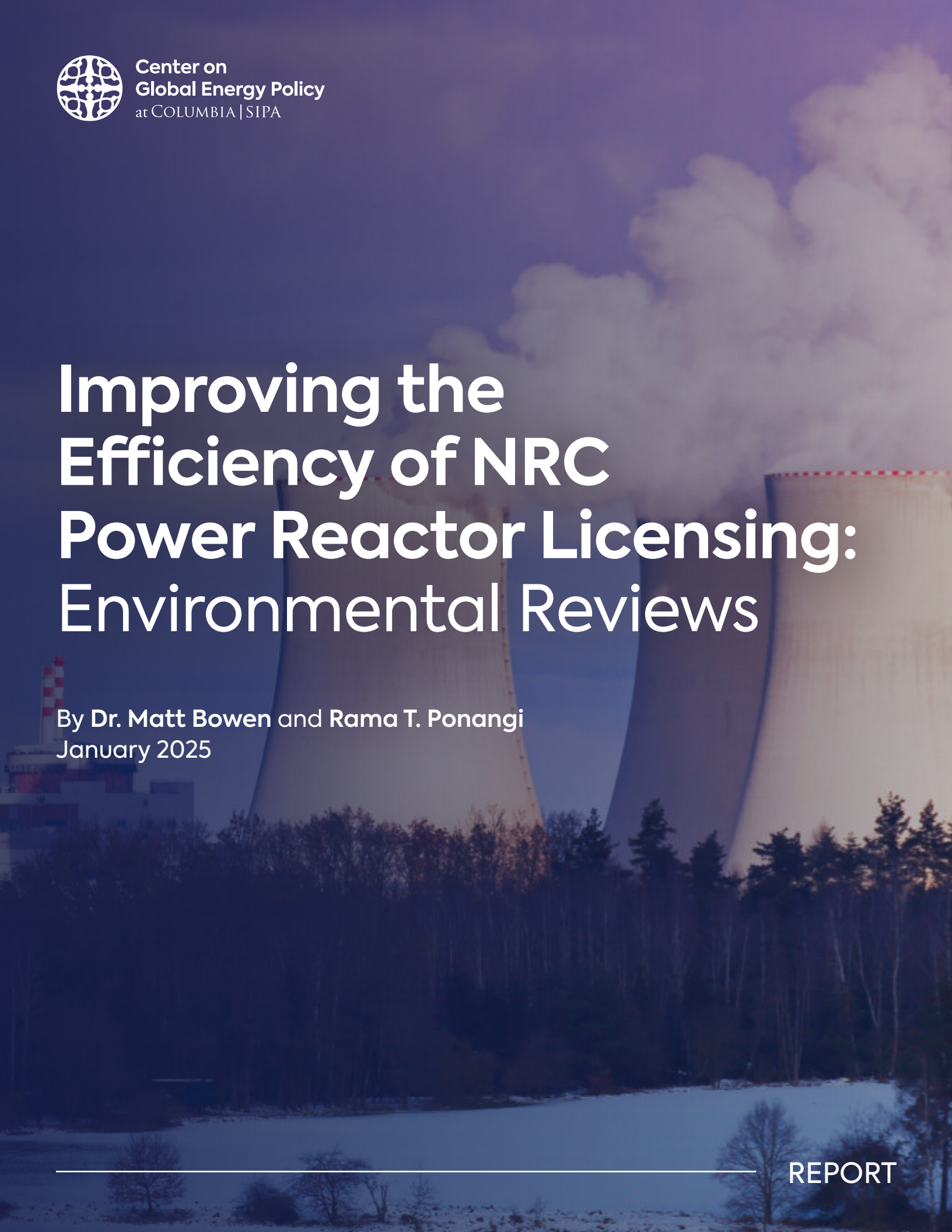

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Improving the Efficiency of NRC Power Reactor Licensing: Environmental Reviews

By **Dr. Matt Bowen** and **Rama T. Ponangi**
January 2025

REPORT

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Acknowledgements

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Executive Summary

Achieving net-zero emissions in the United States by mid-century requires the rapid buildout of low-carbon energy infrastructure. One challenge to this rapid buildout is the environmental reviews required by the National Environmental Policy Act (NEPA), which are part of federal approval processes for new energy projects. This process has increasingly caused significant delays and added costs, and the Fiscal Responsibility Act (FRA) of 2023 was passed by Congress in part to address these issues through amendments to NEPA that impose timelines on environmental reviews.

For nuclear power, a low-carbon energy source that has a role in many US net-zero scenarios, environmental reviews are conducted by the US Nuclear Regulatory Commission (NRC) as part of its reactor licensing process. Because this process has at times been lengthy and costly, Congress passed the 2024 ADVANCE Act in part to require the NRC to implement its responsibilities under NEPA more efficiently. During the 2000s and 2010s, most of the environmental impact statements (EISs) these reviews produced would not have complied with NEPA's new FRA timeline (two years or fewer) and page limit (150, or in extraordinary cases 300). More recent NRC environmental reviews for test reactor deployments have been somewhat quicker and had shorter review documents, perhaps a recognition by the agency that the efficiency of this process needed improvement.

This report, part of a series of publications on nuclear licensing reform at the Center on Global Energy Policy at Columbia University SIPA, focuses on how the NRC can fulfill the new legal mandates on time and page limits for environmental reviews and in general improve the efficiency of these reviews. The report demonstrates that earlier (1970s–80s) environmental reviews for nuclear power reactors licensed under the 10 CFR 50 licensing pathway took less time and generated shorter review documents than those conducted under 10 CFR 52 during the 2000s and 2010s. The latter reviews—all of which were for large light water reactor projects—also utilized substantial NRC resources, thereby incurring significant costs to the applicants. None of these reviews found that the reactor projects were expected to create what the NRC calls "large adverse" environmental impacts, which could destabilize environmental resources. Although some "moderate adverse" impacts were identified, they typically came from unavoidable elements such as new transmission lines and traffic that would result from any large construction project. And beneficial impacts always came in the form of jobs and taxes. At the very least, these findings raise questions about the allocation of time and resources to various aspects of the NRC's environmental review.

The report concludes with policy pathways for the NRC that could help make its environmental reviews more efficient without compromising quality. Specifically, the NRC can:

- Pare down two analytical sections of the EIS—the need for power and alternatives chapters—which are not currently adding much value, especially commensurate with their length.
- Use a generic environmental impact statement (GEIS) approach—which has been effective for reactor license renewals and involves dividing the environmental review into issues that are expected to be generic for new reactor projects and therefore can be examined in a simplified manner and issues that need more in-depth, project-specific evaluations—for new reactor licensing.
- Use the more concise environmental assessment (EA) review instrument instead of an EIS for subsequent deployments of a reactor at the same site or to sites with operating reactors or retiring coal plants, as well as for micro-reactor deployments.
- Remove the EIS requirement for every new reactor licensing from its Part 51 regulations, which would give the NRC more flexibility to tailor its reviews to the specifics of a given reactor project, better enabling in particular use of an EA instead of an EIS.

Introduction

Achieving a net-zero emissions energy supply system by midcentury will require the United States to undertake a large-scale build-out of low-carbon infrastructure.[1] A build-out of this scale in such a short window of time is challenging for a host of reasons. But primary among them is that federal approval for energy-related projects can itself take several years or more, a reality that has compelled energy experts to call for permitting reform.[2]

An integral aspect of this approval process that has particularly become subject to delay and added cost, including from associated litigation, is the federal environmental review.[3] The National Environmental Policy Act (NEPA) of 1970 requires every federal agency to assess the environmental impacts of major proposed actions, though it gives federal agencies broad discretion to determine how to carry out this mandate.[4] Despite predicting in 1981 that federal agencies would be able to complete most environmental impact statements (EISs)—the most resource-intensive review for major federal actions—in 12 months or less, in 2018 the White House Council on Environmental Quality (CEQ) found average time to completion was 4.5 years, with a quarter of the EISs taking longer than six years.[5]

Congress passed the Fiscal Responsibility Act of 2023 (FRA) in part to address these mounting delays and costs by amending NEPA. For instance, Section 321 (the Builder Act) of the FRA requires that federal agencies complete EISs in two years or less or else explain why they cannot meet that deadline.[6] This review time window, if fulfilled, would be a substantial improvement upon the federal performance assessed in the 2018 CEQ analysis.

These new NEPA-mandated environmental review times also apply to the licensing of nuclear power reactors by the US Nuclear Regulatory Commission (NRC). Power reactors are one of the potential sources of new low-carbon energy that could help the United States decarbonize its energy supply. US Secretary of Energy Jennifer Granholm recently said that to reach net zero by 2050, the United States will need to triple its nuclear capacity.[7] New reactors could provide either electricity to the power sector or process heat to nonpower sectors to replace fossil fuel use.

In either case, the reactors would need to be licensed by the NRC, and the NRC licensing process for new reactors has at times been lengthy and costly. The process involves a safety evaluation and a separate review of environmental issues. The principal information product generated by the latter is an EIS.[8] In recent decades, NRC environmental reviews have, on average, taken longer than they did in the past (e.g., the 1970s) and at substantial costs charged to the applicants. The efficiency of the NRC's licensing process will help determine how many new reactors can be built

in the coming decades. In recognition of this reality, Congress recently passed the ADVANCE Act, which was signed into law in July 2024. The law directs the NRC to consider ways of improving the efficiency of nuclear reactor environmental reviews, especially for projects that follow first-of-a-kind deployment and the deployment of new reactors at brownfield sites (including those with retired fossil fuel facilities). In particular, Section 207 requires the NRC to develop expedited procedures for combined licenses (COLs) that, for instance, reference a certified design and are for sites with operating reactors (or had reactors operating there previously), and requires that the environmental review be completed within 18 months ("to the maximum extent practicable").[9]

This report, part of a series on NRC regulation published by the Center on Global Energy Policy, analyzes the new legal mandate on time and pages for EISs that the NRC will need to meet and how it might do so. Chapter 1 examines the early experience with environmental reviews as part of the 10 CFR 50 licensing process. Chapter 2 analyzes the last 20 plus years of NEPA reviews as part of new reactor licensing proceedings under 10 CFR 52. These two regulations, introduced in 1956 and 1989, respectively, involve a two-step process (Part 50) in which a utility submits an application to the NRC for a construction permit and then later submits an application for an operating license, or a one-step process (Part 52) integrating both these steps. Both chapters examine two metrics in particular for which Congress, through the FRA amendments to NEPA, has now set targets: length of time (in years) for environmental reviews and the size of the review documents (in pages). Chapter 3 examines the analysis in EIS documents from Part 52 licensing in recent decades to identify key trends relevant to meeting these two targets. Chapter 4 explores policy pathways, including ongoing NRC initiatives, that could increase the efficiency of NRC environmental reviews and reduce page counts. Chapter 5 presents the research findings and offers recommendations to policymakers.

Research for this report involved analyzing environmental regulations by the NRC (and its predecessor, the US Atomic Energy Commission [AEC]), NRC data related to the licensing of power reactors (including associated environmental reviews) obtained through a Freedom of Information Act (FOIA) request, environmental reviews completed as part of reactor licensing (1970s to present), and related Congressional and NRC policy documents.[10]

Chapter 1: Early Experience with Part 50 Licensing

This chapter analyzes the length of environmental reviews and associated review documents for power reactors licensed under the 10 CFR 50 process that began operations.[11] It finds that early environmental reviews under Part 50 generally took less time and generated shorter documents than the more recent NRC environmental reviews discussed in the next chapter—relatively close to the new targets in the 2023 FRA—meaning there is a precedent for meeting the new requirements imposed by the FRA. This finding takes on added significance in light of the fact that advanced reactor developers today are planning to use the older Part 50 licensing pathway for at least first-of-a-kind deployments because they view this pathway as providing more flexibility for design changes during construction. (Chapter 4 discusses one instance where construction of an advanced reactor has already begun under Part 50, and TerraPower submitted a construction permit application in 2024 to build its first reactor in Wyoming using Part 50.) This section is only meant to provide a precedent and does not analyze how or why review times and document sizes grew over time.

