory Modernization: Presented by the Hamm Institute for American Energy

Executive Summary

The Hamm Institute for American Energy conducted a roundtable with leading nuclear scientists and regulatory experts to examine practical pathways for modernizing the U.S. nuclear regulatory framework to unleash the deployment of nuclear energy for national and economic security interests.

The parties addressed the challenges and opportunities facing the nuclear industry, particularly concerning regulatory frameworks, project timelines, and costs. The discussions focused on the following key topics: foundational definitions and licensing scope, ongoing NRC procedural and oversight issues, NEPA implementation and environmental reviews, and quality assurance and standards. The final discussions also covered workforce quality and project management discipline.

The consensus was that outdated and inconsistent definitions, coupled with rigid, prescriptive (rather than performance-based) regulations, are hindering the development of new nuclear technologies. The roundtable participants proposed a series of targeted reforms designed to streamline processes, reduce unnecessary burdens, and accelerate project deployment without compromising safety. These recommendations include aligning regulatory definitions across agencies, adopting a more proportionate, risk-informed approach to oversight, modernizing environmental review processes, and embracing new technologies and standards.

Collectively, these measures outline a pragmatic yet transformative approach to nuclear regulation, designed to enhance competitiveness, accelerate innovation, and maintain rigorous protection of public health and safety. **These recommendations have been developed in alignment with recent Executive Orders issued by President Trump and upcoming regulatory initiatives aimed at providing alternate pathways for new reactor licensing and existing reactor oversight.** Additionally, unique possibilities for modernization were identified, which are included in the final section.

Key Priorities

- National Environmental Policy Act (NEPA)
- NRC Fee Reform
- Safety-related (SR) definition tied to performance-based, dose-driven criteria
- Proportionate regulatory path for low-consequence reactors
- Align definitions of “construction” to allow for non-fueled construction to start earlier
- Update and amend Linear No-Threshold (LNT) model, the As Low as Reasonably Achievable (ALARA) principle, and explore threshold-based alternatives
- Reactor Oversight Process (ROP)/U.S. Nuclear Regulatory Commission (NRC) ongoing oversight
- Quality Assurance (QA)
- NRC procedural items, including application content, acceptance of applications for review, and license renewal

It is important to recognize that various leading industry organizations have also put forward substantive recommendations which the participants generally support. The reforms outlined herein validate some of those proposals and represent unique outcomes from the workshop as well as a simplified and bold vision shaping the future of the NRC regulations. A table of specific recommendations for changes to existing regulations is included in the appendix to this report.

Foundational Definitions

One of the most significant barriers to efficient licensing is the lack of clarity and consistency in regulatory definitions. Outdated and inconsistent definitions in the regulatory framework are slowing down project timelines and adding unnecessary costs. The new regulatory framework should introduce a fresh perspective on these key definitions.

- Definition of Safety-Related Structures, Systems and Components (SSCs)
Eliminate provisions of the current definition of safety-related which are not technology neutral or performance-based (See Appendix for specific recommended language). Eliminate use of vague or ambiguous safety designations, such as “important to safety” or “safety significant.”
- Definition of Construction
The Department of Energy (DOE) should utilize the same definition of construction designated in the Atomic Energy Act (AEA) used by the NRC as it is less burdensome than the DOE definition.
- Definition of “Microreactors and Modular Reactors”
The Executive Order used the phrase “microreactors or modular reactors” as reactors which are eligible for high-volume licensing process and/or a generic license, and as such these reactor types “low consequence” (LC) or “reduced-risk” (RR) reactors — and should have a performance-based definition – i.e., those reactors with no expected dose at the site boundary exceeding regulatory thresholds such as those specified in 10 CFR Part 100, i.e. 25 rem TEDE (or 300 rem thyroid) offsite for any worst case accident analysis. Regulatory treatment could draw from existing frameworks for non-power reactors (e.g., NUREG-1537), while remaining under NRC jurisdiction to preserve legal protections.

