UNITED STATES
NUCLEAR REGULATORY COMMISSION
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January 16, 2024

MEMORANDUM TO: Andrea D. Veil, Director
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SUBJECT: 10 CFR PART 52 CONSTRUCTION LESSONS-LEARNED REPORT

In accordance with the 10 CFR Part 52 Lessons - Learned Working Group Charter, dated July 12, 2021 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21160A031), this memorandum transmits the 10 CFR Part 52 Construction Lessons-Learned Report. The report identifies best practices, suggestions, and recommendations based on lessons learned from construction at Vogtle Electric Generating Plant, Units 3 and 4, and Virgil C. Summer Nuclear Station, Units 2 and 3, under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." The report also assesses the effectiveness of the agency's effort to achieve the NRC's mission of providing reasonable assurance of adequate protection of public health and safety in a timely and efficient manner, managing resources within established goals, and meeting key schedule milestones. The agency will make the report available to the public in ADAMS.

Enclosure:
10 CFR Part 52 Construction
Lessons-Learned Report
for Vogtle Units 3 and 4 and
V.C. Summer Units 2 and 3

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SUBJECT: 10 CFR PART 52 CONSTRUCTION LESSONS-LEARNED REPORT DATED {{date:long}}

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10 CFR PART 52 LESSONS-LEARNED FROM CONSTRUCTION AT VOGTLE 3 & 4 AND V.C. SUMMER 2 & 3

Enclosure

CONTENTS

EXECUTIVE SUMMARY

In accordance with the 10 CFR Part 52 Lessons Learned Working Group Charter, the working group (WG) evaluated the U.S. Nuclear Regulatory Commission's (NRC's) construction inspection program; inspections, tests, analyses, and acceptance criteria (ITAAC); and licensing activities related to construction of Vogtle Electric Generating Plant, Units 3 and 4, and Virgil C. Summer Nuclear Station, Units 2 and 3, under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." This report highlights actions that contributed to the success of construction program implementation and identifies potential improvements (recommendations and suggestions) that can be made in keeping with the NRC's Principles of Good Regulation (Independence, Openness, Efficiency, Clarity, and Reliability).

This report involved contributions from senior staff members, interviews of the staff involved with the construction of Vogtle Units 3 and 4 and V.C. Summer Units 2 and 3, public meetings with external stakeholders, and a review of previous lessons-learned efforts.

This report presents the lessons learned and potential improvements for oversight of future construction projects that are related to ITAAC, construction inspection, and licensing activities, and the overall oversight program. The potential improvements made throughout the report are marked in the supporting text of the report body by (R.#) for recommendations or (S.#) for suggestions to conveniently match with the table in section IV summarizing all the potential improvements. Recommendations are intended for actions that the working group identified as more important to the success of future construction oversight activities. Suggestions represent additional enhancements intended to support the recommendations.

The following list provides the lessons learned and recommendations:

ITAAC

- Lesson learned: The NRC's process for "targeting" ITAAC (i.e., identifying those ITAAC that the NRC staff planned to inspect) and the programmatic requirements for their inspection were found to be too prescriptive and did not provide for a flexible or user-friendly means to adjust when planned inspections could not be performed due to construction schedule changes.

  Recommendation: Those developing program requirements (e.g., the designated NRC program office) should ensure there is flexibility to select a representative sample of inspections throughout any construction area and not require preselected ITAAC to make up the baseline inspections. This will promote more agile inspection coverage for activities during construction (i.e., quality assurance during the design, fabrication, manufacture, construction, and testing of plant structures, systems, and components) while continuing to maintain reasonable assurance that facilities are built and will operate in accordance with their approved designs and licensing bases. (R.1)

- Lesson learned: At times, there was lack of common understanding of the scope, methods, and acceptance criteria for meeting the ITAAC. As a result, additional time and resources were needed to resolve these issues. Some issues occurred due to problems with the ITAAC language; for example, sometimes the ITAAC language included acceptance criteria that were too restrictive, used terminology that was not well defined, or did not have the appropriate level of detail for how to perform the ITAAC. Other issues

occurred because the methodology for meeting the ITAAC that was provided in the early-submitted uncompleted ITAAC notifications was not detailed or specific enough to allow problems to be identified until inspections occurred.

Recommendation: Ensuring clarity of the scope of each ITAAC, providing clear acceptance criteria with appropriate flexibility, and defining terminology in the ITAAC will help to ensure that the licensee and the NRC have a common understanding of how the ITAAC will be met. Demonstration projects, weekly public meetings, and tabletops with the licensee, in addition to reviewing the early-submitted uncompleted ITAAC notifications, were helpful for this project to clarify the scope of the ITAAC, ensure mutual understanding of the method the licensee would use to close the ITAAC, and identify and resolve issues. The WG recommends conducting these activities for future projects. (R.2)

Construction Inspection

- Lesson learned: Focusing inspection planning on discrete or specific inspection items proved to be problematic for efficient use of inspection time on site. As the licensee revised its construction schedule, the schedule for performing pre-selected inspection items also shifted, and specific in-field inspection opportunities were no longer available. “Chasing” the targeted ITAAC for mandatory inspections led to inefficient use of time when the construction schedule regularly changed.

  Recommendation: For future construction projects, the NRC staff designated to implement the construction inspection program should shift to a plan that is more focused on inspecting the safety related activities during construction. This approach does not mandate specific ITAAC inspection completion, but instead ITAAC could be selected as part of a risk-informed sampling methodology. This will promote the efficient use of resources while continuing to maintain reasonable assurance that facilities are built and will operate in accordance with their approved designs and licensing bases. (R.3)

- Lesson learned: The NRC staffed the number of resident inspectors at the site based in part on the licensee’s published schedule. This was to ensure the agency was prepared to complete the construction inspection program within the estimated construction timeframe provided by the licensee without being an impediment. Ultimately, the strategy was successful in ensuring that NRC staff availability did not unnecessarily delay the construction schedule. However, the licensee’s construction schedule was very dynamic and proved difficult to predict. Through the ebb and flow of the schedule, there were periods when staffing levels did not correlate with the actual pace of construction. Per 10 CFR 170.12, “Payment of fees,” fees will be assessed to recover the full cost for each resident inspector and senior resident inspector assigned to a specific site. This includes resident inspector time spent on indirect activities, such as technical and non-technical training, attending agencywide meetings and other indirect activities. As a result of staffing to the licensee’s schedule, when the construction pace was slow, indirect fee-billable charges increased.

  Recommendation: Although it is critical to have resources available so as not to be an unnecessary impediment to the licensee’s construction schedule, the approach can result in fee-billable charges that are higher than expected. For future construction projects, the NRC should consider a flexible staffing model that can more readily adapt

to the dynamic nature of construction. This could be achieved through inspection planning that allows a more agile approach as well as providing cross-trained inspectors that can support not only multiple disciplines throughout the construction project, but also other divisions. (R.4) Additionally, the NRC should evaluate whether changes to fee billing requirements would be feasible, appropriate, and improve efficiency while facilities are under construction. (R.5)

Licensing

- Lesson learned: It was a best practice to establish regularly scheduled external interactions, such as the Thursday weekly public meetings and construction schedule coordination meetings, to provide the NRC and licensees frequent opportunities to quickly address emerging issues related to licensing actions and ITAAC notifications. Tabletops, workshops, and demonstration projects were also important in preparing for first-of-a-kind activities.