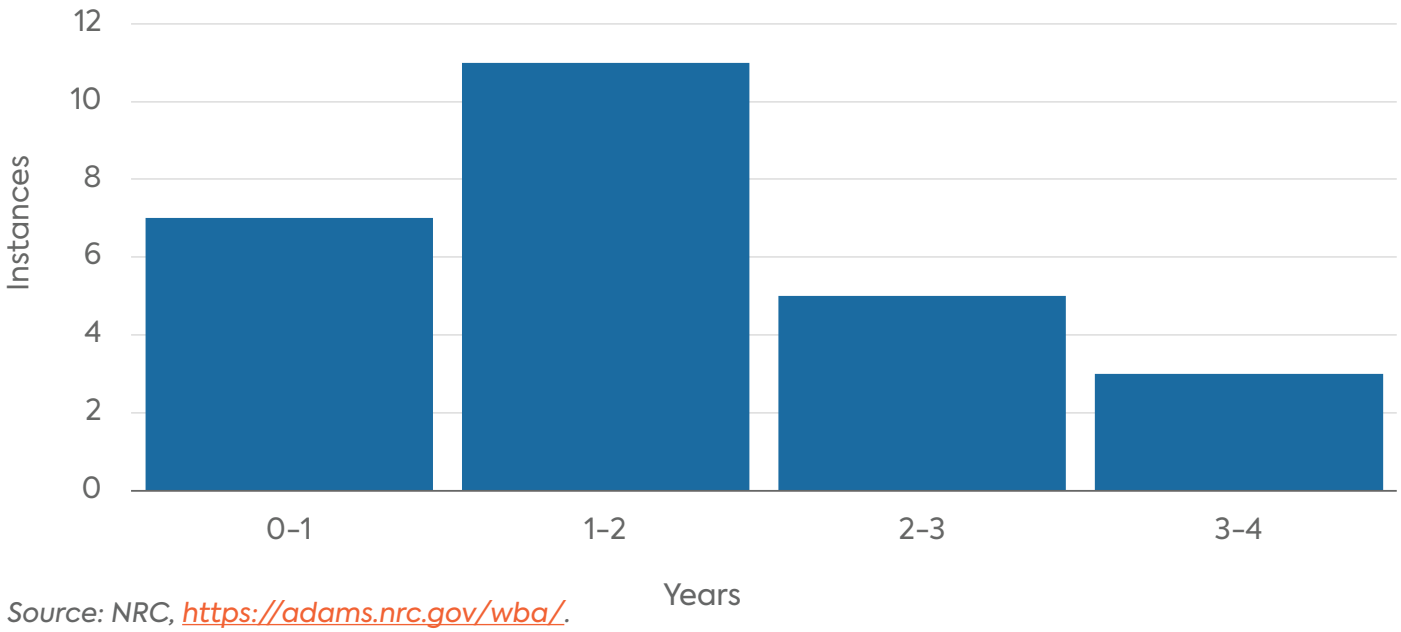
The analysis is based on environmental reviews found on the NRC's web-based ADAMS database.[12] In the authors' review of operating license applications, the environmental review documents usually (though not always) included the dates of when the construction permit application was submitted to the AEC/NRC, the environmental review of the construction permit application was completed, the operating license application was submitted, and the environmental review for the latter was completed. These dates were used to estimate review times for both stages. The authors also found a smaller number of environmental review documents associated with applications for construction permits. These documents, in addition to the environmental review documents for operating license applications, were used to estimate page counts.

The analysis does not include all reactors licensed in this time frame, as the ADAMS database does not appear to contain all of the environmental review documents that were completed for operating license applications.[13] In addition, some of the legacy documents that were scanned contain pages that are illegible or incomplete.[14]

Figure 1 shows review times for a sample of 26 power reactor construction permits (out of a total of 77) issued between 1973 and 1978.[15] The review times are sourced from dates found in the environmental reviews for the associated operating licenses and are measured from construction permit application date to publication of the final environmental statement. Based on the sample,

the average review time in the first decade after NEPA's passage was only 1.45 years, though there was substantial variability, with the shortest time being 0.65 years and the longest being 3.68 years.

Figure 1: Environmental review times for a sample of power reactor construction permits in the 1970s

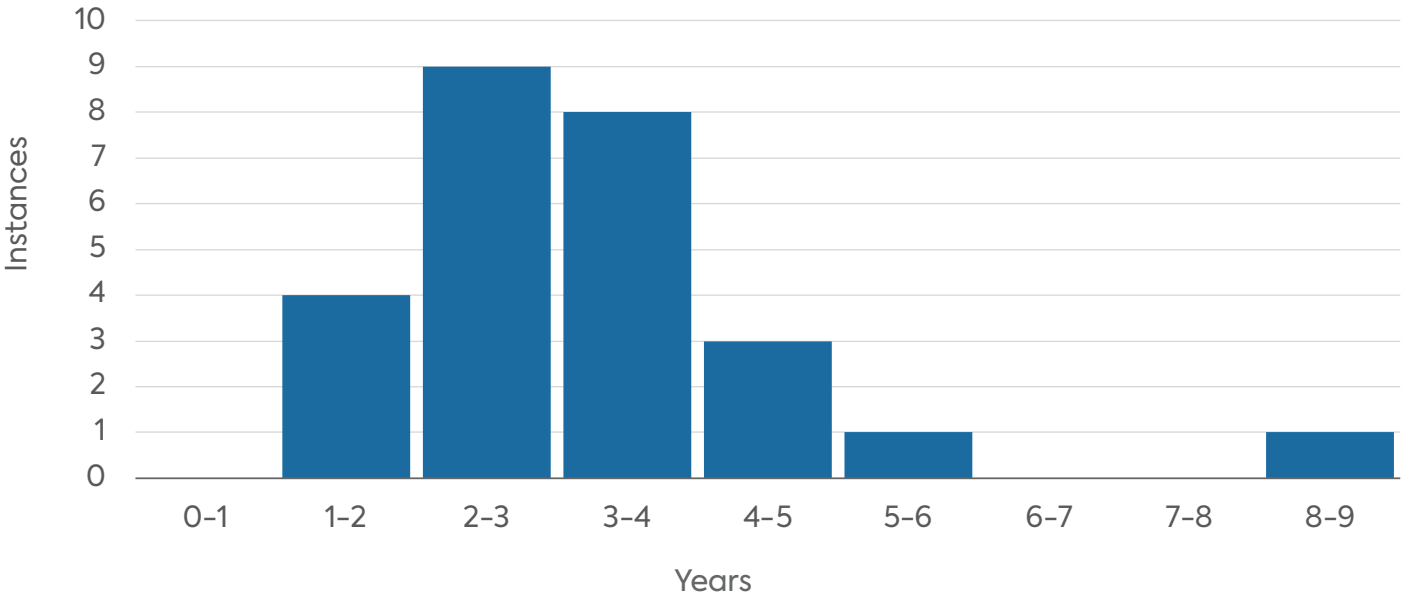


Source: NRC, https://adams.nrc.gov/wba/.

Eight final environmental statements associated with nuclear power plant construction permits were found on the NRC website. For those eight, the average number of pages, excluding appendices, is 254 (minimum 198, maximum 359); the average number of pages in the appendices is 139 (minimum 44, maximum 405).[16]

Figure 2 shows the time taken to complete environmental reviews for a sample of 26 operating license applications (out of a total of 46) issued between 1981 and 1990. Similar to the environmental reviews for the construction permits above, there was a substantial spread in terms of review times (measured from operating license application date to publication of the associated environmental statement). On average, the reviews in this sample took 3.13 years, with the shortest taking 1.42 years and the longest taking 8.08 years.

Figure 2: Environmental review times for a sample of power reactor operating licenses



Source: NRC, https://adams.nrc.gov/wba/.

For the environmental statements related to the operating license applications, the average number of pages excluding appendices is 175 (minimum 106, maximum 311); the average number of pages in the appendices is 131 (minimum 29, maximum 306).[17]

Table 1: Summary of average review times and page lengths for environmental reviews examined in this chapter

	Average review time (in years)	Average number of pages before appendices	Average number of pages of appendices
Construction permit	1.45	254	139
Operating license	3.13	175	131

Summary

In the datasets identified and used for this analysis, early environmental reviews as part of construction permits issued under Part 50 took, on average, under two years to complete. The environmental reviews that were completed as part of issuing operating licenses took, on average, nearly twice as long—close to three years. The associated environmental review documents, excluding the appendices, took up, on average, less than 300 pages. As the next chapter will bear out, this is considerably shorter on both fronts than more contemporary reviews conducted under a different licensing process: 10 CFR 52.

Chapter 2: Part 52 Licensing in the 2000s and 2010s

This chapter examines environmental reviews completed for projects licensed under the 10 CFR 52 pathway, almost all of which involved large light water reactors (LWRs). First introduced in 1989, Part 52 is a one-step process through which a project developer can apply for a COL that authorizes the licensee to construct and (with certain specified conditions) operate a nuclear power reactor at a specific site.[18] A utility can, for example, submit an application that contains all of the safety and environmental information necessary for NRC review. Alternatively, a utility can first submit an early site permit (ESP) application to resolve most environmental issues, and later submit an application for a COL that references the ESP. Both pathways involve the preparation of an EIS and, if the NRC has already issued an EIS for an ESP, a "supplemental EIS" for a COL application that references that ESP. All COLs and ESPs issued by the NRC so far are from the 2000s and 2010s.

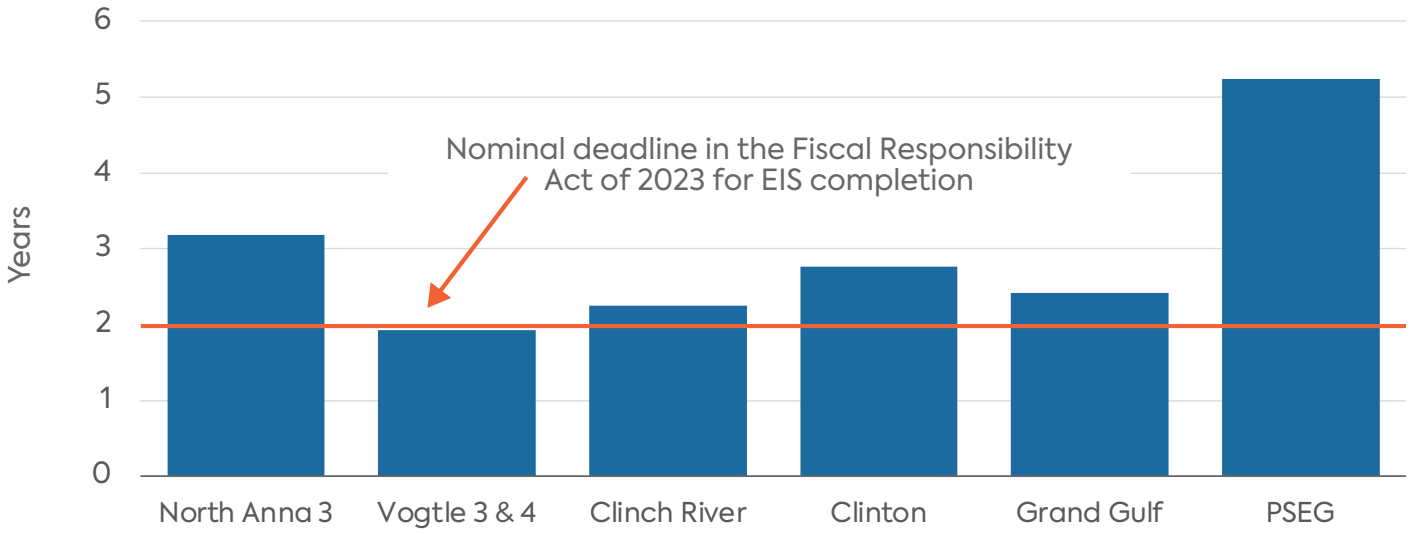
Data on the resources needed by the NRC to complete these environmental reviews was obtained through an FOIA to the NRC. The data provided by the NRC also includes the resources required for the NRC's concurrent safety review for each LWR application. As a result, this chapter includes estimates of both the costs to applicants of the environmental reviews as well as the relative share of total costs to applicants from the two primary reviews involved in new reactor licensing. This chapter also compares the time required for the NRC's environmental reviews with that required for the safety reviews in order to assess the possibility that environmental reviews could delay power reactor licensing.

A. EIS Review Times and Page Counts

The NRC issued six ESPs between 2000 and 2020—five in the early 2000s to several utilities seeking to deploy large LWRs, and one in 2016 to the Tennessee Valley Authority for a potential small modular reactor project at the Clinch River site.

Figure 3 shows the time taken to complete the EIS for each of the six ESPs. The average completion time was about three years, with five taking longer than the two-year time length for completing EISs in section 107(g)(1)(A) of NEPA (added in 2023 by the FRA), and one of those five taking over five years. The EIS for the Vogtle ESP was the only one to be completed in less than two years.