Construction Improvements

In the United States, the only nuclear plants that have recently been built were AP1000 design plants and, were approved through never before fully utilized regulatory pathway known as 10 CFR Part 52. This pathway was developed in the 1970s and 1980s in response to interest in standardized reactor deployment pathways by the Atomic Energy Commission, NRC, and applicants. Part 52 combined licensing activities into a single licensing engagement (versus the split construction and operation licensing in 10 CFR Part 50) and introduced additional new regulatory engagements such as the Design Certification and Early Site Permit. Design certification takes place under rulemaking which has the benefit of more certainty and consistency because the design is locked in as a formal regulation. However, the drawback is that once certified, the design cannot be significantly adjusted during construction, even when changes might improve safety or efficacy. The design certification has a unique characteristic of categorizing components into tiers, which limits flexibility. AP1000 obtained its design certification in 2006 and Vogtle received a combined license under part 52 in 2008; however, the AP1000 design certification underwent close to two hundred revisions over the course of construction, each of which was a time-consuming and costly rulemaking.

- Streamline process and allow for earlier construction at private risk, short of fuel loading or operations which require license approvals.
- Put a new Limited Work Authorization to allow for construction prior to permitting/licensing completed, i.e., a more rapid Limited Work Authorization modeled after §50.10. Such an LWA may be granted upon submission of, and acceptance for review of, a construction permit application or a combined license application (including an initial COLA submission per 2.101 guidelines) and upon meeting requirements 51.10 (e)(iii) and (iv) and that exemptions to full EIS completion and other requirements should be considered flexibly, knowing that the financing risk and change risk is on the applicant.

Radiation Protection Thresholds: ALARA and LNT

Updating radiation protection standards is strongly recommended. The implementation of the ALARA principle is and has been both impractical and unnecessarily restrictive.

- Eliminate the ALARA principle or adopt a reasonable de minimis standard instead.
- Shifting to a reasonable de minimis standard would simplify compliance while improving outcomes by focusing resources where they matter most for public health. A de minimis standard should be established to exempt certain low-risk exposures from specific provisions of 10 CFR Part 20.
- Establishment of a de minimis standard could also result in making an “As Low as Reasonably Practical” (ALARP) standard more effective, which would have the additional benefit of aligning with various international protocols.
- Rescind the Quality Health Objective (QHO) policies, which stem from Linear No-Threshold (LNT) which assumes risk at any dose regardless of magnitude. to improve license review and implementation.

ROP & Ongoing Oversight

Revising the ROP and reactor security rules and requirements to reduce unnecessary burdens and improve response to credible risks is paramount.

- Allow for graded Design Basis Threat (DBT) – the standard set of scenarios that nuclear plants must be prepared to defend against, such as natural disasters or security threats – or completely revisit DBT to establish a reasonable threshold for consideration of external events (E-2 or E-3 which are relatively moderate, credible events; not E-6+ which are extremely severe and highly unlikely events).
- Issue a Staff Requirements Memorandum (SRM) – a formal directive that instructs NRC staff on specific actions – to revise or rescind Regulatory Guide (RG) 5.69 which outline how security requirements apply to advanced reactors but is widely considered outdated. If revision is not feasible, the Commission should direct staff to develop a new regulatory guide that provides clear, modern, and design-specific guidance for advanced reactors.

License Fee Structure

The current NRC fee-for-service model discourages proactive engagement and innovation. Alternatives include moving to a flat-fee or hybrid funding model to encourage interaction and support work on new technologies. Any changes would likely require legislation.

Environmental Review (NEPA)

Environmental reviews under NEPA were identified as a persistent source of delay and litigation risk. Therefore right-sizing NRC NEPA review is very important.

