Evaluation of the NRC's Alternatives Analysis Process for National Environmental Policy Act Reviews

July 21, 2023

Background

The National Environmental Policy Act of 1969, as amended (NEPA), prescribes the Nation's charter for protection of the environment. It establishes policy, sets goals (Section 101), and provides means (Section 102) for carrying out the policy. The White House's Council on Environmental Quality (CEQ) regulations (Title 40 of the *Code of Federal Regulations* (40 CFR) 1500–1508) generally apply to all Federal agencies and instruct agencies regarding compliance with the procedural requirements of NEPA. The U.S. Nuclear Regulatory Commission (NRC, the Commission) voluntarily complies with the procedural requirements of NEPA, where consistent with the NRC's other statutory requirements, and implements Section 102(2) of NEPA through its regulations in 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

The NEPA process is intended to inform the public and decision-makers about the potential environmental impacts of proposed actions and a range of reasonable alternatives to the proposed actions with the goal of fostering environmentally informed agency decision-making. The Atomic Energy Act of 1954, as amended, and NEPA, as implemented through the NRC's regulations, require the agency to perform a safety review and an environmental review, respectively, of proposed agency actions, including licensing actions. The NRC staff documents its environmental reviews in the form of environmental impact statements (EISs), environmental assessments, and categorical exclusion determinations in accordance with 10 CFR Part 51.

The regulations for EIS preparation in 10 CFR Part 51 require the consideration of reasonable alternatives to the proposed action. An important element of NEPA compliance is the evaluation of possible alternatives that can meet the purpose and need of the proposed action to determine whether any of those alternatives will lead to reduced environmental impacts. The CEQ has traditionally considered alternatives analysis to be the "heart of the environmental impact statement," and the NRC has echoed this emphasis in Appendix A, "Format for Presentation of Material in Environmental Impact Statements," to Subpart A, "National Environmental Policy Act—Regulations Implementing Section," of 10 CFR Part 51. Alternatives considered in NRC reactor licensing EISs have commonly included, as applicable, a no-action alternative (required

by 10 CFR Part 51), site alternatives, energy generation alternatives, and system design alternatives. The specific categories of alternatives relevant to a given proposed action are driven by the purpose and need of the proposed action, as informed by the environmental report (ER) that an applicant is required to submit along with its application.

Establishing the NRC's Environmental Center of Expertise (ECOE) in 2019 was key to streamlining the agency's environmental reviews. By combining the environmental review staff for multiple business lines formerly housed in different agency offices, the ECOE has fostered increased communication among environmental professionals, standardization of practices, and sharing of innovative ideas for streamlining processes. For example, one of the first efforts of the new ECOE was the development of a common handbook of environmental review procedures for use across all business lines.

In SECY-21-0001, "Rulemaking Plan—Transforming the NRC's Environmental Review Process," issued December 2020 (Agencywide Documents Access and Management System Accession No. ML20212L393), the staff recommended rulemaking to revise 10 CFR Part 51 to streamline and enhance the flexibility of the NRC's NEPA environmental review process. Part of this rulemaking recommendation included establishing a definition for "reasonable alternatives" that includes consideration of technical and economic feasibility. As an alternative to this recommendation, the staff provided the option that it could continue using the existing regulations in 10 CFR Part 51 without changes (i.e., no rulemaking) and instead revise NEPA guidance for applicants and the staff. In response to SECY-21-0001,[1] the Commission approved the staff's no-rulemaking option. In providing direction on SECY-21-0001, the Commission also instructed the staff to evaluate the NRC's process for selecting the reasonable alternatives that the agency's EISs will analyze in detail and to provide the results of the evaluation and any recommendations to the Commission for consideration. This report documents the staff's evaluation of the NRC's process for selecting the reasonable alternatives for inclusion in EISs and its determination to recommend no alternatives analysis process changes as part of this evaluation.

The Commission direction in SRM-SECY-21-0001 further instructed the staff to continue monitoring ongoing efforts by the CEQ to revise its regulations and consider how these changes impact the NRC's obligations under NEPA. Additionally, the Fiscal Responsibility Act of 2023 recently amended NEPA, including with respect to alternatives. The staff continues to monitor CEQ regulatory changes and is reviewing the recent NEPA amendments to determine any impacts to the NRC's alternatives analysis process. Information obtained from these ongoing efforts is not addressed here and, when they are complete, the staff will reassess its evaluation and inform the Commission separately, as appropriate.