  Recommendation: Considering each licensee's or applicant's needs and resources, the NRC should provide methods for ensuring effective and timely communication to resolve issues. Methods should include facilitating regular stakeholder interactions, such as workshops, to incorporate external ideas into a construction oversight program. (R.6)

- Lesson learned: Senior managers designated all licensing actions for V.C. Summer Units 2 and 3 and Vogtle Units 3 and 4 as high-priority activities and established licensing performance metrics. During key management meetings (e.g., the "Goals and Priorities" meetings held in the Office of New Reactors (NRO) and during Vogtle Readiness Group (VRG) meetings), licensing performance metrics were discussed along with the progress of, and any issues with, licensing actions currently under review. By establishing this priority and ensuring that sufficient dedicated resources were provided, licensing actions were almost always able to be completed by the "requested by" date, which avoided unnecessary delays to the licensee's schedules for construction and startup testing. It was also a best practice for the licensee and the NRC to distinguish between low-complexity and high-complexity licensing actions and for the NRC to implement a review strategy for both types of licensing actions and ensure that dedicated resources would be ready to work on these requested licensing actions efficiently when they were submitted.

  Recommendation: The NRC will need to continue to identify those activities that will benefit from dedicated resources and allow resources to be assigned as priorities are adjusted. Senior management should clearly communicate priorities to the staff, particularly as priorities change, and continue to implement strategies to manage competing priorities. This will be critical for multiple projects occurring at the same time. The NRC should also continue to implement review strategies, including assignment of staff resources, to reviews of licensing actions based on their complexity and consideration of how to most efficiently conduct the reviews. (R.7)

Overall Program

- Lesson learned: Future projects for advanced reactors, fuel facilities, non-power production or utilization facilities, and other smaller nuclear facilities are expected to have shorter construction timeframes and smaller budgets compared to large light-water reactor construction projects. Greater transparency in the expenditure of agency

resources will improve stakeholder confidence in the NRC's ability to monitor and assess the efficiency of our activities.

Recommendation: The NRC should continuously estimate and monitor the total cost to the licensee and assess the efficient use of hours (e.g., estimate licensing hours, track direct and indirect inspection hours, and use fee billing data to evaluate total costs) in a transparent manner. It is important that the cost activity codes and enterprise project identifiers are sufficiently detailed to allow managers to understand the amount of resources being used for each activity in order to provide for adequate oversight of resource use from the beginning to the end of the project. Thresholds should be established so that, as they are approached, managers can investigate any unanticipated resource utilization and assess whether to provide additional resources. (R.8)

- Lesson learned: A key success is related to the organizational structure the NRC developed to ensure it conducted regulatory activities effectively. For example, the agency established the VRG to proactively identify and promptly resolve any licensing, inspection, or regulatory challenges or gaps that could unnecessarily impact the schedule for completion of Vogtle Units 3 and 4. To accomplish this objective, the VRG provided high-level assessments, coordination, oversight, and management direction of NRC activities associated with the licensing, inspection, testing, and operation of Vogtle Units 3 and 4. The VRG was particularly effective in identifying and coordinating the activities the staff needed to do to be prepared for key milestones on the licensee's schedule (e.g., administering the first initial operator licensing examination and transitioning the plants from the construction reactor oversight process to the reactor oversight process).

  Recommendation: The WG acknowledges that it may not be feasible or necessary to establish a readiness group like the VRG for future nuclear power plant construction projects, particularly if there are multiple, simultaneous projects. However, the NRC should continue to proactively identify and promptly resolve licensing, inspection, or regulatory challenges or gaps that could unnecessarily impact the schedule for completion of future nuclear facilities. Mechanisms should be established, appropriate to the scale and scope of future construction projects, to ensure partner offices are engaged to facilitate the resolution of issues encountered during construction and to ensure dedicated resources and proper priority are assigned for tasks related to projects of high priority. The NRC's Office of the Chief Financial Officer should be included as a partner office to ensure an equal focus on and awareness of the financial aspects of construction oversight and as needed to effectively implement R.8. (R.9)

In addition to lessons learned and recommendations, the report addresses the following three fundamental questions regarding the agency's oversight performance during the large light-water reactor construction projects at Vogtle and V.C. Summer under 10 CFR Part 52:

(1) Did the staff achieve the NRC's mission of providing reasonable assurance of adequate protection of public health and safety?
(2) Did regulatory activities unnecessarily delay the construction schedule?
(3) Were NRC resources expended efficiently and within the established goals?

The answer to the first question is yes. In 10 CFR 52.99(e) and 10 CFR 52.103(g), the regulations state that the NRC must ensure that the prescribed inspections, tests, and analyses

are performed and, before operation of the facility, find that the prescribed acceptance criteria are met. To support the 10 CFR 52.103(g) findings for Vogtle Units 3 and 4, the staff reviewed all ITAAC closure notifications (ICNs) and conducted independent inspections of a select sample of ITAAC and programs. The staff documented the results of its reviews and inspections, including the quantity and significance of inspection findings, in the bases documents supporting the 10 CFR 52.103(g) findings for Vogtle Units 3 and 4.[1] The combination of all these activities provided the staff reasonable assurance that the facilities are built and will operate in accordance with their approved designs and licensing bases, achieving the NRC's mission of providing reasonable assurance of adequate protection of public health and safety.

The answer to the second question is no, the NRC's regulatory activities did not cause unnecessary delays to the licensee's construction schedule. The staff anticipated that the construction schedule would be very complex and dynamic and that there would be first-of-a-kind regulatory challenges, given that these plants were the first to fully implement the 10 CFR Part 52 licensing process. The VRG, along with the Vogtle Project Office (VPO) in the Office of Nuclear Reactor Regulation (NRR) (and before the VPO, the Division of Construction and Inspection Support in the Office of New Reactors) and Region II's Division of Construction Oversight (DCO), provided a dedicated team of staff to ensure regulatory activities were accomplished without causing unnecessary delays to the licensees' construction schedules. Under the leadership of the VRG, the NRC staff made a significant effort to proactively identify and anticipate regulatory challenges and identify actions needed to resolve them. The staff also identified and worked to mitigate potential risks to making a timely 10 CFR 52.103(g) finding. For example, the staff's development of an integrated project plan and use of demonstration projects ensured that anticipated challenges, such as a potential ICN surge at the end of construction, would be mitigated to the greatest extent possible. Additionally, from the onset of construction, the NRC managed its resources to ensure staff availability for the performance of required regulatory activities so as not to become an unnecessary impediment to the licensee's construction schedule. It is also noteworthy that, for Vogtle Units 3 and 4, the amount of time between the completion of plant construction (defined here as the time of the licensee's submittal of the "All ITAAC Complete" notification) and the authorization to begin operating (defined here as the 10 CFR 52.103(g) finding) was about 1 week. One of the goals of 10 CFR Part 52 was to eliminate unnecessary delays in the commencement of operation for already constructed plants, compared to the two-step licensing process in 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities"; the NRC achieved this goal at Vogtle Units 3 and 4.

The answer to the third question is yes, resource use was generally within the established targets, with some exceptions, as discussed in section III of this report. Additionally, section III also discusses opportunities to gain efficiencies. The NRC established several targets for resource use for inspection and licensing activities and monitored them for the duration of the construction oversight project (for this report, "construction oversight" refers to the licensing, inspection, assessment, and enforcement activities completed for construction). First, the Commission directed the staff to track direct inspection hours, and the staff has tracked and reported that information for the duration of the project (direct inspection hours are charged during visual inspection of SSCs or reviewing testing documents, and indirect inspection hours are charged for travel associated with inspections and for inspection report generation). The staff also regularly reported resource use in annual Construction Reactor Oversight Process

[1] The staff applied the same approach at V.C. Summer for Units 2 and 3 until South Carolina Electric & Gas Co. cancelled the construction of these units. Because construction was not completed for V.C. Summer Units 2 and 3, the staff did not make a 10 CFR 52.103(g) finding for these units.