- Accelerate Implementation of Generic Environmental Impact Statement (GEIS)
Establish GEIS pathway, exclude qualified new reactors from EIS (see below).
- Reform Treatment of Cumulative Considerations
Utilize current Council on Environmental Quality (CEQ) guidance and terminate expansion of cumulative considerations beyond NEPA statute—particularly via Regulatory Guide 4.2.
- Incorporate Categorical Exclusions from Other Agencies:
Require NRC to employ other agencies' categorical exclusions as outlined in Section 109 of the Fiscal Responsibility Act (FRA).
- Limit Scope
NRC environmental guidance and reviews have expanded to include items beyond the scope of the proposed action. For example, transmission infrastructure is often included, even though it is not necessary to evaluate or license the safe construction and operation of many advanced nuclear power plant designs. Environmental reviews should be limited to the scope of the proposed action, which, under NEPA for commercial power plants, is defined as the issuance of permits and licenses that authorize the construction and operation of the plant.
- Ensure Proportional Public Participation
Federal agencies should only include public comment when required by NEPA.
- Separate Safety and Environmental Analyses
Exclude redundant safety analyses—such as postulated accidents and radiological effluents—from NEPA reviews, ensuring that safety-related concerns remain within the NRC's licensing authority under the Atomic Energy Act.
- Consider Costs, Timeframe, and Existing Data Sources
Reaffirm that NEPA reviews are not required to undertake new scientific or technical research unless such research is essential to making a reasoned choice among alternatives and the associated costs and timeframe for obtaining the data are reasonable. Any reliable data source should be considered acceptable, including, but not limited to, existing studies and statistical analyses based on existing data – for example, National Oceanic and Atmospheric Administration (NOAA) and United States Geological Survey (USGS) data.
- Wider Application for Environmental Assessment (EA)
All nuclear power plants should be eligible for an EA – a shorter, more focused review – rather than defaulting to a full EIS, which can take years and add significant costs. A full EIS would only be required in special cases, such as very large plants or sites with unique environmental challenges. This approach, successfully demonstrated in the Kairos Hermes II licensing process, would speed up reviews and better reflect modern case law. To implement this change, NRC should amend Part

51 to remove the EIS as the default requirement. In addition, new low-consequence reactors – those designed with minimal potential impact – should be considered for a categorical exclusion.

Quality Assurance and Supply Chain Standards

Quality assurance is essential for ensuring the safety and reliability of nuclear facilities, but current NRC requirements, found in 10 CFR Part 50, Appendix B, and Part 21, are outdated and counterproductive. These rules were written decades ago and often exclude suppliers who already operate under modern, internationally recognized quality systems, such as ISO 9001. As a result, they increase costs and narrow the supply chain without delivering meaningful safety improvements.

Allow companies to use a range of recognized quality assurance standards, as research and test reactors are currently permitted to do. The revised framework should no longer rely on Part 21, which establishes a cumbersome defect-reporting process now largely redundant given the more rigorous oversight already conducted by industry organizations like the Institute for Nuclear Power Operations (INPO). Formal recognition of efficient industrial standards such as ISO 9001 would allow the NRC to improve supply chain quality while also reducing unnecessary costs and barriers to entry.

Expedited Licensing Pathways

Addressing licensing timelines and pre-application processes represent a critical step toward delivering reliable and abundant energy to the U.S. grid.

- Pre-application Processes

Curtail volume of unnecessary pre-application administrative requests from the NRC not explicitly required by regulation and clarify that pre-licensing interactions be limited to key questions about application content, structure, or fundamental safety considerations.

Reduce duplication by ensuring that an acceptance review timeline is minimized for applications that have completed a readiness audit and addressed findings.

- Reactor Oversight & Security

Direct NRC staff to exercise greater flexibility in granting exemptions from regulatory requirements. For example, NRC staff in the Office of Nuclear Security and Incident Response (NSIR) have previously indicated that a microreactor could appropriately seek an exemption from all of 10 CFR part 73, which primarily addresses physical security requirements.

- DOE and DOD Proven Reactors

Issue a Policy Statement (see below) and sign a Memorandum of Understanding (MOU) with both DOE and DOD to facilitate expedited licensing.

- Micro or Modular Reactors:

Require consequence-based criteria rather than arbitrary size, power, or special nuclear material (SNM) limits. For such designs, the following regulatory adjustments are recommended:

- Reduce ongoing oversight after granting a license, i.e., no resident inspectors at plant, no significant annual fee.
- Allow for NEPA categorical exclusion under Part 51 recognizing the minimal environmental impact of low consequence designs.
- Consider innovative solutions to license the reactor operators (Part 55) and

oversight on physical security (Part 73)

- The class 104 regulatory standard should be applied to the regulatory review of these LC/RR reactors.