Key Review Considerations

The three ECOE branches support environmental reviews for new and advanced reactor, operating reactor, and materials licensing applications. A team of knowledgeable staff from each of these three branches held a series of meetings to discuss the NRC's process for selecting alternatives for various proposed actions, comparing and contrasting processes for the review of different types of proposed actions. The staff's review built on prior analyses of the current

[1] Staff Requirements Memorandum (SRM)-SECY-21-0001, "Staff Requirements—SECY-21-0001—Rulemaking Plan—Transforming the NRC's Environmental Review Process," is dated April 19, 2022 (ML22109A171).

process that the NRC's NEPA practitioners use to identify alternatives for inclusion in an EIS and lessons learned from previously completed evaluations of alternatives. The staff examined its current EIS development process using the guiding principles below to determine whether potential opportunities exist to enhance the alternatives analyses.

> **"Reasonableness" criteria:** There was consensus among the team that the focus of the process should remain on the reasonableness of alternatives selected for detailed evaluation, as opposed to analyzing a certain number of alternatives. By evaluating alternatives that are not reasonable or do not fit the purpose and need of the action, an EIS could inadvertently misinform the public about what alternatives are technically and economically feasible. The staff examined the NRC's existing processes and guidance for selecting alternatives to determine whether potential process improvements could facilitate the selection and analysis of the most representative alternative(s) for a proposed action. Recognizing that the NRC's regulatory role is, in itself, a threshold, the staff noted the importance of avoiding overly speculative alternatives and using common sense to narrow the field of potential alternatives.
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> **Depth of experience:** The staff has decades of experience conducting environmental reviews for reactor license renewal, new reactor licensing, and materials licensing applications. The processes in these areas are well established and, in many cases, clearly defined through prior Commission direction. In instances where a process has already been sufficiently refined, the staff considered historical programmatic success and determined whether any lessons learned could be applied to future reviews. In contrast, an emerging area with fewer constraints, such as the review of advanced reactor applications, lends itself to a wider range of potential efficiency gains. As part of this review, the staff looked at its current processes for more defined application types to determine whether it could identify areas for improvement. The staff also paired its understanding of anticipated advanced reactor applications with a retrospective look at its recent efforts to develop processes to determine whether any additional guidance or requirements may facilitate efficient selection and analysis of alternatives.
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> **Appropriate flexibility:** Given that reasonable alternatives are inherently tied to the purpose and need of the proposed action, the staff noted the importance of retaining site-specific aspects of the evaluation process. Throughout its discussions, the staff considered the different types of actions for which EISs are prepared, both across and within ECOE branches. A "one size fits all" approach is not conducive to fulfilling the objectives of NEPA's alternatives analysis; therefore, the NRC's process for environmental reviews must allow for appropriate flexibility to develop and analyze alternatives based on a variety of purposes and needs. The staff noted that an overly prescriptive approach could lead to inefficiencies through the unnecessary analysis of alternatives that are not reasonable.

Using the above guiding principles, the staff evaluated whether the current alternatives analysis process is effective in providing appropriate information to agency decision-makers on alternatives for proposed actions under review. The team considered and integrated previous and ongoing efforts for streamlining environmental reviews from both inside and outside the ECOE and the NRC. Due to the differences in proposed actions and the unique considerations associated with identifying alternatives for the wide range of proposed actions under review across the ECOE, the team evaluated its processes for selecting reasonable alternatives in three areas: New and Advanced Reactors, Reactor License Renewals, and Materials.

Evaluation of the NRC's Process for Selecting Reasonable Alternatives

Specific requirements for the NRC's environmental reviews under NEPA are set forth in 10 CFR Part 51. These regulations contain general requirements that are applicable to all environmental reviews, as well as specific requirements for different types of license applications. The staff prepares an EIS for any proposed action that (1) is a major Federal action significantly affecting the quality of the human environment or (2) involves a matter that the Commission has determined should be covered by an EIS, which are listed at 10 CFR 51.20(b). An EIS contains detailed analyses of the environmental impacts of the proposed action and alternatives to the proposed action.

In accordance with the requirements in 10 CFR Part 51, each applicant must submit with its application a separate ER to address issues related to the environmental effects of the proposed action and alternatives to the proposed action. In 10 CFR 51.45(b)(3), the NRC states, in part, the following:

> The discussion of alternatives shall be sufficiently complete to aid the Commission in developing and exploring, pursuant to Section 102(2)(E) of NEPA, "appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources." To the extent practicable, the environmental impacts of the proposed action and the alternatives should be presented in comparative form.

The regulations in 10 CFR 51.71(d) state, in part, the following:

> …the draft environmental impact statement will include a preliminary analysis that considers and weighs the environmental effects…of the proposed action; the environmental impacts of alternatives to the proposed action; and alternatives available for reducing or avoiding adverse environmental effects.

The staff relies on the applicant's ER to identify and evaluate a range of reasonable alternatives meeting the stated purpose and need. However, as with other documentation provided by the applicant, that information is subject to independent verification by the staff to ensure that the applicant has a logical basis for its alternatives analysis.