SECY papers and on the NRC's public website throughout construction. At the time of the 10 CFR 52.103(g) finding for Vogtle Unit 3, actual ITAAC direct inspection hours for Unit 3 were 29 percent over the estimated 15,000 hours, and actual program direct inspection hours for Unit 3 were 22 percent over the estimate of 10,000 hours. The actual reactive and allegation inspection hours for Vogtle Unit 3 were less than 15 percent of the estimated 5,000 hours, and technical support of inspections was 45 percent of the estimated 5,000 hours. At the time of the 10 CFR 52.103(g) finding for Vogtle Unit 4, actual ITAAC direct inspection hours for Unit 4 were 32 percent under the estimate of 15,000 hours, and actual program direct inspection hours for Unit 4 were 30 percent under the estimate of 10,000 hours. The actual reactive and allegation inspection hours for Vogtle Unit 4 were less than 12 percent of the estimated 5,000 hours, and technical support of inspections was 28 percent of the estimated 5,000 hours. Throughout construction, Vogtle Unit 3 trended higher than the estimates for ITAAC and programmatic direct inspections, while Vogtle Unit 4 trended lower, such that overall, the combined direct inspection efforts for Unit 3 and Unit 4 were commensurate with the total direct hours estimated for the combined units. Second, the NRC established targets for completing licensing actions and monitored performance for the duration of the project. Generally, the agency issued requested licensing actions by or in advance of the licensee's requested-by date and within resource estimates.

These lessons will continue to support the NRC's commitment to continuous improvement, add to the agency's learning culture, and emphasize the application of lessons learned and best practices for future projects.

I. BACKGROUND

Overview of the 10 CFR Part 52 Licensing Process

One option for licensing a nuclear power plant is under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." It provides for the issuance of a combined license (COL) enabling the licensee to construct a plant and operate it once construction is complete if it satisfies certain standards identified in the COL. These standards are called inspections, tests, analyses, and acceptance criteria, or ITAAC. The ITAAC are typically derived from one of two sources. The majority of ITAAC are from the design certification for the reactor technology the plant uses. The remaining ITAAC are site specific and are submitted in the licensee's COL or early site permit applications. As required by 10 CFR 52.97(b), the ITAAC identified in the COL must be necessary and sufficient, when successfully completed by the licensee, to provide reasonable assurance that the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act of 1954, as amended (AEA), and the rules and regulations of the U.S. Nuclear Regulatory Commission (NRC).

During construction, the licensee is responsible for performing all inspections, tests, and analyses and ensuring that the specified acceptance criteria are met. Throughout the construction process, the NRC conducts inspections based upon Inspection Manual Chapter (IMC) 2503, "Construction Inspection Program: Inspections of Inspections, Tests, Analyses and Acceptance Criteria (ITAAC) Related Work," and the NRC's construction inspection program at the plant site to confirm that the licensee has successfully completed the ITAAC.

For every completed ITAAC, the licensee must submit to the NRC an ITAAC closure notification (ICN) as required by 10 CFR 52.99(c)(1). The NRC staff reviews each ICN to verify that the ITAAC have been successfully completed. Upon successful completion of all ITAAC, 10 CFR 52.99(c)(4) requires the licensee to submit an "All ITAAC Complete" notification to the NRC. If the NRC staff verifies that all ITAAC are satisfied, it will find, under 10 CFR 52.103(g), that all acceptance criteria are met. The licensee cannot operate the facility until the NRC makes this finding.

Combined License Issuance and 10 CFR 52.103(g) Findings at Vogtle Units 3 and 4 and V.C. Summer Units 2 and 3

The NRC issued COLs NPF-91 and NPF-92 to Southern Nuclear Operating Company (SNC) for Vogtle Electric Generating Plant, Units 3 and 4, on February 10, 2012 (Agencywide Documents Access and Management System (ADAMS) Package Accession Nos. ML112991101 and ML113060407, respectively). In addition, the NRC issued an ESP-004, including a limited work authorization (LWA) (August 26, 2009), and LWA-001 and LWA-002 (February 10, 2012) (ML113350133 and ML113350143), pursuant to 10 CFR 50.10, "License required; limited work authorization."

Ten years following issuance of the COLs, SNC informed the agency on July 29, 2022, that it had completed all ITAAC for Vogtle Unit 3 (ML22210A090). The NRC made the 10 CFR 52.103(g) finding on August 3, 2022 (ML20290A282); as a consequence, SNC was authorized to begin operation (including loading fuel) at Vogtle Unit 3 in accordance with the facility license. This was the NRC's first-ever 10 CFR 52.103(g) finding. The staff documented the basis for the finding in the "10 CFR 52.103(g) Basis Document" for Vogtle Unit 3

(ML20290A276). Also, with the issuance of the finding, Vogtle Unit 3 transitioned from the Construction Reactor Oversight Process (cROP) to the Reactor Oversight Process (ROP). On July 28, 2023, SNC informed the NRC that it had completed all startup testing, and on July 31, 2023, SNC publicly announced that Vogtle Unit 3 entered commercial operation.

SNC informed the agency on July 20, 2023, that it had completed all ITAAC for Vogtle Unit 4 (ML23201A266). The NRC made the 10 CFR 52.103(g) finding on July 28, 2023 (ML22348A093), after which SNC was authorized to begin operation (including fuel load) at Vogtle Unit 4 in accordance with the facility license. The staff documented the basis for the finding in the "10 CFR 52.103(g) Basis Document" for Vogtle Unit 4 (ML22348A088). Also, with the issuance of the finding, Vogtle Unit 4 transitioned from the cROP to the ROP. As of the issuance of this report, Vogtle Unit 4 was performing startup testing in accordance with the facility license and was anticipated to start commercial operation in the first quarter of 2024.

The NRC issued COLs NPF-93 and NPF-94 to South Carolina Electric & Gas Co. (SCE&G) for Virgil C. Summer Nuclear Station, Units 2 and 3, respectively, on March 30, 2012 (ML113190371 and ML113190715, respectively). Following issuance of the licenses, SCE&G began construction of the plants. By letter dated August 17, 2017 (ML17229B487), the NRC received formal notification from SCE&G that construction on V.C. Summer Units 2 and 3 had stopped. SCE&G's cessation of construction activities at V.C. Summer Units 2 and 3, on July 31, 2017, coincided with the departure of most construction workers, support personnel, and managers. By letter dated December 27, 2017 (ML17361A088), SCE&G requested withdrawal of the COLs. The NRC terminated the COLs on March 6, 2019 (ML18198A299).

II. LESSONS-LEARNED EFFORT SCOPE AND METHODOLOGY

Scope

On July 12, 2021, the NRC issued the 10 CFR Part 52 Lessons-Learned Working Group Charter (ML21160A031) and established a working group (WG). The WG evaluated NRC oversight activities conducted during construction of Vogtle Units 3 and 4 through the start of commercial operation for Vogtle Unit 3 and the issuance of the 10 CFR 52.103(g) finding for Unit 4. It also includes NRC activities conducted during construction at V.C. Summer Units 2 and 3 until construction ended; however, the WG focused on the experience gained at Vogtle because the construction program was implemented fully at that site. This report does not cover the topics addressed by previous lessons-learned reports on 10 CFR Part 52 licensing, including "Staff Report: 10 CFR Part 52 Application Reviews—Efficiency Opportunities and Review Timelines," issued 2016 (ML15114A452), "Title 10 of the Code of Federal Regulations Part 52 Implementation Self-Assessment Review: 1 Year Post-Combined License Issuance," issued July 2013 (ML13196A403), and "New Reactor Licensing Process Lessons Learned Review: 10 CFR Part 52," issued April 2013 (ML13059A239).