- Data Driven Thresholds

Safety standards for external events, particularly seismic analysis, have escalated to impractical extremes (e.g., “once in a million year” events). This imposes an exceptional burden on site analysis for every nuclear plant. We suggest that The Commission continue to utilize 10^{-4} as the threshold for worst case events considered for the design basis of the plant, i.e., once in ten thousand years. The Commission could direct staff to adopt seismic data standards comparable to those used in other industries. For example, the American Society of Civil Engineers (ASCE) database, is widely accepted for structural seismic analysis, and is considered sufficient for evaluating the safety of skyscrapers. With appropriate methodologies to ensure conservatism, this data could be used to support structural seismic evaluations for advanced reactors. Additionally, NOAA databases should be considered sufficient for meteorological data.

- Eliminate License Renewal Duplication

Introduce a performance-based audit/inspection path in lieu of full application review, focus reviews on safety-critical programs, and reduce renewal time and staff hours by 50%.

Revise Hearing Process

The Commission can issue a Staff Requirements Memorandum (SRM) consistent with statutory requirements for uncontested hearings utilizing the existing regulatory pathway of the “Part M process.”

- Streamline Adjudicatory Hearings

Significantly reduce the scope and burden of adjudicatory hearings while avoiding changes that could increase the risk of federal court challenges to licensing decisions:

- Tighten intervention requirements by mandating that all supporting evidence be submitted with proposed contentions and provide for expedited Commission review of Atomic Safety and Licensing Board (ASLB) admissibility decisions.
- Assign NRC staff to decide the merits of admitted contentions in parallel with its application review.
- Eliminate procedural inefficiencies by removing late-filed contentions, mandatory disclosures, and motion practice; rely on paper-only hearings and enforce fixed schedules.

Restructure Advisory Committee on Reactor Safeguards (ACRS)

- Limit ACRS review to licensing decisions and topics specifically referred by the Commission.
- Impose firm timelines; avoid duplicative reviews of known designs.
- Make ACRS member selection and retention more transparent to ensure the most qualified candidates are chosen.

Streamline Public Engagement Processes

Issue a Policy Statement revising NRC’s activities to only those necessary for its regulatory responsibilities for public meetings, comment periods and records of interaction. Limit NEPA-related public engagement to material, site-specific items and allow only one comment period.

- Licensing proceedings

Require petitioners to demonstrate standing. Require clear safety concerns from parties with direct, material interest, excluding general public objections or political opposition. Raise the standard for hearings, allow only when new, material evidence justifies reconsideration of staff conclusions, not as a platform for re-litigating settled issues.

- Commission Hearings

Staff decisions should be final unless the Commission acts within 30 days to intervene and determine if a hearing is needed; after 30 days hearing opportunities close by default.

- Petitions

Require petitions to be supported by scientific or operational evidence, not just policy or ideological arguments. Define an early dismissal threshold and remove petitions that do not meet it.

- Public Document Room (PDR) & Agencywide Documents Access and Management System (ADAMS)

Reduce the burden of proprietary reviews and disclosures. Eliminate line-by-line marking; allow entire irrelevant documents to be withheld when appropriate. Employ a transparency standard that serves public safety. Exclude immaterial information that does not impact public risk.

Reduce submittals; eliminate the need for formal letters; allow reference to standing affidavits without resubmission.

Unique Recommendations Outside of Executive Order Directives:

Workforce, Project Management, and Performance Metrics

The final discussion surfaced two major themes that were not covered in depth in earlier sessions: **workforce quality and competitiveness** and **project management discipline**. The consensus was that without the right talent and project execution capability, even the best regulatory changes will fail to deliver results.

Workforce Quality and Competitiveness

The NRC struggles to attract and retain top technical talent due to its inability to compete with private sector salaries, benefits, and career growth opportunities. This is especially critical in a performance-based, risk-informed framework, which requires skilled judgment. Recommendations include legislative changes to allow the NRC to offer competitive salaries, as well as temporary interchange programs to bring in experienced industry personnel.

Project Management Discipline

The quality and timeliness of NRC licensing actions often depend on the skill of the assigned project manager (PM). PM positions at the NRC are often filled by engineers without formal PM training, leading to inconsistent performance. Recommended actions included professionalizing the PM role, conducting independent performance audits to benchmark against best practices, and adopting modern methodologies like Agile.

Performance Metrics and Incentives

Current metrics sometimes reward process volume over substantive safety outcomes. Instead of rewarding the number of issues found, metrics should focus on timeliness, technical accuracy, and the resolution of substantive safety issues. The goal should be high-quality output delivered on time, like software development, rather than high output volume.