In its EIS, the staff describes how it (and the applicant) considered and evaluated alternatives to the proposed action, identifies reasonable alternatives for detailed analysis that meet the purpose and need of the proposed action, and explains why other possible alternatives to the proposed action were screened from detailed analysis. The staff then evaluates the environmental impacts from each alternative identified for detailed analysis for each affected resource considered for the proposed action. The staff characterizes the significance of impacts from each of the alternatives for each affected resource as SMALL, MODERATE, or LARGE, using the definitions from 10 CFR Part 51. Finally, the staff compares the environmental impacts of the proposed action with those for each alternative identified for detailed analysis for each affected resource.

1. New and Advanced Reactors

Summary of the Current Process

The staff prepares EISs for new reactors when receiving applications for construction permits, combined licenses, early site permits, and limited work authorizations, and it prepares supplemental EISs for new reactors when receiving applications for (1) an operating license, (2) a combined license or construction permit referencing an early site permit, or (3) a combined license or construction permit for which it had issued a limited work authorization. Most EISs for new reactors have considered the following categories of alternatives to the proposed action:

- a no-action alternative, under which the proposed new reactor is not licensed and, therefore, not built or operated
- site alternatives, under which the proposed new reactor is sited at another location
- energy alternatives, under which the need for power to be satisfied by the proposed new reactor is met through demand-side management or power generation by methods other than the proposed new reactor
- system design alternatives involving alternative approaches to design features of the proposed new reactor that interface with the environment, especially cooling systems

To determine site alternatives, applicants commonly follow a systematic process, such as that developed by the Electric Power Research Institute, to progressively screen possible alternative sites within a defined region of interest to identify a small number of optimal sites for a detailed environmental impact assessment. The guidance in NRC Regulatory Guide (RG) 4.2, "Preparation of Environmental Reports for Nuclear Power Stations," provides a systematic process for identifying alternative sites and, if the applicant uses it, the staff reviews the applicant's implementation of the process to ensure that it is complete and unbiased. The identification of energy alternatives and system design alternatives is typically less procedural than the identification of site alternatives, but the staff still reviews the applicant's rationale to ensure that reasonable alternatives are not overlooked.

To satisfy its environmental review requirements, the staff follows the guidance in NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan," issued in 2000 and 2007, in which the alternative sites are compared to the proposed site to determine if an alternative site is environmentally preferable. The environmental standard review plans (ESRPs) state that, when there is an environmentally preferrable site, it should be evaluated to determine whether it is "obviously superior" to the proposed site. Neither 10 CFR Part 51 nor the ESRPs establish definitive criteria for what constitutes an "obviously superior" site, but the ESRPs call for basing the determination on a benefit-cost analysis involving environmental, economic, and schedule considerations. Although the "obviously superior" criterion was developed in the context of alternative sites, the staff has increasingly used it when considering any alternatives (e.g., energy alternatives). Most EISs for new reactors completed within the last 20 years evaluated three to five site alternatives, three to five energy alternatives, and two or three site design alternatives in detail. In none of these EISs has the staff identified an environmentally preferable site, let alone an "obviously superior" site, or any other alternative that meets the purpose and need of the proposed action with substantially reduced environmental impacts.

The staff relies on many sources of information to determine which energy alternatives are available and commercially viable. The U.S. Department of Energy's Energy Information Administration (EIA) maintains the official energy statistics of the Federal Government. Along with information from other sources, the staff commonly uses EIA reports, including the Electric Power Annual, Monthly Energy Review, Annual Energy Outlook, and Assumptions to the Annual Energy Outlook, to identify energy trends and inform the staff's analysis of alternatives to the proposed action. The staff considers the existing portfolio of electric generating technologies in the State or utility service area in which the new reactor is proposed to be located, along with State and Federal policies that may promote or oppose certain energy alternatives. The staff may also use EIA's State Energy Profiles, as well as State, regional, and, in some cases, utility or system-level assessments of energy resources and projections (such as integrated resource plans), to identify energy alternatives for consideration. This same approach to energy alternatives is used to review reactor license renewal applications.

For both new (and advanced) reactor and reactor license renewal applications, 10 CFR 51.71(f), footnote 4, states the following:

> The consideration of reasonable alternatives to a proposed action involving nuclear power reactors (e.g., alternative energy sources) is intended to assist the NRC in meeting its NEPA obligations and does not preclude any State authority from making separate determinations with respect to these alternatives and in no way preempts, displaces, or affects the authority of States or other Federal agencies to address these issues.

Relevant Guidance and Other Documents

The environmental review staff for new reactor licensing has developed several sources of guidance over the last several years to streamline the evaluation of alternatives, including the following interim staff guidance (ISG) documents, additions to RGs and standard review plans, and a generic EIS for advanced reactors.