Methodology

The WG conducted a holistic assessment of the NRC's 10 CFR Part 52 licensing and construction oversight and inspection programs to improve the effectiveness and efficiency of future programs. The charter directed the WG to focus on experiences from the construction program development and implementation and to create (1) a Nuclepedia page and (2) a publicly available summary report focused on ITAAC, construction inspection, and licensing insights, with recommendations to improve future construction programs.

The WG solicited input from internal stakeholders by establishing the Nuclepedia page, "Part 52 Agency Experience with Construction of Vogtle Units 3 and 4 and V.C. Summer 2 and 3," to capture the staff's extensive experience with a broad array of topics and to share results of the lessons learned with other NRC staff. The WG led several Nuclepedia writing sessions with the NRC staff involved in the construction inspection and licensing efforts for Vogtle Units 3 and 4 and V.C. Summer Units 2 and 3.

The WG also solicited input from external stakeholders. During a public meeting on August 19, 2021, the staff announced the 10 CFR Part 52 lessons-learned initiative (ML21228A005). On September 27, 2022, the staff held a public meeting with SNC to obtain its perspectives on lessons learned from Vogtle Units 3 and 4 (ML22271A018). The NRC staff's presentation (ML22265A098) included discussion questions and presented data on its license amendment review times, average ITAAC closure notification review times, and total cumulative direct inspection hours. SNC's presentation (ML22265A097) provided an overview of its data on NRC licensing actions, ICNs completed, and direct and indirect inspection hours, as well as its observations on licensing, ITAAC, and inspections. The presentation concluded with SNC's top three recommendations. Section III discusses SNC's observations and recommendations.

On November 15, 2022, the NRC held a second public meeting to gather insights from other external stakeholders (ML22322A167). The NRC staff's opening remarks provided background information and identified potential focus areas to frame the discussions (ML22319A124). The Nuclear Energy Institute (NEI) provided recommendations for improving regulatory efficiency, updating the cROP, and planning for small modular reactors (SMRs) (ML22319A005); these recommendations were very similar in scope and content to SNC's presentation from September 27, 2022. Kozak Innovative Safety Solutions, Inc., described its observations on successes and lessons learned in the implementation of the cROP, inspection program, and significance determination process (ML22319A123). Section III also discusses the observations and recommendations from attendees at this public meeting.

III. LESSONS LEARNED, RECOMMENDATIONS, AND SUGGESTIONS

As directed in the charter, this report documents the WG's evaluation of the NRC's ITAAC, construction inspection, and licensing actions and highlights lessons learned, including best practices, and potential improvements (i.e., recommendations and suggestions) for future projects. Section III.a discusses ITAAC; section III.b discusses construction inspection; section III.c discusses licensing activities; section III.d discusses insights on the overall program, including the NRC's organizational structuring; and section III.e discusses areas to be considered for future rulemaking. Where appropriate, a recommendation marker, (R.#) or (S.#), points to the recommendation summary table in section IV of this report, located at the end of the supporting text.

III.a. **ITAAC**

The AEA requires that the Commission include in the COL those ITAAC that are necessary and sufficient to demonstrate that the plant has been constructed and will be operated in accordance with the license, the AEA, and the Commission's rules and regulations. ITAAC are legal requirements that must be implemented and satisfied as written. Accordingly, it is very important that the wording of the ITAAC be clear and specific, the level of detail be appropriate, and the ITAAC be inspectable as written. The text below gives specific examples of lessons learned and potential improvements.

Additionally, NRC Regulatory Issue Summary (RIS) 2008-05, Revision 1, "Lessons Learned to Improve Inspections, Tests, Analyses, and Acceptance Criteria Submittal," dated September 23, 2010 (ML102500244), addressed issues that were identified following the review of ITAAC submittals to the NRC made before 2008. Though the AP1000 ITAAC predate the RIS, the lessons learned during their implementation, as discussed below, reinforce the guidance put forth in the RIS and continue to demonstrate the need for ITAAC improvement and refinement.

Selecting Appropriate Level of Detail Needed in ITAAC

An ITAAC specified nitrogen as the gas medium for pressurization to conduct an accumulator flow test. The nitrogen system at the plant was not yet complete, and the licensee wanted to use compressed air to allow earlier completion of the ITAAC. This required the licensee to submit a license amendment and exemption request. The use of compressed air rather than nitrogen was technically acceptable, and in this case, the ITAAC did not need to specify the medium to be used for the testing. This example demonstrates that is important to avoid unnecessary restrictions in the ITAAC and ensure the ITAAC specify only the critical test elements. (R.2)

Alignment of ITAAC and the Updated Final Safety Analysis Report

The licensee encountered situations when an ITAAC did not match the technical codes and standards cited in the updated final safety analysis report (UFSAR). For example, UFSAR code requirements could be satisfied, but the acceptance criteria of an associated ITAAC could not be met. Additionally, there were times when the ITAAC was determined to be met, but UFSAR chapter 14 provisions were not met. It is recommended that the ITAAC acceptance criteria be coordinated and aligned with technical codes and standards, such as ensuring that those codes and standards of the UFSAR are correctly reflected or cross-referenced in the ITAAC's acceptance criteria. (S.1)

Expeditious Resolution of Minor Issues

The wording of ITAAC, because of their legal status, at times caused conditions that required significant time and resources to resolve with negligible benefit to public health and safety. Creation of the category of minor inspection findings for ITAAC was advantageous in reducing some of this regulatory burden, and its implementation was widely seen as positive. For example, certain ITAAC required the plant components and piping to be designed and constructed in accordance with American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (ASME Code) section III. Weld splatter is a nonconforming condition under ASME Code section III, requiring the NRC staff to disposition the issue to support ITAAC closure. Although the licensee must resolve any ASME Code nonconformances, this position created an unnecessary burden on the licensee and the NRC staff by having the broad ASME Code requirements associated with ITAAC requirements. The purpose of the ITAAC was to address the pressure boundary requirements, but because the ITAAC was written to include ASME Code section III generally, other elements in the ASME Code were equally important to completing the ITAAC, which was not the NRC's intent. To address the unnecessary burden, the staff created the category of minor inspection findings for ITAAC. Future construction oversight programs should include a screening process that is risk-informed and allows ITAAC inspection findings to be categorized as minor, as applicable. It is recommended that future construction projects continue to use minor ITAAC inspection findings to avoid having the safety aspect of the finding be far outweighed by the licensing aspect and the wording of the ITAAC. (S.2)

Appropriate Flexibility in Acceptance Criteria

The ITAAC for containment coatings included an acceptance criterion for dry film density of greater than or equal to 100 pounds per cubic foot (lb/ft^3). When one batch was identified by the NRC to be slightly under the acceptance criteria (actual value was 99.88 lb/ft^3), an analysis had to be performed to demonstrate the batch's acceptability. The licensee must disposition any nonconformances, requiring additional licensee resources to submit a report justifying its use and additional NRC resources to review the report. Adding flexibility to the acceptance criteria, where appropriate, to account for a wider range of acceptable values (e.g., greater than or equal to 100 lb/ft^3 plus or minus a certain range of acceptable values) and/or minimizing numeric values in acceptance criteria as discussed in SECY-19-0034, "Improving Design Certification Content," issued April 2019 (ML19080A032), could avoid needless expenditure of resources. (R.2)

"As-Built" ITAAC

"As-built" ITAAC are intended to be completed in the final installed location within the plant. Exceptions do exist to allow the as-built ITAAC to be performed at an alternate location if technically justifiable. However, closure of the ITAAC cannot occur until the structure, system, or component (SSC) has been put into its final location within the plant with verification that the ITAAC acceptance criteria have not been adversely affected by subsequent handling, etc., and continue to be met. The ITAAC should specify the final verification of the acceptance criteria, such as distinguishing between the inspection of an "as-built" component versus the "as-built installation" of a component. Having clear and well-defined terminology supporting each test and inspection will avoid delays in resolving differences in how the ITAAC can be interpreted with a licensee's determination of completion of such an ITAAC. (S.3)

An additional consideration is whether "as-built" inspection is required in an ITAAC, as a practical matter. For example, an ITAAC required an as-built inspection of the protective sheaths on the Class 1E thermocouple cables between the thermocouple elements and the connector plate. Because installation of the thermocouples cannot occur until after the fuel is loaded in the core, an as-built inspection could not be performed before the 10 CFR 52.103(g) finding. The use of the term "as-built" was inappropriate for this ITAAC. Ultimately, on October 15, 2021, SNC submitted License Amendment Request (LAR)-21-001 (ML21237A205) to remove the "as-built" requirement from this ITAAC, and the NRC approved it.