Additional Recommendations for Consideration

- Consider a novel rulemaking that allows new licenses, or license amendments, to be issued based on validated digital twin models, rather than relying solely on text-based applications.
- Evaluate commission-based pay structures tied to project success, measured by safety, quality, efficiency, and emissions reductions from faster deployment.

Federal Register Citation	Purpose	Category	Implications	Problem	Rescind or Modify	Proposed Change
10 CFR 2.206 [88 FR 57876, Aug. 24, 2023]	Allows for public input into oversight process.	Public Petition Process Reform	This process can be exploited to cause delays and require significant NRC and licensee resources.	Allows for frivolous “intervention” despite the NRC’s comprehensive oversight process and alternative reporting mechanisms.	Rescind	
10 CFR 2.310(a) [72 FR 49475, Aug. 28, 2007]	Allows different hearing procedures based on licensing action.	Hearing & Adjudication Reform	Requires oral hearings for contested new reactor hearings.	Oral hearings typically cannot begin until the NRC staff completes either a draft safety evaluation for relevant safety topics or the Final Environmental Impact Statement. This timing could result in a contested hearing process which coincides with the critical path for the licensing action. The timeline could take a year or more until the presiding officer issues a decision.	Modify	Require use of a simplified hearing process (subpart L) for NRC contested new reactor licensing proceedings, instead of the existing lengthy and costly hearing procedures.
10 CFR 50.2 - definition of safety-related	Identify structures, systems, and components (SSCs) that dictate the safety of the plant.	Safety Classification Modernization	The definition of safety-related includes three parts: two presume certain SSCs impact safety (i.e., the reactor coolant pressure boundary and systems used for shutdown), and one that is performance-based, tied to meeting dose criteria. This approach requires extra analysis of SSCs that may have little safety relevance.	Requires additional analysis of SSCs that may not be relevant to safety, based on the assumption that SSCs involved in the reactor coolant pressure boundary and shutdown are safety related.	Modify	The definition of safety-related should be updated to make it solely performance based by removing reference to the reactor coolant pressure boundary and shutdown SSCs.

10 CFR 50.10(a) and 10 CFR 51.2 - definition of construction	Delineate between “preconstruction” activities, which do not require NRC approval to perform, and “construction” activities, which require NRC approval to perform.	Construction & Schedule Acceleration	Limits constructors to perform only site preparation activities prior to NRC approval, physical construction is not permitted.	Significant portions of nuclear power plants do not have any impact on nuclear safety but still must wait for lengthy NRC approval processes to begin construction. This increases the overall deployment time of new nuclear. Constructors should be allowed to build non-safety related portions of their plant at their own risk, considering the NRC will not perform regulatory oversight on such SSCs.	Modify	Permit SSCs that do not impact safety to be constructed as a “pre-construction” activity.
10 CFR 50.11 [40 FR 8788, Mar. 3, 1975, as amended at 65 FR 54950, Sept. 12, 2000]	Provides for exceptions and exemptions to the licensing requirements of 10 CFR Part 50.	Federal Authority Alignment (DOE/DOD)	The regulation provides for exceptions to the license requirement for production or utilization facilities under the authority of the Department of Defense or Administration facilities of the types pursuant to section 202 of the Energy Reorganization Act of 1974.	The exceptions and exemptions are limited to facilities which are on U.S. government-owned or controlled sites. This is not a limitation provided in the Atomic Energy Act, which provides statutory support for this exemption.	Modify	Clarify that DOD/DOE may authorize offsite activities within their statutory authority, including activities not located on Government-owned or controlled sites, without requiring NRC approval.
10 CFR 50.33(g)(1), 10 CFR 50.47, 10 CFR 50.160, and Appendix E to 10 CFR Part 50	Provides for planning and actions to cope with plant emergencies.	Emergency Preparedness Modernization	10 CFR 50.160 provides performance-based requirements for emergency planning for small modular reactors, non-light water reactors, and non-power production or utilization facilities. 10 CFR 50.47 and Appendix E to 10 CFR Part 50 provides deterministic requirements for emergency planning to LLWRs.	Regulations could be streamlined by applying performance-based requirements consistently to LLWRs, which can facilitate the removal of regulations in 10 CFR 50.47 and Appendix E to 10 CFR Part 50. 10 CFR 50.33(g)(1) can also be modified to remove the consideration for gas-cooled reactors, since 10 CFR 50.160 already allows emergency planning zones to be determined on a case-by-case	Modify / Rescind	Modify 10 CFR 50.160 to apply to all reactors, including LLWRs. Modify 10 CFR 50.33(g)(1) to remove the part related to gas-cooled reactors. Rescind 10 CFR 50.47 and Appendix E to 10 CFR Part 50.