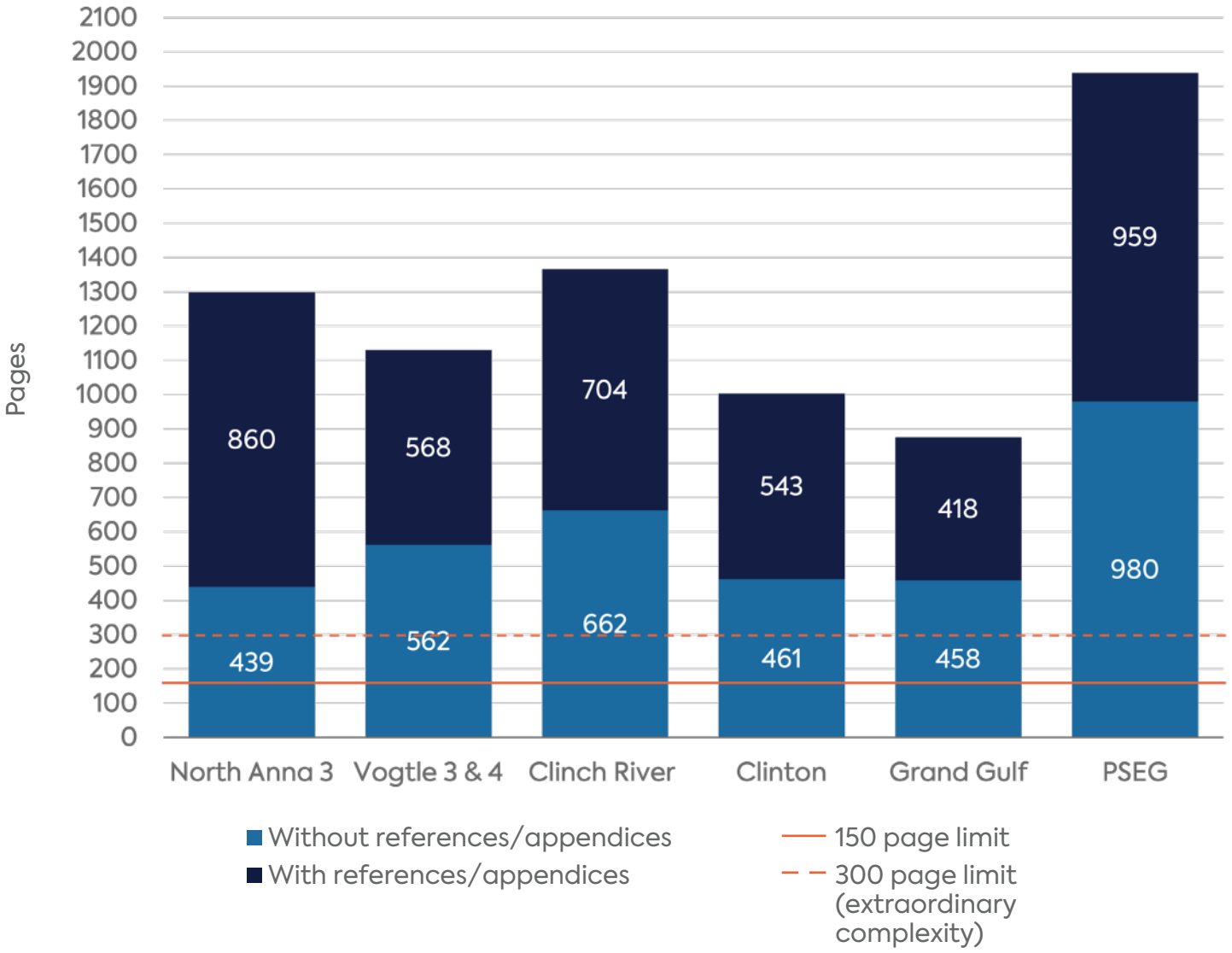
Figure 3: Time taken to complete each ESP EIS compared with FRA-mandated time length



Source: NRC EIS documents for indicated ESP projects.

Figure 4 shows the page length of each ESP EIS. All page lengths are larger than the 150-page limit in the FRA and even the 300-page limit for "agency action of extraordinary complexity." These lengths are specified in section 107(e)(1) of NEPA, which was added in 2023 by the FRA. In fact, the PSEG ESP EIS exceeded 900 pages even without the appendices, which added another nearly 1,000 pages to the document.

Figure 4: Page count for each ESP EIS compared to FRA-mandated page limits

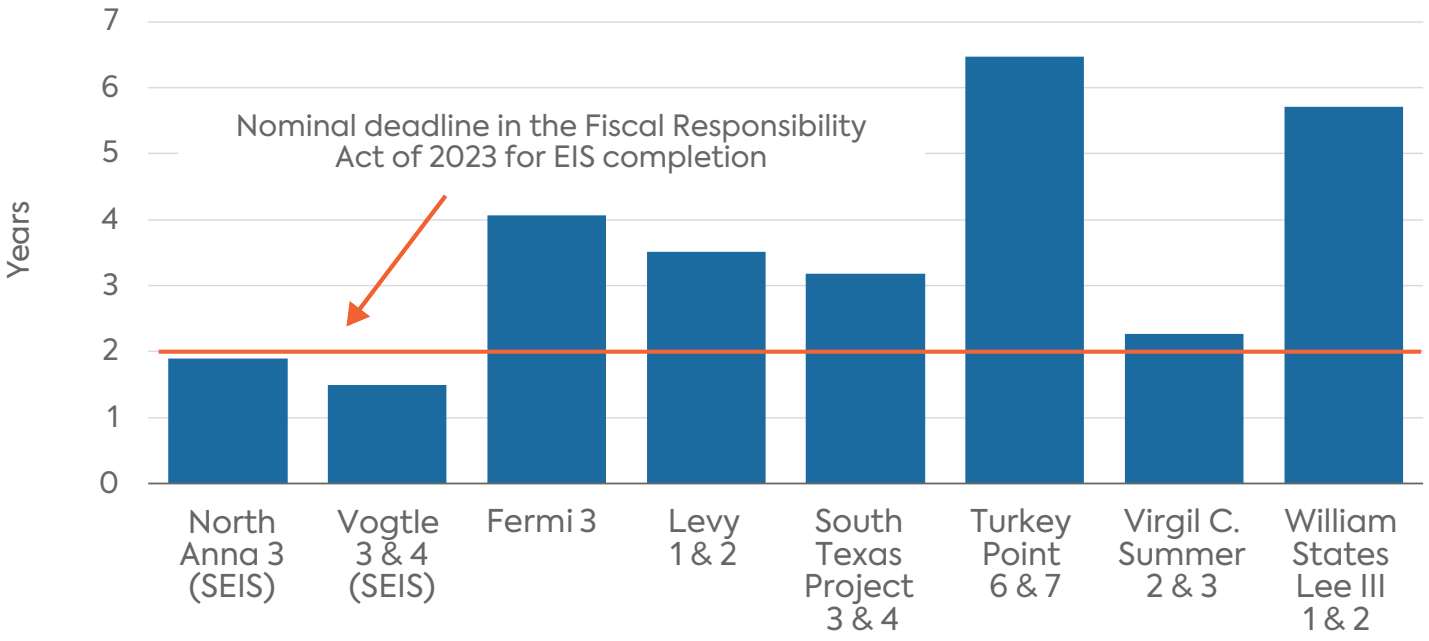


Source: NRC ESP EIS documents.

Two of the large LWR projects (Vogtle and North Anna) that applied for and received ESPs later sought and obtained COLs from the NRC. Six other large LWR projects applied for and received COLs without having first sought an ESP. Figure 5 shows the EIS completion times for these eight projects. Since two—Vogtle and North Anna—received ESPs prior to their COLs, Figure 5 shows the time taken by the NRC to publish the supplemental EIS (SEIS) for each, which one would logically

expect to require less time given the detailed environmental review already done at the ESP stage, and the review times shown in the figure show this to be true.

Figure 5: Time taken to complete each COL EIS compared with FRA-mandated time length

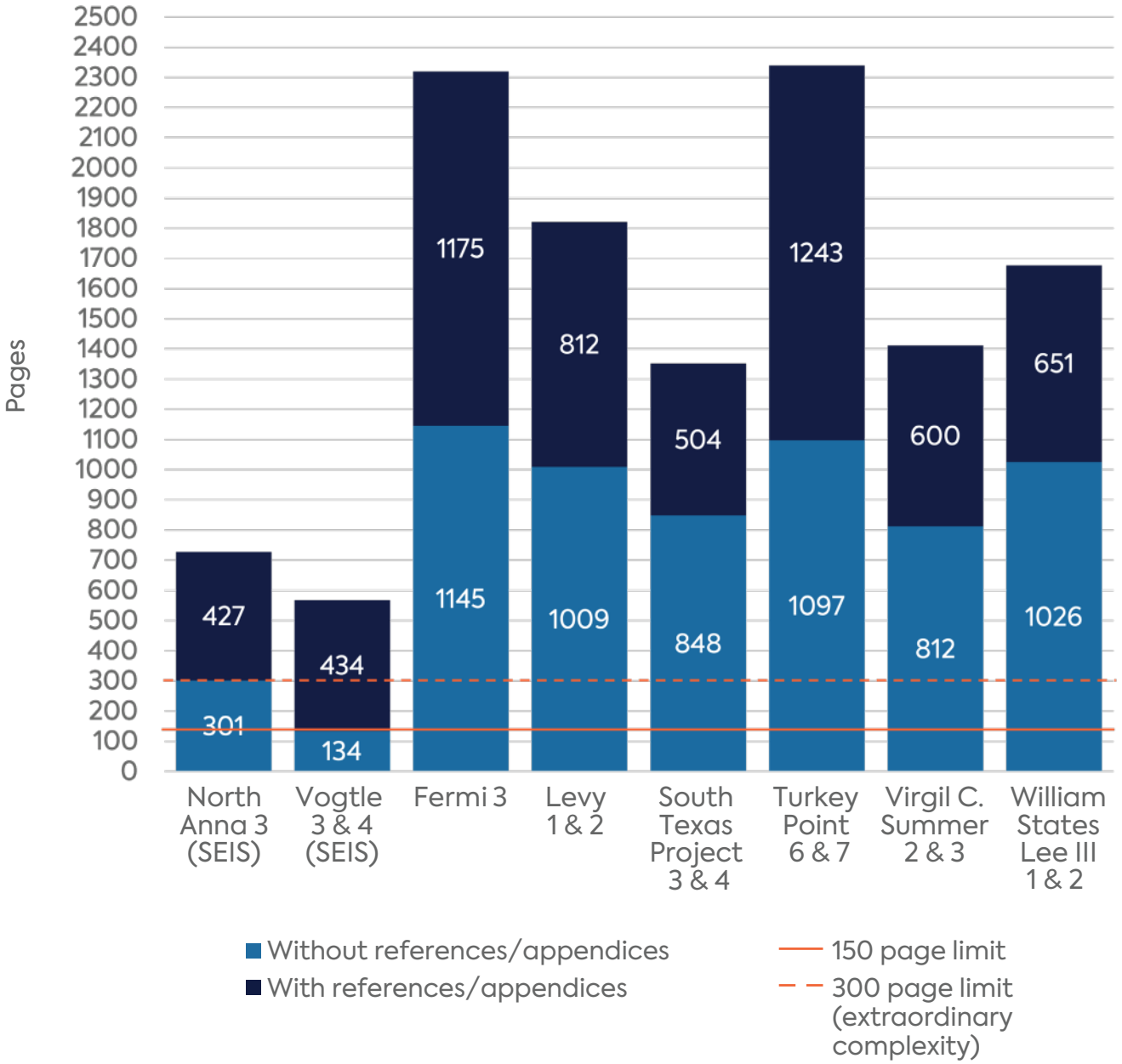


Source: NRC EIS documents for indicated COL projects.

The only two COLs for which an EIS was issued in less than two years were, as explained above, supplements to previously issued EISs for ESPs. The other six EISs exceeded the two-year target now specified in section 107 of NEPA, with two requiring nearly six years.

Figure 6 shows the page counts for the EISs produced for each of the eight COL projects. Except for the Vogtle and North Anna supplemental EISs, these counts exceed the page limit in section 107 of NEPA for an EIS, with the longest (Fermi 3) requiring almost eight times the current 150-page EIS page limit in the FRA and four times the 300-page limit for agency actions of "extraordinary complexity."