- Updates to RG 4.2, "Preparation of Environmental Reports for Nuclear Power Stations" (September 2018; ML18071A400)

  The staff issued a modernized revision (Revision 3) of RG 4.2 that provides guidance to applicants in preparing ERs as part of licensing applications for new reactors. RG 4.2 had not been updated since 1976 and lacked relevant guidance concerning a number of environmental issues, such as wetlands and environmental justice, that had not been widely recognized at that time. The staff is also presently updating the ESRPs (NUREG-1555) that guide the staff in preparing EISs, including alternatives analysis. Portions of the ESRPs have not been updated since 1999.

- "Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan" (NUREG-1555) (March 2000, July 2007)

  The NRC published NUREG-1555 in 2000, with selected sections updated in 2007. The portions of this guidance that are relevant to alternatives include ESRP 9.1, which provides guidance for the evaluation of the no-action alternative, and ESRPs 9.2, 9.2.1, 9.2.2, and 9.2.3, which include guidance for the consideration of energy alternatives. ESRP 9.3 provides guidance for the consideration of alternative sites, and ESRPs 9.4,

9.4.1, 9.4.2, and 9.4.3 include guidance for system design alternatives. The staff prepared the guidance in the ESRPs with an application for a large light-water reactor in mind, although the concepts presented would generally apply to any type of reactor. This is true because, for most sections of the ESRP, the type and size of reactor is irrelevant. In addition, the general guidance of the ESRP directs reviewers to identify, and eliminate from detailed study, issues that are "peripheral, not significant, or that have been covered by prior environmental reviews."

- Interim Staff Guidance Documents

  In ISG-027, "Specific Environmental Guidance for Light Water Small Modular Reactor Reviews," issued August 2014; ISG-029, "Environmental Considerations Associated with Micro-reactors," issued October 2020; and draft ISG-030, "Environmental Considerations for Advanced Nuclear Reactor Applications that Reference the Generic Environmental Impact Statement (NUREG-2249)," issued December 2021 (ML14100A648, ML20252A076, and ML21227A005, respectively), the staff established technical guidance for tailoring environmental reviews for light-water small modular reactors (SMRs) and microreactors and for tiering off of NUREG-2249, "Generic Environmental Impact Statement for Advanced Nuclear Reactors," issued November 2021 (ANR GEIS; ML21222A055). ISG-027 clarifies that the energy alternatives analysis for SMRs may differ somewhat from the analysis for large light-water reactors because of their smaller size. This ISG also alerts reviewers that, for SMRs, the region of interest (ROI) for the site selection process might be much smaller than the ROI for large light-water reactors. ISG-29 explains that microreactors are smaller facilities with a reduced usage of environmental resources and interface with the environment. ISG-29 encourages consideration of only those alternatives meeting the more limited purpose and need of most microreactors relative to the larger reactors that had been the subject of several recent new reactor licensing EISs. ISG-030 echoes much of the guidance regarding alternatives in ISG-027 and ISG-029 for smaller advanced reactors, covering siting, energy alternatives, and system design alternatives. All of these guidance documents are based on the principle that reasonable alternatives include those that are practicable or feasible from the technical and economic standpoint using common sense.

- ANR GEIS, NUREG-2249

  The staff developed draft NUREG-2249 (ANR GEIS) to expedite the preparation of EISs for advanced reactor licensing applications by addressing as many environmental issues as possible through generic analysis, thereby reducing the site-specific analysis needed for future applications. Although the ANR GEIS recognizes that a site-specific alternatives analysis will be needed for each application, its generic analyses can facilitate a more efficient environmental impact analysis for a proposed action. The staff believes that, once the ANR GEIS is finalized, it will result in a more efficient evaluation of environmental impacts from alternatives in future EISs for advanced reactors. The staff submitted the proposed rule package for the ANR GEIS (SECY-21-0098; ML21222A044) to the Commission in November 2021.

- Energy Alternatives White Paper

  As part of its effort to develop the draft ANR GEIS, the staff recognized that its analyses of energy alternatives had been largely repetitive. Therefore, the staff developed a draft white paper containing a generic analysis of many of the more common energy

alternatives, such as those involving the use of natural gas, renewables such as wind and solar, demand-side management, and various combinations of other fuel types and nuclear. Once this white paper is finalized, the staff will be able to incorporate text from it by reference in lieu of repeating much of the analysis of energy alternatives.

Process Efficiencies Considered

Over the last several years, the staff has incorporated efficiencies into its process for preparing EISs for new reactors, including increased incorporation by reference, consolidation of chapters, and reduction of redundant summarization. These strategies have proven successful in reducing the length and improving the readability of the Kairos Power, LLC (Kairos) Hermes test reactor draft EIS, including the chapter on alternatives. The staff has also applied the existing guidance to ensure that its analysis focuses only on reasonable alternatives that clearly meet the purpose and need of the proposed action. For example, the staff did not evaluate energy alternatives in the Kairos Hermes draft EIS because such an analysis is inappropriate for licensing test reactors targeting a specific new technology. Guidance updates also make clear that siting evaluations for certain advanced reactors requiring proximity to a specific facility may involve a much smaller ROI. Finally, a consideration of system design alternatives may not be necessary for proposed reactors not withdrawing from surface water bodies for cooling water.