			10 CFR 50.33(g)(1) includes an additional allowance for emergency planning zones for gas-cooled reactors rated up to 250 MWt to be determined on a case-by-case basis.	basis, regardless of plant technology.		
10 CFR 50.34(f)	Implement lessons learned from TMI accident through requirements.	Post-Accident Requirements Modernization (TMI/Fukushima)	Prescribes requirements based on technology from the 1970s.	Large majority of the requirements address issues that are not applicable to modern advanced reactors (e.g., providing onsite Technical Support Center and Operational Support Center), have been obviated due to advances in technology (e.g., providing a containment purge system), or do not add value (e.g., a cost-benefit analysis for alternative hydrogen control systems). These requirements add unnecessary cost without providing additional protection to public health and safety, or the environment.	Rescind	
10 CFR 50.34(g) and 10 CFR 50.44	Ensure combustible gas control to prevent explosions during beyond design basis accidents.	Post-Accident Requirements Modernization (TMI/Fukushima)	Requires plants to have systems designed to mitigate the consequences of a 100% clad-coolant reaction (100% core damage) event though this is a beyond-design-basis event. These systems must also be designed to withstand environmental conditions leading to this event despite being irrelevant.	Excessive design considerations lead to increased complexity and cost without commensurate increase in public health, safety, or environmental protection.	Rescind	

10 CFR 50.34(i), 10 CFR 50.155, and 10 CFR 52.80(d)	Implement lessons learned from Fukushima accident through requirements.	Post-Accident Requirements Modernization (TMI/Fukushima)	Requires licensees to bolster emergency plans and have available equipment to mitigate beyond-design-basis events.	Additional design and programmatic considerations are required to address these events which are beyond-design-basis governed by the NRC. Emergency planning requirements already exist elsewhere.	Rescind	
10 CFR 50.34a Appendix I to 10 CFR Part 50	Provides information to the NRC staff to review the adequacy of the design with regard to radioactive effluents.	Effluents & Environmental Review Streamlining	Adds unnecessary requirements for applicants.	Applicants already provide design descriptions of the facility. Adding further requirements is unnecessary, as EPA limits on radioactive materials to the environment are already in place. Compliance should be verified through inspections rather than prescribing additional application requirements.	Rescind	

Potential Policy Statement

“Establish an expedited pathway to approve reactor designs that the DOD or the DOE have tested and that have demonstrated the ability to function safely.”

The Commission should issue a Policy Statement that data generated by the DOD or DOE to demonstrate safety performance is acceptable for use in the licensing of commercial reactors and this Policy statement should be transcribed into interim staff guidance (ISG) incorporating the following:

For reactor designs previously tested and demonstrated by the Department of Energy (DOE) or Department of Defense (DOD), the Commission may find sufficient information exists for licensing if:

- (i) The DOE or DOD demonstration included integrated system testing that evaluated operational behavior under normal and accident conditions.
- (ii) The applicant provides a safety case using data from the federal demonstration, including analysis of system performance, safety margins, and failure modes.

- (iii) The design submitted for licensing is substantially equivalent to the system that was demonstrated.
- (iv) Any deviations from the federally tested design are clearly identified and analyzed for safety implications.
- (v) An agreement or memorandum of understanding exists between the NRC and DOE or DOD, as applicable, to facilitate the validation and transfer of relevant test data.

For these types of reactors, 10 CFR 50.43(e) should be found to be sufficiently met. If the NRC staff challenges an applicant's assertion, then the NRC staff must present compelling evidence of an underlying safety concern that would directly affect the health or safety of the public. If there is no objective evidence, then advanced reactors that are based on safety fundamentals demonstrated by the DOD or DOE would meet the requirements of 10 CFR 50.43(e) by default.