Mutual Understanding of What Is Needed to Meet ITAAC

In most cases, the "early" reviews of uncompleted ITAAC notifications (UINs) allowed the staff to review the ITAAC closure methodology and discuss it with the licensee to ensure a mutual understanding of the methods used to close the ITAAC and that the methodology is acceptable to the staff. The "early" review of UINs is a practice the WG encourages for future 10 CFR Part 52 construction projects. (S.4) However, the staff did still encounter differences with the licensee on the interpretation of ITAAC performance. In some situations, the descriptions of methodologies in the early-accepted UINs were not specific enough to identify these differences, which were not revealed until inspections occurred.

For example, there was disagreement between the NRC and the licensee over the interpretation of the ITAAC for personnel and vehicular access control. The licensee viewed the ITAAC as a simple inspection of the configuration of the barriers to prevent unauthorized entry. However, the ITAAC was intended to verify not only the configuration but also the functionality of the

components. Ultimately, the licensee completed the testing to satisfy the ITAAC. In addition to demonstrating the importance of the ITAAC wording, this example shows the need to include sufficient details in the UIN and ICN. Had the UIN and ICN provided more detail on the licensee's actions to satisfy the ITAAC, this difference in interpretation could have been identified much earlier. This demonstrates the need to coordinate with a licensee to ensure that there is a common understanding of the activities needed to complete each ITAAC (e.g., by doing tabletops), and that emphasis is put on ensuring sufficient detail and specificity in the UINs, and later ICNs, to demonstrate that the licensee satisfies the ITAAC requirements. (R.2)

Additionally, various ITAAC required that testing be performed under "pre-operational test pressure, temperature, and flow conditions." The term "pre-operational" conditions, though, was not defined in the COL or the final safety analysis report (FSAR) with specific values of pressure, temperature, or flow. At times, this led to disagreements between the staff and the licensee on what constituted preoperational conditions. One ITAAC for which this terminology was problematic was the stroke test of the automatic depressurization valves. Performing the test under full operational conditions would have subjected the plant to a significant transient because the pressurizer would have been blown down to containment as the outboard isolation valve was stroked open and closed. ITAAC must use clearly defined terminology to ensure the staff and the licensee have a mutual understanding of what comprises ITAAC completion. Clear language will also assist with assessing each ITAAC's effect on safety and better inform the staff on how to proceed with discrepancies in interpretation. Added detail on the methodology for satisfying the ITAAC is also beneficial when reviewing early-submitted UINs as preapproval for acceptable ITAAC closure methodologies. (R.2)

Changes to ITAAC during Construction

SNC indicated that it experienced excessive administrative burden because of the volume of ITAAC, particularly the number of internal reviews and approvals the notifications needed before each submittal to the NRC. To reduce the number of required ICN submittals, the licensee chose to submit LARs to consolidate certain individual ITAAC into one larger ITAAC.[1] The licensee also submitted requests to delete ITAAC for which the objective of one ITAAC was verified as part of another. Combining ITAAC led to ITAAC that were large and complex (e.g., the ASME Code section III ITAAC) and prevented closure of certain ITAAC activities completed earlier in construction until the entire ITAAC was closed near the end of construction. Right-sizing the ITAAC and eliminating redundant activities during ITAAC development and COL issuance could avoid these burdens. (S.5)

Guidance for ITAAC

The staff worked closely with industry stakeholders to develop guidance on ITAAC completion early during the Vogtle and V.C. Summer projects. The NRC endorsed, with exceptions, the resulting guide, NEI 08-01, Revision 5 – Corrected, "Industry Guideline for the ITAAC Closure Process Under 10 CFR Part 52," issued June 2014, in Regulatory Guide (RG) 1.215, Revision 2, "Guidance for ITAAC Closure Under 10 CFR Part 52," issued July 2015 (ML15105A447). At times, the staff found it would have been advantageous to revise the RG to clarify guidance in light of disagreements between the staff and the licensee on the meaning or

[1] Nothing in NRC regulations or guidance prohibits a licensee from submitting closure notifications together in more than one ITAAC. In other words, ITAAC do not need to be consolidated for a licensee to submit closure notifications for multiple ITAAC together.

application of the guidance. Changes to the endorsed guidance, such as NEI 08-01 on ITAAC closure, needed to be completed in weeks or months to be of benefit to the staff and the licensee applying that guidance rather than the standard 2-year RG revision process. NEI 08-01 started as a "living document" that would be updated regularly during nuclear power plant construction, but the endorsement process by RG could not be used to capture issues in real time. A faster process for issuing staff-endorsed guidance would be more useful during facility construction. In situations where the staff is conducting first-of-a-kind activities, such as reviewing ICNs for the first-time implementation of Part 52, the staff should select methods for endorsing and revising staff guidance that can capture needed changes on a timeframe that will benefit current and future users of the guidance. (S.6)

Additionally, future efforts to revise RG 1.215 or any other NRC guidance related to ITAAC should evaluate the examples resulting from this lessons learned effort for inclusion in future revisions, as appropriate. (S.7)

Selecting ITAAC for NRC Staff Inspection

The NRC staff is not required to independently inspect all the ITAAC in a COL. Rather, the staff inspects a sample of the ITAAC. The ITAAC that the NRC chooses to inspect are known as targeted ITAAC. The targeted ITAAC for the AP1000 design were chosen based on a prioritization process that identified the inspections that would provide the most safety benefit while providing reasonable assurance that no significant construction flaw goes undetected, consistent with the NRC's Principles of Good Regulation.

One key lesson was related to programmatic requirements for targeted ITAAC inspection. Specifically, an inspection program requirement existed to ensure and verify that an inspection activity was performed for every significant section of an ITAAC inspection procedure. This programmatic requirement was implemented, in part, to provide a consistent application for all inspectors with exposure and practical use of the inspection procedures. As construction on Vogtle Units 3 and 4 progressed, the inspection and oversight effort evolved. The staff came to recognize that (1) the programmatic requirement was too prescriptive, (2) the requirement did not provide for needed inspection planning flexibility to align with the fluidity of the construction schedule, (3) the requirement diverted staff resources to track inspection attributes for each ITAAC, and (most importantly), (4) the requirement resulted in an inspection effort that, in many cases, was not fully risk-informed.