Figure 6: Page count for each COL project EIS compared with the FRA-mandated page limits

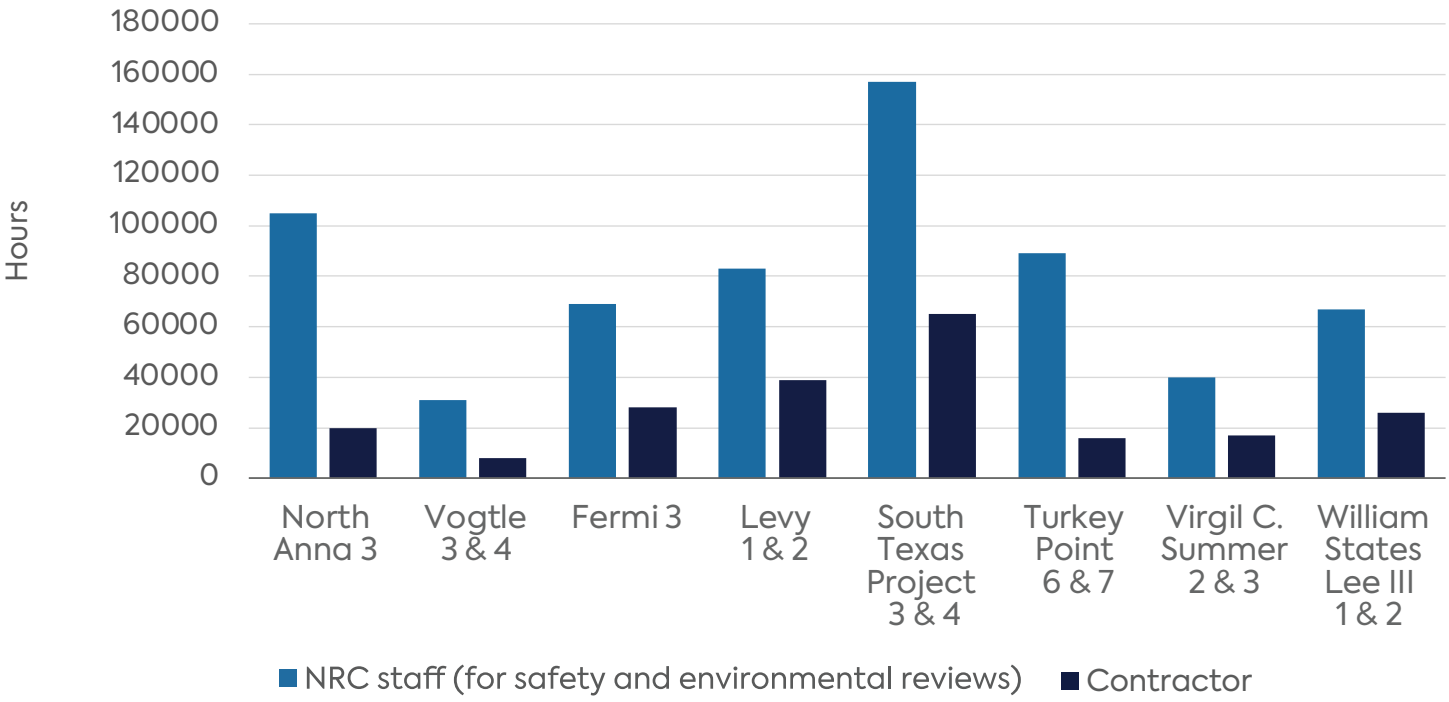


Source: NRC COL EIS documents.

B. Staff Hours Expended and Comparison with Safety Reviews

The NRC staff and its contractors spend thousands of hours performing environmental and safety reviews for new reactor applications. The NRC bills these hours to the applicant, resulting in millions of dollars in costs to developers. To provide at least a partial illustration of the resources involved with these reviews, the authors submitted an FOIA request to the NRC for the eight large LWR projects discussed previously, which involved 14 individual reactors and thus 14 COLs in total. In response, the NRC shared the total number of NRC staff hours used for the safety and environmental reviews, which are shown in Figure 7. As the figure illustrates, the number of NRC staff hours ranged greatly across reviews: from a low of 31,000 to a high of 157,000. Using the FY2023 NRC staff hourly rate of $300/hour, this past range of hours would equate to $9,300,000–$47,100,000 in applicant fees today. This includes neither all of the NRC fees charged to an applicant as part of power reactor licensing[19] nor the costs borne by applicants to prepare their applications and interact with the NRC prior to and during the application reviews (e.g., responding to requests for additional information). The contractor hours shown in Figure 7 are not billed at a constant rate but instead depend upon the specifics of each contract. A rough estimate of possible costs incurred by the use of those contractors can be made by converting the range of contractor hours shown in Figure 7 (8,000 to 65,000 hours) to dollars using the FY2023 NRC staff hourly rate (in place of whatever the actual contractor rates were), which results in an additional $2.4–$19.5 million charged to applicants.

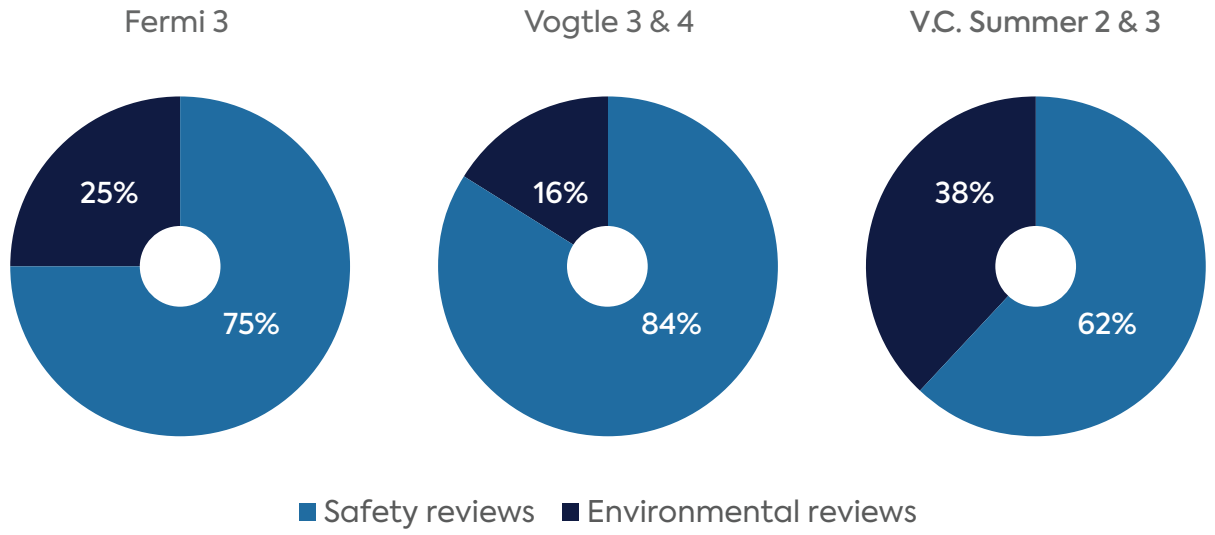
Figure 7: Approximate NRC staff hours for safety and environmental reviews and contractor hours for each project



Source: FOIA-2024-000044, https://www.nrc.gov/docs/ML2404/ML24040A032.pdf.

For most of the projects listed in the FOIA response, the NRC provided only the sum of staff hours required to complete the safety and environmental reviews, and not the number of hours required for each. However, the NRC did provide separate tallies for three projects. As Figure 8 shows, NRC staff hours spent on environmental reviews for these ranged from 5,000 to 17,000, which in all three cases was less than the number of hours for the respective safety reviews. Environmental review staff hours as a percentage of the total hours for both reviews varied from 16 percent to 38 percent. Given the larger total number of hours for the safety and environmental reviews in four of the other cases—especially the South Texas project—it is possible, perhaps even likely, that even more NRC staff hours were expended on the environmental reviews in those cases. (No division of the contractor hours for safety and environmental reviews was provided for any of the projects.)

Figure 8: NRC staff hours used for the environmental and safety reviews for three reactor projects



Source: FOIA-2024-000044, https://www.nrc.gov/docs/ML2404/ML24040A032.pdf.

Safety and environmental reviews can also be compared with each other to assess which has taken longer in the past. For four of the six ESPs discussed above (Clinton, Grand Gulf, North Anna, and PSEG), the EIS took longer to complete than the safety evaluation report (SER). For the eight projects where COLs were issued, the SER took longer than the environmental review, though sometimes only narrowly (i.e., one month). Environmental reviews have thus in some cases taken longer than safety reviews and for that reason could delay licensing actions in the future if safety reviews become more efficient—especially for subsequent deployments of the same reactor design. (Chapter 4 discusses the recent issuance of two construction permits for two test reactor projects under Part 50 for which the environmental reviews took longer than the concurrent safety reviews.)

Summary

NEPA, as amended by the FRA, now contains time and page limits on environmental reviews that the federal government writ large has not been achieving. As this chapter has shown, the NRC's environmental reviews in the 2000s and 2010s grew from earlier reviews in the 1970s and 1980s in terms of both completion time and document size (in pages). Moreover, more recent NRC environmental reviews for large LWRs licensed under Part 52 have, on average, substantially exceeded the deadlines and page limits in the new section 107 of NEPA.

The total NRC staff hours needed to complete the safety and environmental reviews for COLs have varied widely across projects, with one using five times as many NRC staff hours than another. The NRC also made extensive use of contractors, and contractor hours have likewise varied significantly, with one case taking nearly eight times the contractor hours of another. From the three COL cases for which the NRC reported time spent on safety and environmental reviews separately, the environmental reviews accounted for 16 percent, 25 percent, and 38 percent of the number of hours that the concurrent safety reviews took. The environmental reviews entailed NRC fees costing millions of dollars or even over $10 million—without considering the costs incurred by applicants to prepare the required application documents and respond to NRC requests during the application evaluation stage.

Chapter 3: The Environmental Analysis in Each EIS Chapter

This chapter examines the analysis within the EISs issued for the eight projects that received COLs to ascertain relevant trends and provide a basis for assessing how the NRC's environmental analyses could be streamlined.

As part of modern licensing for new reactors, the NRC may conduct activities before an application is submitted to become familiar with the proposed project. NRC staff also establishes points of contact within other federal, state, and local agencies, and holds public outreach meetings. If the NRC finds an application (which includes the environmental report) to be acceptable for docketing and detailed technical review, it publishes a notice of intent to prepare an EIS; conducts a "scoping" process that includes an opportunity for public comment and possibly public meetings; prepares a draft EIS, which it makes available for public comment, including through public meetings; and prepares the final EIS, which includes responses to the comments on the draft EIS.

Chapters 1–3 in each EIS provide an introduction to the environmental review, a description of the affected environment, and a description of the power plant and site layout. Chapters 4–7 examine environmental impacts from construction and operation of the power plant as well as from fuel cycle, transportation, decommissioning, and cumulative effects. Chapters 8 and 9 examine the need for power and alternatives. Chapter 10 summarizes the findings in the earlier chapters. In all eight of the COL proceedings under discussion, the EIS recommended that the COL be issued based on the NRC staff's environmental review of the project. The following two subsections focus on the analytical chapters (4–9).

A. Environmental Impacts from the Proposed Reactor Projects

Chapters 4 and 5 of the COL EISs include NRC staff evaluations of construction and station operational impacts on various resource categories such as land use, water, ecology, socioeconomics, environmental justice, historical and cultural resources, and air quality. NRC staff characterize these impacts at the end of each chapter with three ratings:

- **Small:** Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

- **Moderate:** Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
- **Large:** Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

Tables A-1 and A-2 in the appendix show the NRC staff characterizations for the eight large LWR projects for which the NRC issued COLs. No resource category for any of the projects—greenfield or brownfield—was judged to have large adverse (i.e., destabilizing) impacts.

As Tables A-1 and A-2 additionally show, in every case the impacts to many resource categories (e.g., all the water-related subcategories, air quality, nonradiological health, and radiological health) were assessed to be small. This was true even for greenfield projects such as Levy 1 and 2 and William States Lee III 1 and 2. Where adverse impacts were assessed to be moderate, they tended to be due to:

1. New transmission lines leading to impacts on aesthetics, land use, and terrestrial ecosystems
2. Construction and jobs leading to increased traffic and housing shortages

Impacts were not all judged to be adverse; in fact, all of the projects were judged to have beneficial economic impacts ranging from small to large through job creation, tax base additions, and other factors.

Chapter 6 examined the impacts from uranium fuel cycle and solid waste management, transporting radioactive material, and decommissioning the proposed nuclear power plants. The impacts in every case were judged to be small for these categories.

Chapter 7 dealt with "cumulative impacts." While NEPA does not mention cumulative impacts, the CEQ's implementing regulations (in 40 CFR 1508.7) define them as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." The regulations further explain that cumulative impacts can result from "individually minor but collectively significant" actions that take place over long periods of time.

The resource categories assessed in chapter 7 were the same as in chapters 4 and 5 with an added category of "fuel cycle, transportation, and decommissioning" (from chapter 6). No impacts were judged to be large. Typically, the characterizations were the same as those in the previous chapters. For example, if both construction and operation impacts were small, the cumulative impact was usually judged to be small, too.

B. Need for Power and Alternatives

Chapter 8 of the EISs contains NRC staff assessments of whether the utility applying to construct a reactor (or reactors) actually needs the power it claims to need. In all eight cases where COLs were issued, NRC staff did not contest the utility's claim.

Chapter 9 analyzes alternatives to the proposed action. NEPA and CEQ regulations require that federal agencies consider reasonable alternatives to a proposed action that can fulfill the same purpose. The alternatives that the NRC examines in power reactor licensing are:[20]

- **No-Action Alternative:** A baseline scenario where the proposed action does not proceed. This alternative helps in understanding the environmental impacts of not taking any action and serves as a point of comparison for other alternatives.
- **Energy Alternatives:** These include options for meeting the power demand through methods other than constructing the proposed new reactor(s), such as demand-side management or alternative power generation.
- **Alternative Sites:** These include different locations where the proposed new reactor(s) could be built in lieu of the applicant's proposed site.
- **System Design Alternatives:** These include alternative approaches to design features of the proposed new reactor that interface with the environment, especially cooling systems.

In all cases, the no-action alternative presented fewer environmental impacts but did not address the utility's need for power. To assess energy alternatives, building a new nuclear plant was compared to building a coal or natural gas plant in every case, but in no case were the fossil fuel plants determined to be environmentally preferable to the nuclear plant. For alternative sites, the NRC standard of denying a license based on the location is whether a different site is "obviously superior." In no case did the NRC identify such a site. Finally, in no case did the NRC conclude that a different approach to system design (e.g., a cooling water system) would be environmentally preferable.