Development of the Kairos Hermes Draft EIS

In 2021, the staff accepted a construction permit application from Kairos for the proposed Hermes test reactor, which is designed to test a new advanced reactor technology involving molten salt. The facility would include a single unit with a maximum thermal power of 35 megawatts. The staff considers its draft EIS for this construction permit application as its first EIS for licensing an advanced reactor. The staff reviewed the application as a nonpower reactor based on the design, purpose, and need. Although the draft ANR GEIS was not available for use in the development of the draft EIS for the Hermes test reactor, the staff still applied many streamlining strategies to its environmental review, such as incorporation by reference, chapter consolidation, and reduced summarization, to simplify the process. While most recent new reactor EISs had exceeded 1,000 pages of technical analysis, this draft EIS was fewer than 150 pages. Although a portion of the savings in effort and pages was a result of the simpler review required for a nonpower reactor,[2] the staff intends to use the Kairos Hermes EIS as a model to guide its future preparation of EISs for advanced reactor projects.

Recommendations

The staff believes that it has made demonstrable progress in streamlining its alternatives analysis process for new reactor environmental reviews and recommends the continuation of these ongoing efforts. The staff developed the guidance documents discussed above, and it is using the Kairos Hermes construction permit application as an opportunity to implement its proposed streamlining practices. The staff has received an application for two new test reactors from Kairos and expects several additional new reactor licensing applications in 2024, including an operating license application for the Kairos Hermes, a combined license application for the Carbon Free Power Project, a construction permit application for the Tennessee Valley Authority Clinch River Site referencing an early site permit, and potentially several other applications. The staff anticipates additional new reactor licensing applications using different technologies over the next several years. These applications will give the staff ample

[2] For example, the staff is not required to perform a need-for-power analysis for a nonpower reactor.

opportunity to implement its recently developed guidance and streamlining strategies on a diverse range of licensing scenarios. Due to the dramatic increase in workload anticipated over the next several years, the staff believes that its limited resources will be best focused on effective implementation of the processes already developed. As these reviews are completed, the staff will continue to use this additional experience to determine whether further process improvements would be helpful in streamlining the alternatives analysis process for new reactor licensing applications.

2. Reactor License Renewals

Summary of the Current Process

The NRC staff considers the status of alternative energy technologies (replacement power alternatives) and State and regional energy policies when selecting reasonable alternatives for each site-specific license renewal environmental review. It is inevitable that rapidly evolving energy technologies will outpace the replacement power alternatives information presented in NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants," issued June 2013 (license renewal (LR) GEIS; ML13106A241), including the information for considering alternatives for reducing or avoiding adverse environmental effects (e.g., converting to closed-cycle cooling).

Typically, the only alternative to renewing a nuclear power plant operating license would be to not renew the license. Not renewing the license means that reactor operations would cease, and decommissioning would begin at the end of the licensing period. For license renewal environmental reviews, the staff assumes that the electrical power lost by not renewing the operating license would need to be replaced. Therefore, alternatives to license renewal include other means of generating electricity, as well as offsetting demand using energy conservation and energy efficiency measures (demand-side management), delaying planned retirements of other existing plants, or purchasing sufficient power from other electricity providers or through some combination of these options.

For license renewal, environmental reviewers establish a reasonable set of replacement power alternatives. To determine if a replacement power alternative is reasonable, the staff considers technological, economic, and regulatory factors and whether the alternative is (or is expected to become) commercially viable on a utility scale and operational prior to the expiration of the operating license. Additionally, in certain scenarios, there may be limitations to replacement power alternatives because of legislation enacted by States.

A wide range of alternative energy sources can replace the power generated by a nuclear power plant, such as another nuclear power plant(s), fossil-fueled power plants (e.g., natural gas), and renewable energy (e.g., wind and solar). Other alternatives include demand-side management, delayed retirement of other existing power plants, and purchased power, or a combination of these and one or more types of power-generating technologies. As discussed above, this approach is similar to the approach used in EISs for new reactors.

The reactor license renewal environmental review has well established requirements and Commission direction. The following excerpts from the statements of consideration for the NRC's final rule regarding environmental review for license renewal, published in the *Federal Register* (FR) (61 FR 28467; June 5, 1996), provide the basis for the staff's current consideration of alternatives in its reactor license renewal environmental review process:

- …the Commission has clarified the purpose and need for license renewal in the [LR] GEIS as follows:

  > The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and, where authorized, Federal (other than NRC) decisionmakers.