The NRC adjusted the set of targeted ITAAC to incorporate lessons learned. For example, the staff used a more risk-informed process in selecting which emergency preparedness (EP) and security ITAAC to inspect. The staff also deleted an unnecessary requirement to inspect at least one ITAAC in every ITAAC family. An ITAAC family refers to the grouping of ITAAC by similar attributes, such as engineering discipline and different areas of construction. These family groups made managing inspections of the ITAAC easier because the staff could determine adequate coverage for all the construction areas. The staff position described in the prioritization guidance documents required that every ITAAC family contain at least one targeted ITAAC, regardless of the risk or inspection value. In addition, all EP and security ITAAC were initially automatically determined to be targeted. As a result of this optimization initiative, the staff un-targeted ITAAC that had low risk and low inspection value; EP ITAAC that were redundant to other NRC inspections (e.g., those associated with EP exercises); and duplicative construction ITAAC (e.g., where one ITAAC required a motor-operated valve stroke test during construction and a separate ITAAC required the same stroke test during preoperational testing). The staff incorporated these changes into IMC 2506.

The adjustments described above enhanced the staff's inspection flexibility and allowed it to continue to provide reasonable assurance of adequate protection of public health and safety while ensuring licensing and inspection resources were focused on the most risk-informed activities. In general, the requirement to inspect targeted ITAAC as part of the baseline program inhibited this flexibility when selected SSCs were not available due to changes in the construction schedule. Therefore, to improve inspection flexibility, it is recommended that future programs do not require preselected ITAAC to make up the baseline inspections. The NRC can achieve equal assurance and gain more agile inspection coverage by selecting a representative sample for any construction area instead of requiring the inspection of targeted ITAAC. (R.1)

External Stakeholder Feedback on ITAAC

SNC stated that early completion of UINs was very helpful, and dedicated office support (e.g., VPO) provided a central focal point for executing UIN and ICN reviews.

SNC also emphasized that establishing the right ITAAC during design certification or COL application is critical. Specifically, SNC recommended the following:

- Improvements can be made to avoid duplicative, iterative, and redundant ITAAC. ITAAC should not duplicate regulatory requirements.

- ITAAC should focus on safety-significant SSCs.

- Implementation should be considered when writing the ITAAC. Unnecessary detail should be avoided and the endpoint kept in mind for programmatic and ongoing requirements.

  The WG agrees with these recommendations except the recommendation that ITAAC should not duplicate regulatory requirements, which the staff understands as a recommendation not to have ITAAC to verify that regulatory requirements are met. Section 185b. of the AEA requires ITAAC to be necessary and sufficient to provide reasonable assurance that, if the ITAAC are satisfied, the facility has been constructed and will be operated in accordance with, among other things, NRC regulations. Since the purpose of the ITAAC, in part, is to verify that the regulations are met, the existence of a regulation on a topic is not a reason to eliminate an ITAAC. Recommendation R.2 addresses the agreed-on attributes to be included in future ITAAC development. The NRC should consider each ITAAC's endpoint.

SNC also emphasized that, while lessons learned have been captured for future licensees (e.g., "shaping NRC policy regarding what should/should not be in ITAAC"), these lessons should also be applied to the impacted licensee. The NEI provided similar feedback as SNC, with an emphasis on "optimizing" the number and scope of ITAAC, including developing standardized ITAAC, and recommended NRC endorsement of NEI 15-02, "Industry Guideline for the Development of Tier 1 and ITAAC Under 10 CFR Part 52," which includes a proposal for a set of standardized ITAAC. The NEI also recommended focusing on performance-based acceptance criteria rather than on the process for achieving safety standards.

  The WG agrees that impacted licensees should also be able to take advantage of lessons learned. The WG also agrees with the overarching comment on "optimizing" the set of ITAAC issued with a COL that are necessary and sufficient to provide reasonable assurance that the facility has been constructed and will be operated in conformity with

the license, the provisions of the AEA, and the Commission's rules and regulations. Starting in early 2014, the NRC staff worked with the NEI and other industry stakeholders to develop a set of standardized ITAAC. The NEI developed and submitted NEI 15-02, Draft A of Revision 0, for endorsement on May 27, 2015 (ML15147A672), which included proposed standard ITAAC and guidance for the development of Tier 1 information. Although the NRC staff did not endorse NEI 15-02, the NRC staff issued "Standardized DCA ITAAC" (ML16097A123) on April 8, 2016, which provided the scope and language for the standardized ITAAC that are expected to be applicable to a light water reactor design certification application (DCA). On June 21, 2016, the NRC staff issued "Additions/Modifications to Standardized DCA ITAAC" (ML16160A175).[2] The standardized DCA ITAAC and additional guidance for ITAAC and other content to be included in COL and DCA applications are included in Regulatory Guide (RG) 1.206, "Applications for Nuclear Power Plants," Revision 1 (ML18131A181). The efforts to develop a set of standardized DCA ITAAC began after the NRC issued the AP1000 design certification and after the COLs were issued to SNC for Vogtle Units 3 and 4 and to SCE&G for V.C. Summer Units 2 and 3. Therefore, SNC and SCE&G were not able to benefit from that effort when the COLs were issued. To benefit from that effort, additional actions would have been necessary (for example, the licensees could have requested a license amendment and exemption request to revise the ITAAC in Appendix C of the COLs to incorporate any or all of the standardized ITAAC).

Furthermore, the WG also agrees generally with the comment to focus on performance-based acceptance criteria and observed that the standardized DCA ITAAC are focused primarily on performance-based acceptance criteria. However, there may be certain instances when acceptance criteria related to a design process or a design acceptance criteria (DAC) ITAAC may be warranted in order to verify that an as-built facility conforms to the approved plant design and applicable regulations.

III.b. **Construction Inspection Program**

The cROP and its associated construction inspection program are structured to provide reasonable assurance of safety and ensure that nuclear reactor facilities are constructed in accordance with the approved design. This includes inspection of the licensee's implementation of the ITAAC in its COL. Other aspects of the overall cROP and construction inspection program include inspection planning and execution, enforcement, resources, and allegations. Various elements of the program could be updated and revised to resolve issues encountered during the implementation without impacting safety.

Inspection Planning and Execution

A key lesson was that focusing the inspection planning on the licensee's ITAAC completion schedule proved to be problematic for efficient use of inspection time on site. The mandatory inspections of targeted ITAAC to provide reasonable assurance that all ITAAC were satisfactorily completed caused inspection planning to put higher importance on those targeted ITAAC instead of allowing more flexibility in the field. As the licensee's construction schedule shifted, ITAAC inspections deemed critical also shifted, and specific onsite inspection opportunities were no longer available. "Chasing" the targeted ITAAC for mandatory inspections led to inefficient use of time when the construction schedule regularly changed. For future

[2] As discussed in RG 1.206, the draft standardized ITAAC do not represent the complete set of ITAAC that would be required to be included in a design certification application.

construction projects, such as advanced reactors with shorter construction timeframes, allowing flexibility for planning which ITAAC to inspect will promote inspection coverage that continues to maintain reasonable assurance that facilities are built and will operate in accordance with their approved designs and licensing bases. (R.3)

The use of targeted ITAAC also exposed a flaw in the methodology for planning some ITAAC inspections. The initial ITAAC prioritization process resulted in many redundant and inefficient inspections by imposing a threshold for targeting ITAAC and not screening for duplicative inspections. This threshold does not consider the similarity of targeted ITAAC in its selection criteria. Rather, it would be more efficient to inspect across all families of ITAAC that are grouped by common attributes, informing the time spent on each family based on the overall risk of that family. This would promote more flexibility to accommodate a fluid schedule, would adopt a risk-informed approach, and would not be tied to the licensee's schedule. For smaller construction projects, like SMRs, the NRC should consider (1) planning inspections based on the available inspection hours per quarter and issues such as the most significant items to review during that time; (2) grouping ITAAC by common attributes and general construction areas for available inspections to promote a more flexible and risk-informed approach; and (3) not tying inspection activities to the licensee's schedule. These recommendations would promote better safety focus and more efficient inspection planning. (S.8)