Table 2 shows the average page length of each chapter in the EIS documents for projects with COLs. Given NEPA's new constraints of 150 pages and a maximum of 300 pages for agency actions of "extraordinary complexity," the NRC will need to find ways to streamline these chapters without compromising the quality of the environmental review.

Table 2: Number of pages for each COL EIS chapter

	Fermi 3	Levy 1 & 2	North Anna 3 (SEIS)	South Texas 3 & 4	V.C. Summer 2 & 3	Turkey Point 6 & 7	Vogtle 3 & 4 (SEIS)	William States Lee III 1 & 2
Introduction	13	9	6	10	12	12	9	14
Affected Environment	238	193	56	174	159	231	10	190
Site Layout and Plant Description	38	39	12	26	38	40	7	58
Construction Impacts	130	138	30	87	95	147	33	133
Operational Impacts	149	136	60	119	101	154	21	117
Fuel Cycle, Trans. & Decommission	44	42	8	39	42	39	5	41
Cumulative Impacts	48	54	8	57	39	46	11	51
Need for Power	25	11	20	32	25	12	1	21
Alternatives	308	250	30	216	215	258	4	250
Conclusion and Recommendation	38	30	20	29	27	28	6	33

Source: NRC COL EIS documents.

Table 3 shows the average length of each EIS chapter for the six COLs for which no prior ESP was issued. (For the other two projects, the full analysis is recorded in the ESP EIS, but the EISs for ESPs have a somewhat different organization of material within the chapters, making a direct chapter-to-chapter length comparison difficult.)

Table 3: Average length (in pages) of each chapter for six COL EISs without a prior ESP

	1	2	3	4	5	6	7	8	9	10
Average Length	12	198	40	122	129	41	49	21	249	31

Note: Data is from the six projects that received COLs but did not receive prior ESPs.
Source: NRC COL EIS documents.

Summary

The tables in the appendix show discernible patterns. Certain resource categories tend to have small adverse impacts or beneficial ones. As explained above, moderate adverse impacts typically involve certain resource categories (e.g., land use, historic and cultural resources, and socioeconomics) and activities (e.g., preconstruction and construction). In no case—for both the greenfield and brownfield deployments totaling what would have been 14 gigawatt-class reactors—did the NRC assess adverse impacts to be large (i.e., destabilizing). In no case did the NRC find that the utility had no need for new power or that an alternative would be environmentally preferable.

Building on this retrospective analysis, the next chapter discusses policy options that could help streamline environmental review times, shorten EIS page counts, and thus potentially achieve (or at least come closer to achieving) the targets in NEPA as amended by the FRA without sacrificing quality.

Chapter 4: Policy Options to Increase Efficiency

Efforts to improve the government-wide implementation of NEPA reviews have been ongoing for years, in some cases well predating the 2023 FRA. They include legislation passed while President Obama was in office, regulatory initiatives at CEQ during President Trump's first term, and the aforementioned FRA amendments to NEPA that President Biden signed into law in 2023.[21] The NRC has also undertaken numerous initiatives to streamline and enhance the agency's environmental review process further. In response to the FRA, for example, NRC staff recently published a paper identifying "opportunities to enhance clarity, reliability, efficiency, and transparency in NRC's regulations and procedures, as well as to streamline environmental reviews while balancing meaningful public engagement."[22] The NRC is also working to meet the ADVANCE Act's deadlines for making changes to guidance and regulations and to provide reports to Congress. For example, per section 207 of the ADVANCE Act, the NRC is establishing "an expedited procedure for the review of qualifying combined license applications" under Part 52.[23] As a result, the NRC has numerous options it could pursue to improve the efficiency of its environmental reviews.[24]

Rather than discuss every policy option the NRC has considered in this area—which are listed in the NRC documents cited in this chapter—this chapter focuses on three bigger policy options that could plausibly streamline environmental reviews for new reactors, reduce page counts, and in the process decrease the cost and schedule uncertainty burden on applicants. These options include paring down the need for power and alternatives analyses, employing a generic EIS, and expanding the use of environmental assessments (EAs)—each of which is discussed in detail below. Along with the many other options recounted in the aforementioned NRC documents, these measures could help the NRC meet the new review times and page counts in NEPA for EISs and, more generally, rightsize environmental reviews for new reactor projects.

A. Pare Down the Need for Power and Alternatives Analyses

Meeting the new page count limits in section 107 of NEPA for future power reactor licensing will require the NRC to shorten the EIS sections discussed in chapter 3 as compared with the large LWR licensing actions from the 2000s and 2010s discussed in earlier chapters. That could include shortening the introductory chapters, for example. But two analytical chapters in particular could

be greatly reduced without compromising quality: chapter 8 on need for power and chapter 9 on alternatives. As the last chapter showed, in the EISs completed for the projects receiving COLs, these chapters took up, on average, about 20 and 250 pages, respectively. In no case did the NRC contest the utility's need for power or require a different site or alternative technology.

A US ratepayer or taxpayer might reasonably question why the nation's nuclear safety regulator is weighing in at all on whether a US utility has a need for power or whether the utility should build an alternative power plant instead of a nuclear reactor, much less devote substantial time and resources to such evaluations, which are then charged back to the ratepayer or taxpayer. Regulated utilities work with their state public service commissions to determine whether they need new power and which new power plants they should build, and their evaluations of alternatives go well beyond environmental impacts (to include, e.g., reasons of fuel diversity). Some utilities have also made decarbonization commitments or operate in states that have passed clean energy standards. In each of the EISs discussed above, the NRC analyzed the environmental impacts if the utility built a coal plant or a natural gas plant as an alternative to a nuclear plant. Given rising energy demands and costs and a desire to shut down existing fossil plants to reduce air pollution and greenhouse gas emissions, it is perhaps surprising that the nation's nuclear safety regulator would undertake such an analysis in the first place. The climate change context is worth emphasizing: natural gas-fired generation is now the largest source of carbon emissions in the power sector[25] after 100,000 megawatts of new capacity were added by utilities over the past two decades—and there are plans to build more.[26]

Congress has also suggested that the NRC consider streamlining the alternatives analysis. Following the 2023 FRA amendments to NEPA regarding federal agencies' alternatives analyses, Section 506(b)(2)(G) of the ADVANCE Act directed the NRC to consider "opportunities to streamline the Commission's analyses of alternatives, including the Commission's analysis of alternative sites." And the NRC has already begun to do so. As detailed in SECY-24-0046, the staff recommended a policy direction (Option 1.b) that would generally limit the proposed agency action to the regulatory or licensing decision (e.g., whether to issue an operating license), stating that "the NRC generally would not consider alternatives to the proposed action that the agency does not have the authority to implement (e.g., siting and energy alternatives)."[27]

The Commission has not yet made a decision in this realm, but overall it would appear the need for power and alternatives sections could be greatly pared down without reducing the value of the broader review.

Federal Energy Regulatory Commission EISs for Natural Gas Projects

Though the regulatory contexts are different, the Federal Energy Regulatory Commission (FERC), another independent regulator, offers an alternative approach to the EIS, and particularly its power and alternatives sections, that the NRC could consider. Among other roles, FERC regulates the interstate transmission of natural gas and reviews proposals to build interstate natural gas pipelines. Third-party contractors assist FERC staff in reviewing the environmental aspects of project applications and preparing the environmental documents required by NEPA, and these contractors are funded by project applicants. Table 4 analyzes eight FERC EISs related to natural gas pipeline and station projects that were published in 2023.[28] On average, it took FERC about one year from when it received an application to finalize an EIS. The length of these EISs (measured from page 1 to the start of the appendix) averaged about 200 pages, and the appendices averaged about 150 pages.

Table 4: Average review times and section lengths from eight EISs published by FERC for natural gas projects

Category	Review time	EIS length before appendices	EIS appendices	"Purpose and Need" subchapter	"Alternatives" chapter
Average	1 year	200 pages	150 pages	1 page	10 pages

Source: FERC, https://www.ferc.gov/environmental-documents-2023-2005.

The statements in these FERC EISs on the need for the natural gas–related projects are terse (about one page), mostly citing the private developer's assertions about energy demand and reliability. Similarly, the "Alternatives" chapters in each EIS are concise, averaging about 10 pages. They are also narrow in scope: none seriously consider low-carbon alternatives to the planned natural gas projects; instead, they consider the no-action alternative as well as modifications to existing pipelines, different routes for new pipelines, and other ways to deliver natural gas to customers. Compared to the NRC COL EIS analyzed in chapter 3, the FERC EISs are thus more focused on the environmental impacts of the proposed project and devote less space—only around 5 percent by page count—to the need for power and alternatives analyses.

B. Create and Use a Generic Environmental Impact Statement

The analysis in chapter 3 supports the notion of a more targeted approach to the environmental review. Some resource categories invariably had the same result across all projects—even for the greenfield site-based reactors. For example, a detailed analysis of a given new reactor project does not seem needed to reach the conclusion that it will create jobs and tax revenue; nor does it seem needed to conclude that new transmission corridors will have aesthetic impacts and land use implications. Focusing on aspects that are specific to each site (e.g., endangered species or historical and cultural resources) would be a better use of NRC resources.

In that direction, the NRC began developing an advanced nuclear reactor generic environmental impact statement (GEIS) in 2019.[29] The GEIS (NUREG-2249) uses a technology-neutral regulatory framework and performance-based values and assumptions (i.e., the plant parameter envelope) to identify environmental issues that would have small adverse or beneficial impacts for different advanced reactor designs that fit within the parameters set forth in the GEIS (Category 1 impacts). It also identifies which environmental issues will require project-specific analysis (Category 2 impacts). The staff also developed a site parameter envelope that provides limiting values and assumptions related to the site. The GEIS presents generic analyses that evaluate the possible impacts of a reactor that fits within the bounds of the plant parameter envelope on a site that fits within the bounds of the site parameter envelope.

The draft GEIS identifies a total of 121 environmental issues relevant to the construction, operation, and decommissioning of advanced nuclear reactors. These are divided into three categories:

- **Category 1:** 100 issues where the NRC staff preliminarily determined that a generic conclusion regarding the potential environmental impacts of issuing a permit or license for an advanced nuclear reactor could be reached. NRC staff determined that the impacts would either be negligible, beneficial, or no more than small adverse.[30]
- **Category 2:** 19 issues where the NRC staff determined that a generic resolution was not feasible. Both the applicant, in its environmental report, and the NRC staff, in its draft SEIS, would have to conduct detailed, site-specific analyses to assess these issues.
- **N/A (uncertain):** two issues that did not fall under Category 1 or Category 2 due to uncertainty regarding their environmental impacts.

The NRC staff's qualitative assessment concluded that employing a GEIS for environmental reviews of advanced reactors would have a positive impact on both the duration of environmental reviews

and the page length of EISs. Based on a 24-month review schedule, it estimated that a GEIS would also reduce the cost of the reviews by at least 20 percent and perhaps as much as 45 percent. Similarly, if a supplemental EIS referencing a GEIS is employed for an advanced reactor deployment, the staff estimated the review document length could be reduced to about 250 pages from 400 pages.[31] On April 17, 2024, the NRC commissioners voted to approve the staff's recommendation to publish the proposed rule, amending Part 51 to codify the findings of the advanced nuclear reactor GEIS.[32] The final rule is scheduled to be published in June 2026. (NRC staff also recently proposed using design-specific GEISs that tier from the new reactor GEIS to facilitate efficient licensing of "nth-of-a-kind" microreactors.[33])