  Using this definition of the purpose of and need for the proposed action, which stresses options for the generation of power, the environmental review will include a characterization of alternative energy sources as being the alternatives to license renewal and not merely the consequences of the no-action alternative….

- …the [LR] GEIS contains a discussion of the environmental impacts of alternative energy sources based on currently available information. The information in the [LR] GEIS is available for use by the NRC and the licensee in performing the site-specific analysis of alternatives and will be updated as appropriate.

- The NRC has no authority or regulatory control over the ultimate selection of future energy alternatives. Likewise, the NRC has no regulatory power to ensure that environmentally superior energy alternatives are used in the future.... The Commission has always held the view that alternative sources of energy should be compared with license renewal and continued operation of a nuclear power plant.

As stated in the 1996 final rule that incorporated LR GEIS findings in 10 CFR Part 51, the NRC recognizes that environmental impact issues (including alternatives) might change over time and that additional issues and information may need to be considered in license renewal reviews. As stated in the 1996 final rule, “the NRC will review the rule and [LR] GEIS on a schedule that allows revisions, if required, every 10 years.”

Consequently, the NRC staff completed its first 10-year review of the LR GEIS and amended the 1996 rule in 2013 by incorporating lessons learned and knowledge gained from license renewal environmental reviews conducted by the NRC since 1996. The final rule, published on June 20, 2013 (78 FR 37281), revisited the consideration of alternatives:

- The NRC has updated the final revised [LR] GEIS to incorporate the latest information on replacement power alternatives, but it is inevitable that rapidly evolving technologies will outpace the information presented in the final revised GEIS. Incorporation of this information is more appropriately made in the context of plant-specific license renewal reviews, rather than in the evaluations contained in the revised [LR] GEIS. As with renewable energy technologies, energy policies are evolving rapidly. While the NRC acknowledges that legislation, technological advancements, and public policy can underlie a fundamental paradigm shift in energy portfolios, the NRC cannot make decisions based on anticipated or

speculative changes. Instead, the NRC considers the status of replacement power alternatives and energy policies when conducting plant-specific reviews.

An update to the LR GEIS is currently ongoing, which constitutes the NRC staff's second 10-year review. This effort to revise the LR GEIS includes an evaluation of the environmental issues and findings in the 2013 LR GEIS (including alternatives) and will update the analysis and assumptions to fully support subsequent license renewal.

Relevant Guidance

The LR GEIS does not present any conclusions on the environmental impact or acceptability of alternatives to license renewal. Accordingly, the staff reviewer identifies and analyzes reasonable alternatives to license renewal in site-specific environmental reviews. The analysis of replacement power alternatives does not involve the determination of whether any power is needed or should be generated. The decision to generate power and the determination of how much power is needed are at the discretion of State and utility officials. The staff uses the following guidance for its alternatives analysis.

- Regulatory Guide 4.2, Supplement 1, Revision 1, "Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications" (June 2013; ML13067A354)

  RG 4.2 states that each replacement power alternative should meet the purpose and need for the proposed action. The purpose and need adopted by the NRC are to meet future system generating needs. Alternatives that meet the stated purpose and need are (1) to build new generating capacity (i.e., construct and operate a new fossil fuel or renewable energy power plant), (2) to purchase power, or (3) to reduce power requirements through demand reductions and conservation or energy efficiency measures. These alternatives must also be commercially viable on a utility scale and operational before the expiration of the reactor's operating license or expected to become commercially viable on a utility scale and operational before its expiration.

  RG 4.2 also states that the applicant should describe the process used to identify and select alternatives to the proposed action. The applicant should describe all the replacement power alternatives considered and indicate which alternatives were evaluated in detail. In addition, the applicant should explain why it eliminated certain alternatives from detailed study. The applicant should also discuss the extent to which alternatives have been considered by State, utility, or, where applicable, Federal authorities (e.g., public service commissions; environmental, natural resource, or energy agencies; or other groups vested with energy planning authority, depending on existing energy regulatory structures) and how such considerations relate to the applicant's evaluation. This discussion should include any existing State regulations that promote, enhance, prohibit, or challenge particular alternatives.

- NUREG-1555, Revision 1, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal" (June 2013; ML13106A246)

  NUREG-1555 states that the staff analyzes the environmental impacts of renewing the operating license of a nuclear power plant (the proposed action) and the alternatives to renewing the license. After considering the environmental impacts associated with license renewal and replacement power alternatives, the staff will determine whether the

adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decision-makers would be unreasonable.