Complex and long-lead ITAAC inspections included verifying that safety-related and risk-significant systems like the reactor coolant system or passive core cooling system met ASME Code requirements, or safety-related structures like containment met seismic Category I requirements[3]. Ensuring the inspection program was prepared for these long lead ITAAC inspections required extensive planning. The NRC staff conducted multiple tabletop exercises throughout the years with the licensee and its contractors to understand how they planned to meet construction requirements and their construction schedule for specific tasks, especially for those infrequently performed activities or for construction attributes that are made inaccessible as part of the construction process. Therefore, it is recommended that tabletop exercises and demonstration projects be promoted for future construction projects that will implement complex and long-lead inspections. (S.9)

One factor that led to additional inspections was the need to reperform quality assurance (QA) inspections in accordance with the construction inspection procedures. During construction, the Vogtle project licensee changed the construction management and the project lead contractors on site. Although this type of change, which occurred following the Westinghouse bankruptcy, is relatively rare in large construction projects, this caused reinspection of the QA program to re-establish reasonable assurance that the QA program was adequately performed and that adequate provisions for a corrective action program were in place. Another reason for the increased inspections was the internal requirement to perform samples from each technical area of the inspection procedures; this led to completing potentially unnecessary inspections to thoroughly comply with an inspection procedure's requirements as written. Therefore, it is recommended that future construction oversight projects apply a sampling band for the 18 criteria for QA, or the equivalent, that increases or decreases inspection samples in response to licensee performance, as well as evaluate a project's overall QA performance, while still reperforming appropriately scoped inspections if major changes in management or contractors occur during the project and additional inspections are needed to reestablish reasonable assurance in QA. (S.10)

[3] "Long-lead" ITAAC inspections mean inspections that were of relatively longer duration than other inspections and that required a greater amount of planning.

Better construction insights and experience in construction inspection could have provided a more focused inspection effort than the one originally developed. The range of required inspection samples (bands) included in the agency's construction inspection information technology platform were overly conservative. The inspection sample bands included inspection activities associated with types of construction and testing methods like welding, building structural work, non-destructive testing, etc. and included types of SSCs to inspect like valves, pumps, large components, etc. These sample bands cascaded into inspection plans that did not adequately consider direct experience that could have limited the number of samples to be completed from the entire population of available SSCs for that activity. This initial approach was overly conservative and led to potentially oversampling areas that may not have been risk-informed. Starting in 2019, the agency reviewed all remaining inspection activities for Vogtle Units 3 and 4 and made risk-informed revisions to the number of samples and types of inspections needed to be completed for reasonable assurance of adequate protection. For future construction projects, this should be done upfront and through continuous assessment to ensure a construction inspection program is and remains risk-informed and focuses NRC staff on the most safety-significant aspects. In addition, the inspection procedures included estimated hours that may have benefitted from more experienced development. This, coupled with more details on when each inspection procedure should be used, would ensure better tracking of hours spent for each procedure. For future construction oversight activities, it is recommended that the original estimates be better formulated to align with past oversight performance. (S.11)

During this project, the COVID-19 pandemic occurred, and inspectors experienced constraints with conducting in-person or visual inspections. As discussed in Section 2, "Background," of the "Final Report for the Follow-On Review of the Lessons Learned, Best Practices, and Challenges during the Covid-19 Public Health Emergency" (ML22172A159), the NRC staff developed inspection guidance for adjusting inspections, where possible, to limit on-site inspection and face-to-face interaction with licensee personnel (e.g., many inspections utilized a combination of on-site and remote inspection methods, in which a remote review of licensee documents and records was combined with limited on-site inspection for those that required on-site observation of licensee personnel or equipment walkdowns). The NRC staff also evaluated whether the adjustments that were developed during the pandemic should be expanded to inspections when there is not an ongoing pandemic. Section 6 of this report states, in part, "…the primary focus of most inspections should include on-site verification of licensee equipment and observations of licensee personnel by the inspection team." Given that there could be future situations where resources are limited for visual inspections during construction activities, the WG recommends that guidance be developed to help prioritize what construction inspection activities must be conducted onsite through visual inspection (for example, by identifying attributes for consideration, such as uniqueness, first-of-a-kind activities, and significant activities that the construction process made inaccessible), consistent with guidance that may be developed for the ROP to implement recommendations resulting from the NRC's COVID-19 lessons learned effort. (S.12)

Last, the operational program inspection procedures were written to require verification of the program itself as well as inspection of its implementation. While some operational programs, such as security or EP, would require samples associated with implementation before operation, others would not. For example, the NRC's inspection procedures for the maintenance rule and inservice inspection programs required samples to be taken to evaluate the effectiveness of the program. This was ineffective, as it required the NRC's inspection procedures to be completed after the plant entered its operational phase and delayed the completion of the program. A more efficient approach would be to evaluate which programs need implementation samples and

which could have the implementation portion of the inspection completed through normal ROP inspections. (S.13)

Enforcement

Section 6.9, “Inaccurate and Incomplete Information or Failure to Make a Required Report,” of the Enforcement Policy includes a severity level (SL) III example related to inaccurate or incomplete information associated with an ITAAC notification letter. It would be helpful to provide an SL IV example in a future revision to the Enforcement Policy (e.g., for situations where an ITAAC notification is submitted but does not require the NRC to reconsider a regulatory position or undertake a substantial further inquiry) to help differentiate when escalated enforcement is warranted. (S.14)

The construction significance determination process (cSDP) can unnecessarily escalate finding significance due to several features that do not align with finding significance during construction. These features include the use of risk achievement worths (RAW values) and lack of precise language defining a finding’s impact on SSC functionality and risk. This leads to inaccuracies in significance determination of construction findings. For example, findings associated with “high-risk systems” and more than one train affected, as part of initial screening, usually screen as greater than green. As a result, a significant amount of effort would be required by both the NRC staff and the licensee to disposition the finding, when in most cases, the end result was of very low safety significance. Further, the cSDP is not clear about how to determine the significance of findings that only partially affect SSC functionality. This can result in escalated enforcement determinations due to assumptions of complete SSC nonfunctionality and requires licensees to perform detailed, and sometimes lengthy, functionality analyses to avoid escalated enforcement findings. The process for determining the significance of construction findings could be changed to promote a risk-informed, safety-focused inspection and enforcement process, such that time spent by the NRC and the licensee is in proportion to the safety and risk significance of the SSC, along with the potential to have remained undetected and impact plant operations, and results in escalated enforcement only when warranted. (S.15) This also correlates with the recommendation collected from a comment-gathering public meeting with SNC to revise the cSDP to ensure resources are focused on the most safety-significant issues.

Early in the construction schedule for Vogtle and V.C. Summer, the majority of inspections were conducted at vendor locations. During this first-of-a-kind inspection process for ITAAC, vendor inspection notices of nonconformance were sometimes issued without a clear description of the impact on ITAAC. This required the issues to be reevaluated to ensure ITAAC acceptance criteria were met. Any inspection findings related to ITAAC inspections should be better coordinated when identifying which ITAAC the findings impact, and closure of the issues should be clearly documented to support the 10 CFR 52.103(g) finding. Vendor inspections and construction inspections should be closely coordinated to ensure that NRC construction oversight management fully understands the licensing compliance implications of vendor findings. (S.16)

Safety Culture and Allegations

The allegations program is an important part of the oversight process and directly supports the NRC mission. The agency ensures adequate staffing to process allegations. As a result of the dynamic nature of construction, resource needs can be hard to predict. Historically, allegation staffing needs may change when licensees or applicants undergo changes in major contractors

or large staffing changes occur. Ensuring the NRC has both adequate and flexible staffing, including the use of a tiger team, if needed, and staff training was helpful when changes in the number of allegations occurred. Also, understanding the construction schedule or major activities can be useful in determining resources needed for allegation support. It is recommended to ensure adequate staffing, including tiger team structure, and training for allegation processing during new construction projects. (S.17) One notable observation is that when licensees built more robust employee concerns programs, commenced periodic work area assessments with involvement from the site leadership, and monitored their progress, licensees were very successful in identifying and correcting safety-culture concerns early.