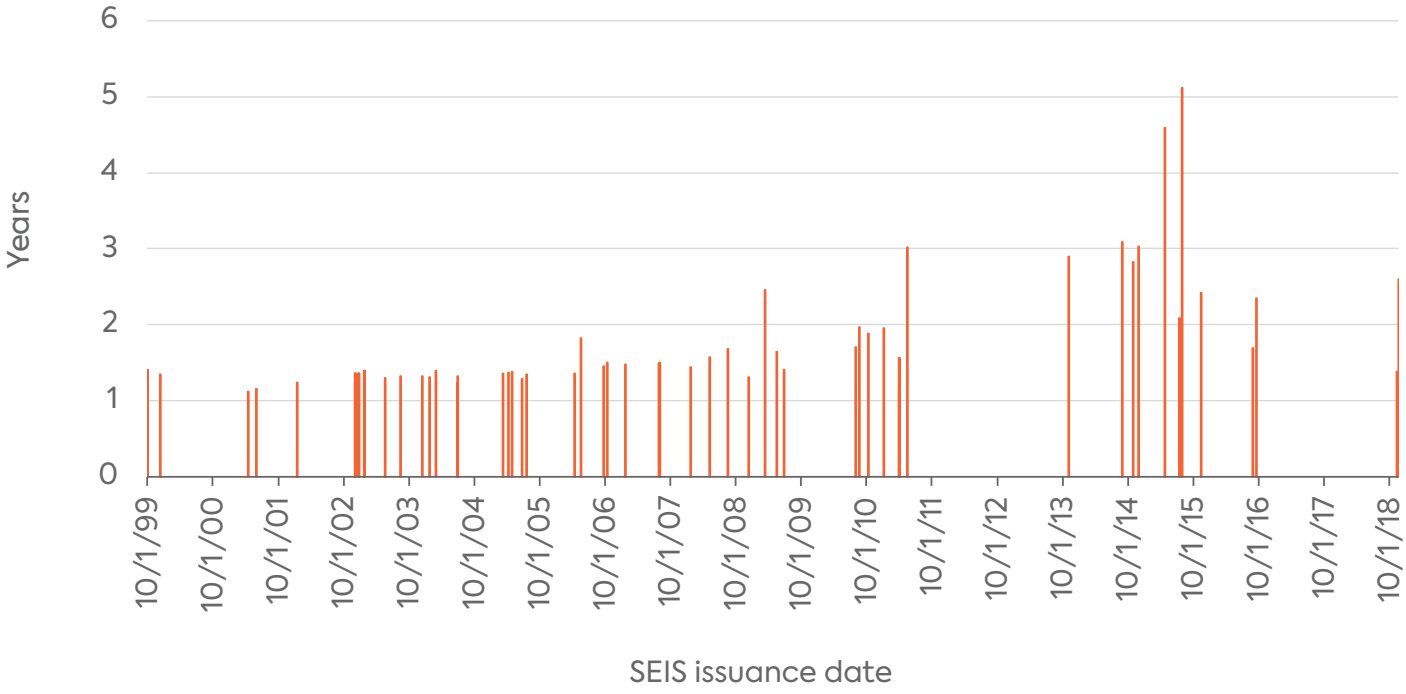
The License Renewal GEIS Example

The NRC already uses a GEIS approach as part of environmental reviews within other licensing actions, such as for the continued storage of spent nuclear fuel or decommissioning of nuclear facilities.[34] It also uses it in the renewal of operating licenses for existing reactors. Before the first US power reactors completed their initial term of operation, the NRC began to develop a GEIS for potential application to the 20-year renewal of operating licenses. The intent was to "determine which issues would result in the same impact at all nuclear power plants and which issues could result in different levels of impact at different plants and thus require a plant-specific analysis for impact determinations."[35] First published in 1996, the GEIS assessed 92 environmental issues, 68 of which were determined to be Category 1 and thus not requiring additional plant-specific analysis.

The license renewal GEIS rules were to be reviewed on a 10-year basis (as the draft new reactor GEIS described above would be as well) to provide an opportunity to make changes as needed. The first GEIS review began on June 3, 2003, and after multiple scoping periods the final report was published in June 2013. In the revised version of the rule, the NRC identified 78 generic environmental issues, of which 17 were identified as Category 2 and thus requiring site-specific analysis in the SEIS.[36] Each license renewal analysis was published as a supplement to NUREG-1437.[37]

Figure 9 shows the amount of time it took to complete 57 SEISs as part of reactor relicensing proceedings from application submittal to publication of the SEIS. Most were completed in under two years, while 12 exceeded this amount of time, with all but one of those 12 occurring in the second decade of implementation (which may show a need for constant managerial attention lest review times creep upward over time). In the 21 license renewal SEISs analyzed,[38] the main chapters had an average length of about 290 pages, while the remainder (i.e., references and appendices) averaged about 470 pages. Thus, in the license renewal case, the GEIS approach more or less met the new time and size targets in NEPA (though in the latter case only for cases of "extraordinary complexity").

Figure 9: GEIS review times for nuclear power plant license renewals



Note: Indian Point, which had a review time of 13.5 years, is excluded from this analysis because the State of New York's opposition at points to its relicensing may have contributed to the exceptional length of its review. See, for example, news articles covering the relicensing of Indian Point. Reuters, "Entergy N.Y. Indian Point Nuclear Plant Relicensing," November 23, 2016, https://www.reuters.com/article/idUSL1N1DO1HN/.
Source: NRC GEIS documents from ADAMS, https://adams.nrc.gov/wba/.

On the other hand, license renewal for an existing reactor is fundamentally different in nature than authorizing new reactor construction, and perhaps the Category 2 issues in the latter will prove more challenging and time consuming than those in the former. In addition, since license renewals have always been done with a GEIS, there are no non-GEIS environmental reviews with which to compare review times to see if the GEIS improved efficiency. Still, the experience using a GEIS for reactor relicensing renewals suggests that its application to new reactor licensing could help the NRC meet the new timelines and page limits for environmental reviews set forth in NEPA, as amended by the FRA, without sacrificing quality.

C. Expand Use of Environmental Assessments

For the gigawatt-class LWR projects discussed in chapter 3, not one—including the greenfield projects—was assessed to have large (i.e., destabilizing) environmental impacts. Advanced reactors under development have even more advanced approaches to passive safety and much smaller thermal outputs/radionuclide inventories (and microreactors would be 100 or even 1,000 times smaller), and their associated environmental footprints, such as water and land use, should be correspondingly smaller. These observations favor a less intensive and more time-efficient environmental review for their deployment than an EIS.

The next level of environmental review below an EIS is an EA. This level of review covers all the same areas as an EIS but is supposed to be more concise in terms of review time and page length. For example, in addition to setting targets for EISs, the FRA amendments to NEPA set new time and page limits for EAs of one year and 75 pages, respectively.

EAs typically include a brief discussion of the purpose of and need for the proposed action, alternatives to the action, the environmental impacts of the action and the alternatives, and a list of agencies and persons consulted.[39] If the agency determines the action will not have significant environmental impacts, it will issue a finding of no significant impacts (FONSI) with an accompanying explanation. If the agency finds the proposed action will have significant impacts on the human environment or potential impacts cannot be conclusively determined, the agency will prepare a more detailed EA in the form of an EIS. Federal agencies utilize many more EAs than EISs each year—thousands versus hundreds.[40]

By way of example, in April 2021 the NRC accepted an application for detailed review from GE-Hitachi Nuclear Energy Americas for the subsequent renewal of its license for special nuclear material at the Morris Operation Independent Spent Fuel Storage Installation in Illinois.[41] The NRC ultimately issued an EA and FONSI in November 2022, where the EA document was 43 pages including seven pages of references.

However, under 10 CFR 51.20(b), any nuclear power reactor or testing facility licensed under Part 50 or Part 52 requires an EIS for construction and operation (i.e., for a construction permit, operating license, or COL). The next section discusses an example of where the NRC has exempted itself from that rule.

Environmental Assessment for the Hermes 2 Test Reactors

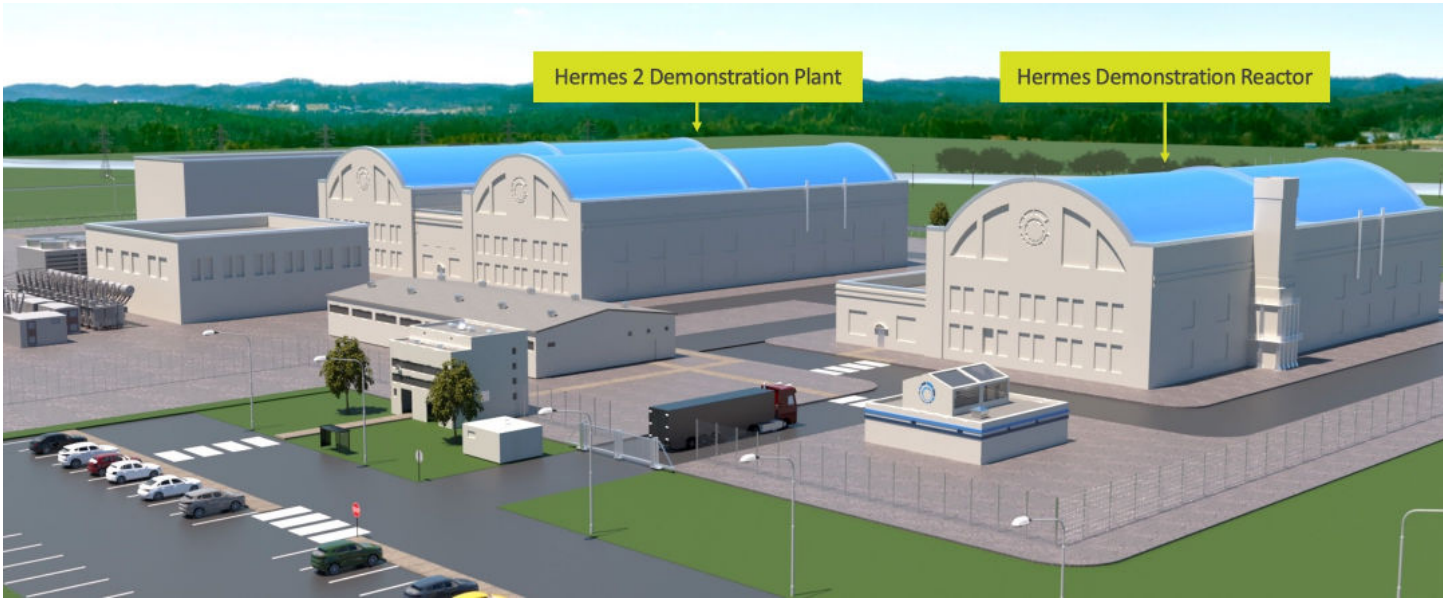
The most recent EIS that the NRC completed as part of reactor licensing was part of the Hermes test reactor project now under construction in Tennessee. In September of 2021, Kairos Power

submitted an application to the NRC for a construction permit. The location for the Hermes Demonstration Reactor was a "brownfield" site: it was previously used for the Oak Ridge Gaseous Diffusion project (buildings K-31 and K-33) before the buildings were taken down and the land underwent environmental remediation.

The NRC staff issued the final EIS[42] in August 2023—about two years after the application had been submitted—at a final length of about 140 pages (258 including references and appendices). The final EIS took longer to complete than the final safety evaluation, which was published in June 2023.

In July 2023, Kairos Power submitted a new application to the NRC to build the Hermes 2 project, which would involve two reactors similar to the Hermes reactor that would also be licensed as test reactors but would produce electricity.[43] Given the reactor similarities and the colocation with Hermes (shown in Figure 10), NRC staff proposed preparing an EA to determine whether an EIS was necessary.[44]

Figure 10: Kairos Power Hermes and Hermes 2



Source: Kairos Power LLC.

Given that 10 CFR 51.20(b) requires an EIS for all new reactor licenses, including test reactors, the NRC needed to issue exemptions from its own regulations—which is allowed under 10 CFR 51.6 if the NRC determines that it is authorized by law and in the public interest. The unique factors relevant to

Hermes 2 identified by NRC staff included the following:

- Similar design of Hermes 2 and Hermes
- Proposed siting of Hermes 2 within a few hundred feet of Hermes
- Industrial nature and heavy prior disturbance of the site
- Recent thorough NEPA review performed by NRC staff as published in its final EIS for Hermes
- Staff's final EIS for Hermes covering the same site as Hermes 2 and documenting all impacts as *small*[45]

In August 2024, the NRC published the final EA and FONSI for Hermes 2.[46] As the construction permit application was submitted on July 14, 2023, and docketed September 11, 2023, the environmental review took close to one year—a substantial improvement over the reviews examined in chapter 2, though still longer than the concurrent safety evaluation for Hermes 2, which was completed in July 2024.

Congress has passed laws referencing the EA approach. The 2023 amendments to NEPA added a new section—106(b)(2)—that states, "An agency shall prepare an EA with respect to a proposed agency action that does not have a reasonably foreseeable significant effect on the quality of the human environment," assuming the action is not eligible for a categorical exclusion.[47] A year later, Congress specifically suggested to the NRC that it consider using EAs instead of EISs for reactor licensing actions. Section 506(B)(2)(I) of the ADVANCE Act directs the NRC to consider amending 10 CFR 51.20(b) "to allow the Commission to determine on a case-specific basis whether an [EA] (rather than an [EIS] or supplemental [EIS]) is appropriate for a particular nuclear reactor application."

In SECY-24-0046, NRC staff recommended initiating a rulemaking to revise 10 CFR 51.20 and 51.21 to reflect the new language in NEPA (sections 106 and 109).[48] Among other actions, the rulemaking would explore eliminating 10 CFR 51.20(b), which currently requires an EIS for new reactors. As noted in SECY-24-0046, this change would allow for greater flexibility and eliminate the need for exemptions to prepare an EA for a new reactor.

FERC's Use of EAs

Again, the NRC could look to FERC as an example of an independent regulator that employs EAs for licensing of energy projects (though FERC does so for fossil energy infrastructure). For 20 EAs published by FERC in 2023, the average time from application submission to EA publication was 8.7 months and the average length of the EA (excluding appendices) was 94 pages.[49] The EAs in this

sample evaluated applications for, among other purposes:

- Building new natural gas pipelines
- Replacing existing natural gas pipelines, including to uprate the capacity
- Abandoning natural gas pipelines
- Siting, constructing, and operating new natural gas stations

The EAs employed by FERC for various fossil fuel infrastructure licensing actions were thus comparatively quick (in terms of review time) and short (in terms of page length). Likewise, the NRC, another independent federal regulator with impacts on the energy sector, could use EAs to streamline environmental reviews for new reactor licensing.