According to NUREG-1555, the staff reviewer requires, in part, the following information:

– list of reasonable alternatives considered by the applicant and state authorities

– list of environmental issues associated with continued plant operations during the renewal term and refurbishment

– list of alternatives eliminated from detailed study

The staff reviewer examines the applicant's ER and considers the range of reasonable alternatives. Alternatives considered are (1) build new generating capacity, (2) purchase the power from outside the system, (3) reduce power requirements through demand reduction, and (4) the no-action alternative. The staff reviewer identifies the criteria used in evaluating the reasonableness of the alternatives and explains which alternatives would not be considered for detailed analysis and the reasons why. A reasonable alternative must be commercially viable on a utility scale and operational prior to the expiration of the reactor's operating license or expected to become commercially viable on a utility scale and operational before its expiration. The staff reviewer identifies the alternatives that are carried forward for comparison with the proposed action (renewing the operating license of a nuclear power plant). The staff reviewer also discusses the extent to which these alternatives have been considered by State authorities (e.g., public service commissions and environmental, natural resource, or energy agencies).

Process Efficiencies Considered

The staff is constantly working to make license renewal environmental reviews more efficient by, in part, focusing its analysis of reasonable alternatives on the technologies most likely to be available for providing replacement power in the relevant service area. The most likely replacement power alternative would generally be a mix of energy generating technologies, including renewables (e.g., wind and solar), offset by energy conservation, demand-side management activities, and, if necessary, power purchases. In most instances, these alternatives are already in use or are being expanded within the service area.

In addition, public utilities or merchant plant operators would generally already be supplying electricity to the service area from a portfolio of existing alternative energy generating technologies including renewables. The licensee typically has a realistic view of the service area's current energy needs, has plans for meeting future energy demand, and has a range of alternative replacement power options. The licensee (working with State authorities) is usually in the best position to determine the mix of various alternative sources of energy generating technologies, energy conservation, and demand-side management practices, that would be used to replace the power generated by the nuclear power plant.

The staff reviewer satisfies NEPA, in part, by considering a reasonable set of alternative energy generating sources to the proposed action of license renewal. This does not preclude any State authority from making separate determinations with respect to these alternatives and in no way preempts, displaces, or affects the authority of States or other Federal agencies to address these issues. Based on the above, the set of alternatives is largely limited to a mix of alternative sources, including energy conservation and demand-side management.

In subsequent license renewal reviews, the staff reviewer incorporates by reference the alternatives impact analysis conducted for the initial license renewal review to the extent possible to focus on new information or the most likely replacement power alternatives.

Recommendations

The current alternatives analysis process for reactor license renewal reviews has been streamlined and optimized to the maximum extent practicable, based on decades of staff reviews and lessons learned. There are no process changes recommended as a result of this evaluation. The staff should continue to leverage its prior experience and lessons learned on the viability of alternative sources of energy and energy offsetting measures. Given that typically the only alternative to renewing a nuclear power plant operating license would be to not renew the license, the staff reviewer only evaluates in detail the most likely replacement power alternatives in addition to the proposed action and the no-action alternative. The licensee (working with State authorities) is in the best position to identify the reasonable alternative sources of energy generating technologies or energy offsetting measures that could be used to replace or offset the power generated by the nuclear power plant. Therefore, the NRC staff reviewer should continue to analyze the alternatives identified by the licensee in conjunction with integrated resource plans and regional energy trends.

3. Materials

Summary of the Current Process

In complying with NEPA for materials-related licensing actions, the staff applies standard procedures for determining the level of review and documentation of reasonable alternatives to a proposed action. These standard procedures ensure consistent treatment of environmental requirements related to a wide variety of materials licensing actions, such as licensing of new facilities, amendments to existing licenses, decommissioning, and license termination, as well as to rulemaking activities. For materials licensing, the types of actions that typically require an EIS are applications for facilities such as uranium mills, uranium conversion plants, uranium enrichment plants, independent spent fuel storage installations at a site not occupied by a nuclear power plant, and low-level waste disposal facilities.

To establish alternatives as part of the NEPA review process, the staff first evaluates the incoming license requests to develop a purpose and need statement. This statement describes the underlying need for the proposed action and, therefore, forms the basis for the potential alternatives. In developing the purpose and need statement, the “purpose” defines the goals to be attained, while the “need” is the problem to be solved. By focusing on developing a straightforward and succinct purpose and need statement, the staff gains review efficiency because it sets an appropriate scope for the review.

After developing potential alternatives based on the purpose and need of a proposed action, the staff determines which of the alternatives are reasonable. Reasonable alternatives are those that meet the objectives of the proposed action and applicable environmental standards and are technically feasible. An alternative could be deemed to be unreasonable for a variety of reasons, including the maturity of alternative technology, the geographic area of interest, or capacity limitations. This filtering process results in a range of alternatives to evaluate in detail.