Summary

Federal government–wide environmental review initiatives now span three administrations: Obama, Trump, and Biden. The NRC has been working on reform initiatives for nearly the same amount of time. Three policy possibilities with prospects to shorten document sizes and reduce review times have been examined in this chapter.

Pare down the need for power and alternatives analysis. These two analytical sections of the EISs do not seem to add much value while taking up substantial space. Moreover, Congress has already suggested the NRC consider streamlining the alternatives section.

Finish the new reactor GEIS. The new reactor GEIS described in this chapter is still in draft form and subject to a rulemaking process that will not conclude until 2026. The extent to which a GEIS will streamline site-specific environmental reviews for new reactors is thus not yet known, but the experience with using a GEIS approach to power reactor licensing renewal provides experiential support that it could potentially achieve around a two-year average review time.

Expand use of EAs. This approach could be used for subsequent deployment of a given reactor design (that is, following its initial deployment) at the same site where it is already deployed or at another existing nuclear plant site or perhaps a coal plant site. FERC has used EAs effectively for substantial additions and modifications to US fossil fuel infrastructure. If NRC commissioners want to enable the NRC to use this approach, they should amend Part 51 to remove the requirement for an EIS.

In the long term, how the NRC handles environmental reviews for nth-of-a-kind deployments will be important as the safety case for standardized reactor designs will be essentially known at that point apart from site-specific issues. Industry has told the NRC that it is looking for highly efficient

licensing paths (e.g., half a year)[50] for microreactors, which could necessitate policy options that are even speedier than a GEIS or an EA, and Section 208 of the ADVANCE Act requires the creation of a new microreactor licensing regime.

Chapter 5: Conclusions and Recommendations

When NEPA was passed in 1970, climate change was not yet perceived as an urgent issue, and thus there was no wide-scale effort to rapidly deploy large amounts of low-carbon energy. That is no longer the case. The US now finds itself in the situation of undertaking a rapid and large-scale build-out of low-carbon infrastructure to mitigate risks posed by climate change. This effort likely requires finding ways of reducing the time and resources dedicated to federal environmental reviews for new low-carbon energy infrastructure.

Despite early predictions that EISs under NEPA would take around a year to complete, actual review times in recent years have been over four times longer. Environmental reviews at the NRC as part of licensing actions for new reactors have also grown in terms of both time to completion and size of review documents. In addition, there have been instances in the past where environmental reviews have taken longer than safety reviews, and environmental reviews could end up on the critical path for licensing in the future and delay the associated projects, especially if safety reviews for nth-of-a-kind reactor deployments become more efficient.

In amending NEPA in 2023, Congress clearly sought to speed up the federal permitting process, in part by establishing deadlines and page limit targets for EISs and EAs. Over the past 20 years, the EISs produced as part of NRC licensing for potential new reactor deployment have, by in large, not complied with NEPA's new timeline (two years or less) or page limit (150, or in extraordinary cases 300 pages).

Meanwhile, in no case from the license proceedings in the 2000s or 2010s did the NRC find that a new reactor project would create large (i.e., destabilizing) adverse impacts—for either a brownfield or a greenfield host site. The moderate adverse impacts on resource categories typically came from unavoidable elements such as new transmission lines and traffic, while positive (and in some cases "large") impacts always came in the form of jobs and taxes. A decarbonization effort by midcentury to avoid potentially destabilizing impacts from climate change, regardless of the technology pathway used, will involve many new transmission lines and lots of new power plant construction (and associated traffic and jobs),[51] so none of these commonalities is a reason not to deploy new nuclear power. Indeed, one of nuclear power's valuable attributes is that it requires less land and fewer new transmission lines per megawatt hour generated compared with much higher renewable energy scenarios.[52]

Even before the passage of the FRA and the ADVANCE Act, the NRC had undertaken numerous initiatives related to environmental review modernization. These initiatives identified ways of making environmental reviews more efficient, and the ADVANCE Act of 2024 also pointed to some of these same options. While the NRC clearly could have done more to speed up its environmental reviews in the 2000s and 2010s discussed in chapter 2, more recent experience (e.g., with Hermes and Hermes 2) has been positive, and there are indications that NRC staff are trying to institute changes. What the Commission will ultimately choose to do is unknown, but the analysis in this report has argued:

- The NRC will need to shorten its new reactor EISs from those of the large LWR licensing actions in the 2000s and 2010s in order to meet the new target page counts in the FRA. Two analytical sections in particular the NRC can pare down without compromising overall quality are the need for power and alternatives chapters, which are not currently adding much value, especially commensurate with their length.
- A GEIS approach for reactor license renewal has worked reasonably well, and to the extent that such an approach for new reactors would not be qualitatively more difficult and time consuming, it seems plausible that a new GEIS for advanced reactor deployment could help the NRC consistently achieve the less-than-two-years timeline in NEPA that was added by Congress in 2023.
- Using EAs instead of EISs is another promising pathway to streamlining environmental reviews for new reactors. This review instrument could be appropriate (i.e., a better use of resources than conducing an EIS), for instance, for subsequent deployments of the same reactor at the same site. EAs could also be considered for subsequent deployments of a given reactor to either sites with operating nuclear reactors or sites with retiring coal plants, as well as for microreactor deployments.

Given the initiatives that have been underway for years, their underlying drivers, and more recently the FRA and ADVANCE Act, the NRC may consider undertaking a major revision to 10 CFR 51. NRC staff documents issued in 2024 indicate the NRC may already be headed in this direction. One change in particular that the NRC could make as part of such a rulemaking is to remove the EIS requirement for every new reactor licensing—this would provide the NRC more flexibility to tailor its reviews to the specifics of a given reactor project and avoid the need for exemptions if it concludes that an EA is a better review instrument for a given project.

Improving environmental review efficiency at the NRC is not only an issue of good governance—it is now compelled by statute. Those reviews will also influence nuclear energy's ability to help the

United States address energy and environmental challenges. If safety reviews are more efficient (e.g., as fast as six months) for standardized designs deployed multiple times, slower environmental reviews would delay the licensing process and slow reactor deployment. The NRC should have minimal safety work to complete, other than site-specific assessments, for standardized reactor designs that it has already approved. Unless the NRC can shorten environmental reviews, these will likely be on the critical path for NRC licensing schedules, unnecessarily delaying large-scale deployment of advanced reactors intended to help meet national policy goals.

Appendix: Summary of Assessments in EIS Chapters 4 and 5

Tables A-1 and A-2 show NRC staff assessments of impacts to resource categories from the construction and operation of nuclear power plant projects in eight projects that were issued COLs by the NRC. The assessments are taken principally from the summaries at the end of chapters 4 and 5 in each EIS, supplemented by data from elsewhere in those chapters. (See the explanatory note below for more information on how the tables were constructed.)

Table A-1: Environmental impacts to resource categories (Vogtle, Fermi, V.C. Summer, Levy)

	Vogtle 3 & 4		Fermi 3		V.C. Summer 2 & 3		Levy 1 & 2	
Resource Category	Precon-struction & Construction	Operation	Precon-struction & Construction	Operation	Precon-struction & Construction	Operation	Precon-struction & Construction	Operation
Land Use								
Site and Vicinity	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	MODERATE	SMALL
Transmission Lines and Offsite Areas	MODERATE	SMALL	SMALL	SMALL	MODERATE	SMALL	MODERATE	SMALL
Water - Related	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Ecology								
Terrestial Ecosystems	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL	MODERATE	SMALL to MODERATE
Aquatic Ecosystems	SMALL to MODERATE	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Socioeconomics								
Physical	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL
Demography	SMALL to MODERATE	SMALL	SMALL (beneficial)	SMALL (beneficial)	SMALL	SMALL	SMALL	SMALL
Economic Impacts on Community	SMALL to MODERATE (beneficial)	SMALL to LARGE (beneficial)	SMALL to LARGE (beneficial)	SMALL to LARGE (beneficial)	SMALL (beneficial)	LARGE (beneficial)	SMAll to MODERATE (beneficial)	SMALL to LARGE (beneficial)
Infrastructure & Community Services	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL

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	Vogtle 3 & 4		Fermi 3		V.C. Summer 2 & 3		Levy 1 & 2	
Resource Category	Precon-struction & Construction	Operation	Precon-struction & Construction	Operation	Precon-struction & Construction	Operation	Precon-struction & Construction	Operation
Environmental Justice	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL	SMALL
Historical and Cultural Resources	MODERATE	SMALL	MODERATE	SMALL	MODERATE	SMALL	SMALL	SMALL
Air Quality	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Nonradiological Health	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Radiological Health	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Nonradioactive Waste	n/a	n/a	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Postulated Accidents	n/a	SMALL	n/a	SMALL	n/a	SMALL	n/a	SMALL

Table A-2: Environmental impacts to resource categories (North Anna, South Texas, Turkey Point, William States Lee III)

	North Anna 3		South Texas 3 & 4		Turkey Point 6 & 7		William States Lee III 1 & 2	
Resource Category	Precon-struction & Construction	Operation	Precon-struction & Construction	Operation	Precon-struction & Construction	Operation	Precon-struction & Construction	Operation
Land Use					MODERATE	MODERATE		
Site and Vicinity	SMALL	SMALL	SMALL	SMALL			MODERATE	SMALL
Transmission Lines and Offsite Areas	SMALL	SMALL	SMALL	SMALL			MODERATE	SMALL
Water - Related	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Ecology								
Terrestial Ecosystems	SMALL	SMALL	SMALL	SMALL	MODERATE	MODERATE	MODERATE	SMALL
Aquatic Ecosystems	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	MODERATE	SMALL
Socioeconomics								
Physical	SMALL	SMALL to MODERATE	SMALL	SMALL	SMALL (adverse) to MODERATE (beneficial)	SMALL	MODERATE	SMALL
Demography	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL	SMALL	SMALL	SMALL (beneficial)
Economic Impacts on Community	SMALL to MODERATE (beneficial)	SMALL to LARGE (beneficial)	SMALL to MODERATE (beneficial)	SMALL to LARGE (beneficial)	SMALL	SMALL (beneficial)	SMALL (beneficial)	SMALL to LARGE (beneficial)

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	North Anna 3		South Texas 3 & 4		Turkey Point 6 & 7		William States Lee III 1 & 2	
Resource Category	Precon-struction & Construction	Operation	Precon-struction & Construction	Operation	Precon-struction & Construction	Operation	Precon-struction & Construction	Operation
Infrastructure & Community Services	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL to MODERATE	MODERATE	SMALL
Environmental Justice	SMALL	SMALL	SMALL	SMALL	NONE	NONE	SMALL	SMALL
Historical and Cultural Resources	SMALL	SMALL	SMALL	SMALL	MODERATE	SMALL	SMALL to MODERATE	SMALL
Air Quality	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Nonradiological Health	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Radiological Health	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Nonradioactive Waste	n/a	n/a	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Postulated Accidents	n/a	SMALL	n/a	SMALL	n/a	SMALL	n/a	SMALL

Note: Not all of the summary tables in these eight EISs have the exact same set of categories. For example:
• Some EISs say "construction" versus "preconstruction and construction" where the latter is used in these tables
• Some EIS say "transmission line rights-of-way," "offsite transmission line corridors," "transmission line corridors and other offsite areas," or "transmission lines and offsite areas" where the last of these is used here.
• Some EISs say "Meteorology and Air Quality" or "Air Quality" where the latter is used here.
Other choices have been made as well. "Water-related" typically has three or four sub-categories but these have not been shown here for reasons of space and because in every case the impact is "small." Some subcategories appear in one EIS but not in others. The Vogtle and North Anna values are taken from the respective ESP EISs, where in the Supplementary EIS done for the Vogtle COL, the onsite terrestrial impacts changed from small to moderate. In cases where a resource has multiple subcategories or sub-subcategories that are assessed differently, the assessment shown in the table displays the range (e.g., if at least one underlying assessment was "small" and at least one other underlying assessment was "moderate", then the category or subcategory is shown as "small to moderate").

Notes

1. Eric Larson, Chris Greig, Jesse Jenkins, Erin Mayfield, Andrew Pascale, Chuan Zhang, Joshua Drossman et al., "Net-Zero America: Potential Pathways, Infrastructure, and Impacts," Final Report Summary, Princeton University, October 29, 2021, https://netzeroamerica.princeton.edu/.
2. Colin Mortimer, "Manchin's Permitting Reform Effort Is Dead. Biden's Climate Agenda Could Be a Casualty," Vox, December 16, 2022, https://www.vox.com/policy-and-politics/2022/12/12/23500140/permitting-reform-inflation-reduction-act-congress-manchin.
3. Melissa Lott and David Hill, "A Chance to Get Some Key Environmental Rules Right," Morning Consult, February 25, 2020, https://morningconsult.com/opinions/a-chance-to-get-some-key-environmental-rules-right/.
4. Samuel Walker and Thomas R. Wellock, "A Short History of Regulation, 1946–2009," 2010, p. 43, https://www.nrc.gov/docs/ML1029/ML102980443.pdf.
5. CEQ, "Update to the Regulations Implementing the Procedural Provisions of the National Environmental Policy Act," *Federal Register* 85, no. 137 (July 16, 2020), https://www.govinfo.gov/content/pkg/FR-2020-07-16/pdf/2020-15179.pdf.
6. PL 118-5, Fiscal Responsibility Act of 2023, https://www.congress.gov/bill/118th-congress/house-bill/3746.
7. "Remarks as Delivered by Secretary Jennifer M. Granholm on Startup of Vogtle Unit 4 and Growth of U.S. Nuclear Industry," May 31, 2024, https://www.energy.gov/articles/remarks-delivered-secretary-jennifer-m-granholm-startup-vogtle-unit-4-and-growth-us.
8. In the years immediately after NEPA's passage, some of the environmental reviews conducted by the AEC/NRC for new reactors were titled "environmental statements," not "environmental impact statements."
9. This timeline for a very specific scenario in the ADVANCE Act contrasts with the timelines in the Fiscal Responsibility Act of 2023 that apply to federal actions broadly, so this report focuses on the latter.
10. During the research for this report, the authors also hosted a roundtable discussion under Chatham House rules with academics, national laboratory staff, former NRC staff, utility staff, and advanced reactor developers on the challenges and opportunities associated with

NRC environmental reviews for advanced reactor deployment. See Matt Bowen, Andrew Evans, Hamna Khan, and Rama T. Ponangi, "Reforming Nuclear Reactor Permitting and Environmental Reviews: Roundtable Report," June 2024, https://www.energypolicy.columbia.edu/publications/reforming-nuclear-reactor-permitting-and-environmental-reviews-roundtable-report/.

11. Some reactor projects were granted construction permits by the AEC before the passage of NEPA but had environmental reviews conducted for Part 50 operating licenses that were issued after 1970. For consistency, this review only includes projects with construction permit applications submitted after 1970 where the reactors in question reached commercial operations.

12. The environmental statements for operating license application reviews typically contain the dates of the construction permit submittal, the final environmental statement associated with the construction permit, and the operating license application submittal. The NRC's ADAMS website is: https://adams.nrc.gov/wba/.

13. To collect the dataset, the "document type" on the ADAMS system search was set to "starts with" and "ENVIRONMENTAL IMPACT STATEMENT, ALL VERSIONS," and the docket numbers were set to those associated with nuclear power stations. In some cases, no operating license environmental statement was found.

14. For example, the document posted on the NRC ADAMS website for the final environmental statement related to the operation of Susquehanna Steam Electric Station Units 1 and 2 (NUREG-0564/ML17139A290) ends with chapter 6, while the table of contents indicates the statement contains 10 chapters and 11 appendices.

15. The 26 projects under analysis include Comanche Peak 1&2; Grand Gulf 1&2; VC Summer; Susquehanna 1&2; Waterford 3; Columbia Generating Station; Byron 1&2; Callaway; Clinton; Palo Verde 1, 2, and 3; St. Lucie 1&2; Wolf Creek; Catawba 1&2; Shearon Harris 1&2; Braidwood 1&2; Limerick 1&2; Millstone 3; Beaver Valley 2; Nine Mile 2; River Bend; Vogtle 1&2; South Texas 1&2; and McGuire 1&2.

16. The nuclear stations used in this analysis and corresponding year of construction permit environmental statement are as follows: Grand Gulf (1973), Waterford (1973), Columbia Generating Station (1972), Byron (1974), Palo Verde (1975), Seabrook (1974), Limerick (1973), Vogtle (1974). The page counts estimated in this report are based on the pages of the scanned PDFs uploaded to the NRC website. The estimates do not use the much more complex methodology for counting a page in CEQ regulations (40 CFR 1508.8).

17. The nuclear reactor stations used in this analysis and corresponding year of the operating license environmental statement are as follows: Comanche Peak (1981); Grand Gulf (1981); VC Summer (1981); Columbia Generating Station (1981); Byron (1982); Callaway (1982); Clinton (1982); Palo Verde (1982); Perry (1982); Seabrook (1982); St. Lucie (1982); Wolf Creek (1982); Catawba (1983); Shearon Harris (1983); Braidwood (1984); Hope Creek (1984); Limerick (1984); Millstone (1984); Beaver Valley (1985); Nine Mile (1985); River Bend (1985); Vogtle (1985); South Texas (1986); San Onofre (1981); and McGuire (1976).

18. The NRC is currently developing a new advanced reactor licensing process, 10 CFR 53, which is not examined here because it has not been published in final form, much less used. But this new licensing pathway will also have to comply with NEPA.

19. For example, after the safety and environmental reviews are complete, the NRC licensing process entails an adjudicatory period, which currently involves an "uncontested" hearing that alone can consume another 6,000 hours of NRC staff time. See Matt Bowen, Rama T. Ponangi, and Stephen Burns, "Improving the Efficiency of NRC Power Reactor Licensing: The 1957 Mandatory Hearing Reconsidered," November 2023, https://www.energypolicy.columbia.edu/publications/improving-the-efficiency-of-nrc-power-reactor-licensing-the-1957-mandatory-hearing-reconsidered/.

20. NRC, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants," NUREG-1555 (October 1999), https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1555/sr1555.pdf.

21. During the Obama Administration, Congress passed the Fixing America's Surface Transportation Act, which was then signed into law. Title 41 of that act is focused on improving federal environmental review for covered infrastructure projects, including nuclear energy (see Permitting Council, "FAST-41 for Infrastructure Permitting," 2020, https://www.permits.performance.gov/sites/permits.dot.gov/files/2020-05/FAST_41_FS_20200325.pdf). During the Trump Administration, CEQ published "Update to the Regulations Implementing the Procedural Provisions of the National Environmental Policy Act," *Federal Register* 85, no. 137 (July 16, 2020), https://www.govinfo.gov/content/pkg/FR-2020-07-16/pdf/2020-15179.pdf. The stated reasoning in the final rule for the new regulations was that the NEPA process had become "increasingly complicated and can involve excessive paperwork and lengthy delays." For example, CEQ noted that after it published these regulations for the first time in 1978, it predicted in 1981 that federal agencies would be able to complete most EISs in 12 months or less. However, in a modern CEQ review of recent federal EISs, the average time for completion was found to be 4.5 years, with 25 percent of the reviews taking over six years.

22. NRC, "SECY-24-0046: Implementation of the Fiscal Responsibility Act of 2023 National Environmental Policy Act Amendments," June 13, 2024, p. 1, https://www.nrc.gov/docs/ML2407/ML24078A013.html.

23. This is how it is described on the NRC's webpage devoted to implementing the ADVANCE Act as of December 3, 2024: https://www.nrc.gov/about-nrc/governing-laws/advance-act.html.

24. For example, SECY-21-2001, December 31, 2020, https://www.nrc.gov/docs/ML2021/ML20212L393.pdf.

25. EIA, "Energy and the Environment Explained," accessed October 14, 2024, https://www.eia.gov/energyexplained/energy-and-the-environment/where-greenhouse-gases-come-from.php.

26. EIA, "New Natural Gas-Fired Capacity Additions Expected to Total 8.6 Gigawatts in 2023," October 16, 2023, https://www.eia.gov/todayinenergy/detail.php?id=60663.

27. SECY-24-0046, Encl. 1 at 6 (emphasis added). *See also id.*, Encl. 7 at 3 ("Other alternatives such as locating the proposed action at alternative sites would not be considered.").

28. The eight EISs (FERC/EIS-0324F, FERC/EIS-0319F, FERC/EIS-0332, FERC/EIS-0329F, FERC/EIS-0325F, FERC/EIS-0326F, FERC/EIS-0327F, FERC/EIS-0330F) can be found here: https://www.ferc.gov/environmental-documents-2023-2005.

29. SECY-21-0098, November 29, 2021, https://www.nrc.gov/docs/ML2122/ML21222A053.pdf.

30. An applicant cannot ignore Category 1 issues, even though they have been generically dispositioned. It still needs to perform a new and significant analysis to ensure the plant in question does indeed fall within those parameters. Still, this is much less time intensive than addressing Category 2 issues, which do require a full site-specific analysis.

31. NRC, SECY-20-0020, p. 4, February 28, 2020, https://www.nrc.gov/docs/ML2005/ML20052D175.pdf.

32. NRC, SRM-SECY-21-0098, https://www.nrc.gov/docs/ML2410/ML24108A200.pdf.

33. See NRC staff-prepared white paper, "Nth-of-a-Kind Micro-Reactor Licensing and Deployment Considerations," September 2024 draft, released to support ACRS interaction, https://www.nrc.gov/docs/ML2426/ML24268A310.pdf.

34. NRC, "Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel," NUREG-2157, https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr2157/index.html; NRC, "Final Generic Environmental Impact Statement on Decommissioning of Nuclear

Facilities," NUREG-0586, https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0586/index.html.

35. NRC, NUREG-1437, Revision 1, p. iii, https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1437/r1/index.html.

36. NRC, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants," NUREG-1437, vol. 1, Revision 1, page S-5, June 2013, https://www.nrc.gov/docs/ML1310/ML13106A241.pdf.

37. On August 6, 2024, the NRC published in the *Federal Register* (89 Fed. Reg. 64166) its final rule, "Renewing Nuclear Power Plant Operating Licenses—Environmental Review," to amend its environmental protection regulations in 10 CFR Part 51 by updating the Commission's 2013 findings on the environmental effects of renewing the operating license of a nuclear power plant. As reflected in revised Table B-1 of Part 51, the final rule redefines the number and scope of the environmental issues that must be addressed during the review of each application for license renewal. As part of this update, the NRC issued Revision 2 of the license renewal GEIS to account for new information and address the impacts of initial license renewals, which the previous versions considered, as well as the first subsequent license renewals. Consistent with the Commission's directive, the final rule and revised GEIS apply to one term of both license renewal and subsequent license renewal.

38. The 20 license renewals in this analysis are Kewaunee, Vermont Yankee, Palo Verde, Prairie Island, Salem 1 & 2 and Hope Creek 1 & 2, Columbia, Pilgrim, Limerick 1 & 2, Callaway, Sequoyah 1 & 2, Byron 1 and 2, Davis-Besse, Braidwood 1 & 2, LaSalle 1 & 2, Grand Gulf, Fermi 2, South Texas 1 & 2, Indian Point 2 & 3, River Bend, Waterford Steam, and Seabrook.

39. Environmental Protection Agency, "National Environmental Policy Act Review Process," accessed August 28, 2024, https://www.epa.gov/nepa/national-environmental-policy-act-review-process.

40. CEQ, "The Fourth Report on Cooperating Agencies in Implementing the Procedural Requirements of the National Environmental Policy Act (NEPA)," October 2016, https://ceq.doe.gov/docs/ceq-reports/Attachment-A-Fourth-Cooperating-Agency-Report_Oct2016.pdf; Government Accountability Office, "National Environmental Policy Act: Little Information Exists on NEPA Analyses," April 2014, https://www.gao.gov/assets/gao-14-369.pdf.

41. *Federal Register* Notice, "GE-Hitachi Nuclear Energy Americas, LLC; Morris Operation," June 30, 2021, https://www.federalregister.gov/documents/2021/06/30/2021-13891/ge-hitachi-

nuclear-energy-americas-llc-morris-operation.

42. NRC, "Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor," August 2023, https://www.nrc.gov/docs/ML2321/ML23214A269.pdf.

43. NRC, "Hermes 2—Kairos Application," https://www.nrc.gov/reactors/non-power/new-facility-licensing/hermes2-kairos.html.

44. SECY-23-0080, September 13, 2023, https://www.nrc.gov/docs/ML2321/ML23214A165.pdf.

45. NRC, "Environmental Assessment and Finding of No Significant Impact for the Construction Permits for the Kairos Hermes 2 Test Reactors," Draft Report for Comment, April 2024, p. xv, https://www.nrc.gov/docs/ML2410/ML24103A002.pdf.

46. NRC, "Environmental Assessment and Finding of No Significant Impact for the Construction Permits and Environmental Review Exemptions for the Kairos Hermes 2 Test Reactors," August 2024, https://www.nrc.gov/docs/ML2424/ML24240A034.pdf.

47. 42 USC 4336(b)(2).

48. SECY-24-0046 on pp. 5 and 6; also discussed in Enclosures 2 and 9.

49. Authors' analysis of 20 EAs published by FERC. The EAs are available at https://www.ferc.gov/environmental-documents-2023-2005.

50. See letters and presentations from Shepherd Power to the NRC: https://www.nrc.gov/docs/ML2406/ML24068A021.pdf and https://www.nrc.gov/docs/ML2413/ML24130A196.pdf.

51. Princeton, Net-Zero America, https://netzeroamerica.princeton.edu/.

52. Ibid.

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