The staff determines the need for detailed evaluation for alternatives (other than the no-action alternative) on a case-by-case basis, depending on the licensing action proposed and the

characteristics of the licensing action. Although the number of alternatives considered in materials-related licensing actions is generally fewer than for reactor applications, the number of alternatives ultimately analyzed in detail depends on the scope of the project and the range of potential environmental impacts. Two recent examples of evaluations in materials-related licensing actions that included alternatives other than the no-action alternative are NUREG-2243, “Environmental Impact Statement for the Disposal of Mine Waste at the United Nuclear Corporation Mill Site in McKinley County, New Mexico,” issued January 2023 (ML22356A145), and NUREG-2248, “Environmental Impact Statement for the License Renewal of the Columbia Fuel Fabrication Facility in Richland County, South Carolina,” issued July 2022 (ML22201A131).

The staff uses the following guidance for its alternatives analysis.

Relevant Guidance

NUREG-1748, “Environmental Review Guidance for Licensing Actions Associated with NMSS Programs” (August 2003; ML032450279)

NUREG-1748 explains the staff’s approach to evaluating alternatives for materials-related licensing actions. The staff is currently updating this guidance document and will incorporate realized efficiencies in the next version.

As stated in NUREG-1748, and as specified in 10 CFR 51.30(a)(1)(ii), alternatives to the proposed action are developed in accordance with NEPA Section 102(2)(E). The guidance states that the staff should discuss the no-action alternative, the proposed action, and the reasonable alternatives, including those that will avoid or minimize adverse effects upon the quality of the human environment. All alternatives, including the no-action alternative, should receive equal and objective treatment. The phrase “range of alternatives” includes all reasonable alternatives (including the no-action alternative) to the proposed action, as well as those other alternatives that are eliminated from detailed study, with a brief discussion of the reasons for eliminating them. Reasonable alternatives are those alternatives that meet the proposal objectives and applicable environmental standards and are technically feasible.

NUREG-1748 also states that, for those actions involving a very small impact, it is reasonable to consider a very limited range of alternatives, but at a minimum, the no-action alternative must be addressed. The no-action alternative is a discussion of the results from a lack of action (i.e., status quo or the existing state). For example, if the proposed action is the cleanup of a site for unrestricted use, then the no-action alternative is to continue to keep the material licensed and on site, without disposal.

Process Efficiencies Considered

The staff continually evaluates potential efficiencies in its NEPA process. Recently, the staff incorporated efficiencies into its process for preparing EISs for materials licenses, including increased incorporation by reference, consolidation of chapters, and reduction of redundant summarization. The staff did not identify any additional actions that would potentially improve the current alternatives analysis process but did reevaluate the current process. The staff determined that the current process sufficiently establishes a range of reasonable alternatives for detailed staff evaluation. For most of the materials-related environmental evaluations completed to date, the staff analyzed the proposed action and the no-action alternative in detail. However, depending on the nature of the licensing action and the purpose and need for the

action, the process directs the staff to identify other reasonable alternatives, where appropriate, that would require detailed review.

Recommendations

The staff has optimized its current approach for selecting and analyzing alternatives in materials-related environmental reviews to the maximum extent practicable, and it recommends no additional process changes as a result of this evaluation. Given the broad range of materials-related licensing actions, the staff believes that the existing process is sufficient to develop an alternatives analysis that provides appropriate information to decision-makers on proposed actions under review.

Conclusion

Based on its evaluation of its current alternatives analysis process, the staff recommends no process changes at this time. The staff has substantial experience conducting environmental reviews for reactor license renewal, new reactor licensing, and materials licensing applications. The staff has streamlined the current alternatives analysis process in these areas to the maximum extent practicable based on decades of experience and expertise.

Although it recommends no alternatives analysis process changes as part of this evaluation, the staff continues its efforts to streamline and improve the efficiency and effectiveness of its NEPA review process, including in the area of alternatives analysis. For example, in the emerging area of advanced reactor applications, the staff has developed and implemented several strategies for improving and streamlining its process for evaluating alternatives in its EISs. The staff recently achieved demonstrable success in the practical application of streamlining this process in its development of the Kairos Hermes draft EIS. The staff will continue to build on its initial success, implement these strategies on reviews of a range of anticipated new reactor licensing applications, evaluate based on the results of this implementation, and identify lessons learned from practical experience. The high number of anticipated licensing applications over the next several years will give the staff ample opportunity to implement the recently developed guidance and streamlining strategies on a diverse range of licensing scenarios. Also, because of this anticipated increase in workload, the staff believes that its limited resources will be best focused on effective implementation of the process already developed. The staff will continue to monitor and participate in Governmentwide initiatives by the U.S. Federal Permitting Improvement Steering Council and CEQ to streamline the NEPA process, including the alternatives analysis process. Additionally, the staff will continue to review the recent NEPA amendments included in the Fiscal Responsibility Act of 2023 to determine any impacts to the NRC's alternatives analysis process.