Additionally, during some inspections at vendor locations during the early construction period of Vogtle and V.C. Summer, it was noted that some 10 CFR Part 50 Appendix B-approved vendors of safety-related SSCs did not fully understand expectations for the allegations process, such as required onsite postings promoting employee awareness. Licensees should be reminded that they are responsible for the quality assurance program, including contractor adherence to regulatory requirements passed down in purchase orders. The NRC should plan more extensive outreach for meeting those expectations, particularly for the various new vendors of SMRs and advanced reactors. (S.18)

Other Areas

The assessment element for an overall construction oversight program provides a key method for determining and resolving issues impacting safety. The cROP used an annual frequency for assessment. Looking forward, SMRs and advanced reactors may have shorter timeframes and, therefore, include faster completion times for structures and systems. The annual assessment frequency is potentially too long for a faster moving project, and as a result, a shorter assessment cycle is recommended. Future construction oversight programs should consider a system of more continuous assessment and the public communications associated with them. (S.19)

Another aspect of construction with respect to reasonable assurance of safety was the inspector exchange program and international participation regarding the AP1000 technology. Over the years, multiple international regulators have been to the V.C. Summer and Vogtle construction sites to understand the NRC nuclear construction oversight process; most notably the Polish National Atomic Energy Agency spent several months during three different visits observing plant construction and learning about the NRC licensing and inspection process. The NRC has participated in other inspector exchange programs, including with regulators from the Finnish Radiation and Nuclear Safety Authority and the National Nuclear Safety Administration of China (NNSA). Specifically, as part of the agreement in the memorandum of cooperation signed in 2007, the NRC and NNSA participated in an inspector exchange program. This allowed NRC inspectors to gain valuable experience and insights for future inspection activities of the AP1000 units that, at the time, were under construction in the United States. The NRC staff observed construction, preoperation, and startup tests for the AP1000 being built in China over approximately 7 years.

These observations included familiarization with the AP1000 design and layout by performing plant area and system walkdowns; obtaining lessons learned from first-plant-only tests (FPOTs) and other major startup testing activities; and observing additional testing that provided insights into the inspections of operational programs. Specific benefits from the international exchange were that NRC inspectors gained valuable experience and insights for future Vogtle inspections, including considerations for inspection procedures and plans; AP1000 training was enhanced by

the information obtained on the actual physical plant layout of important safety systems and the components and operational insights gained by observing integrated systems operations during the startup testing program at Sanmen Units 1 and 2; and in support of the memorandum of cooperation, knowledge and inspectors insights were successfully shared between NNSA and NRC inspectors. The NRC should consider establishing an inspector exchange program, as applicable, with international regulators, when the same or similar types of nuclear plants are being built. Key lessons should be implemented in NRC inspection program guidance documents, inspection planning, possible credit inspections (e.g., AP1000 FPOTs), and simulator and training development. (S.20)

External Stakeholder Feedback on Construction Inspection

One of the top three recommendations from SNC and the NEI was to update the cROP to reflect the latest risk insights and incorporate lessons learned from the ROP to the cROP. For example, SNC and the NEI recommended applying the "low safety significance issue resolution (LSSIR)" process to plants under construction (e.g., as stated by the NEI, "when verbatim compliance issues arise within ITAAC inspections when there is no significance or impact to ITAAC intent"). Kozak Innovative Safety Solutions, Inc., also supported this recommendation and emphasized timely incorporation of ROP improvements or changes into the cROP.

> The WG understands the industry's recommendation to apply the LSSIR process as a recommendation to apply the "very low safety significance issue resolution" (VLSSIR) process, which is a process that is part of the ROP for operating reactors, to plants that are under construction. The VLSSIR process is defined in NRC Inspection Manual Chapter 0612, "Issue Screening" (ML23067A031), as, "A process used to discontinue inspection of an issue involving an unresolved licensing basis question in which: (1) the resolution of the issue would require considerable staff effort; and (2) the agency has chosen to not expend further effort to resolve the question because the issue would be no greater than green under the ROP or SL IV under the traditional enforcement process, if it were determined to be a violation." Because the staff must find that the acceptance criteria are met before operation of the facility can commence, the VLSSIR process would need to be adapted before it could be applied to ITAAC findings to ensure it provided a means for allowing the staff to determine whether the acceptance criteria are met. Consistent with ongoing agency efforts to continue to refine the VLSSIR process and incorporate lessons learned, it is recommended that the staff explore ways to adapt VLSSIR for potential construction findings. Specifically, the staff should explore expanding VLSSIR to potential non-ITAAC construction findings and use the risk insights from the VLSSIR process to inform the level of effort and time expended determining whether acceptance criteria are met for issues that would not be greater than green or SLIV significance (S.21). Although not part of the VLSSIR process, as discussed in recommendation S.2, the category of minor ITAAC inspection findings is used to address known ITAAC compliance issues of minor safety significance in a risk-informed manner.

SNC, the NEI, and Kozak Innovative Safety Solutions, Inc., also recommended limiting the significance of licensee-identified findings (e.g., to no more than minor violations), based on the rationale that, when properly corrected, a licensee-identified violation will not impact future plant operation. Additionally, SNC and the NEI recommended revising the cSDP to ensure resources are focused on the most safety-significant issues. SNC said that at least seven inspection issues in the last 3 years expended additional resources beyond what plant programs would warrant (e.g., assessment of use-as-is conditions even when nonconformances will be

corrected). These were presented as examples of times when resources were used for the cSDP that could have been focused on more risk-significant activities. The NEI stated that the cROP was based on the ROP where the public actually incurs some risk; however, this risk is never realized by the public during the cROP because plant programs ensure nonconforming conditions are addressed before operation. Kozak Innovative Safety Solutions, Inc., noted that applying traditional enforcement for the cROP may be an alternative to the cSDP and also recommended that the staff consider eliminating the construction significance determination matrix and using risk-informed qualitative analyses to estimate the risk significance of inspection findings. It was also noted that the significance determination matrix can result in attributing different significance to similar findings.

> As part of the lessons learned, the WG is reviewing the cSDP for possible revisions and will consider changes that would support enforcement actions that are risk-informed, based upon the actual safety significance of the violation. (S.15)

SNC also emphasized that early inspection planning meetings and inspections are necessary for ITAAC related to programs that are executed over the life of the project (e.g., ASME, as-built reconciliation processes). SNC stated that having a dedicated NRC inspection program organization is very helpful to aid inspection planning, scheduling, and execution.

> The WG agrees with this recommendation. Extensive work was done during the construction project to have many inspection planning meetings and public meetings, such as demonstration projects and workshops, to discuss concerns and challenges for long-lead, complex ITAAC, where construction and testing activities can occur over years. Examples like ASME, structural reconciliation, and electrical cable separation ITAAC benefited from detailed interactions to ensure a common understanding between the NRC and the licensee on the requirements to complete the ITAAC. It is recommended that all future construction projects make regular use of public meeting tabletops and inspection planning meetings. (R.6)

SNC also discussed the need for inspector flexibility to inspect ITAAC or non-ITAAC common activities, which could minimize the difficulty in scheduling and coordinating specific inspections in a rapidly changing construction environment. Kozak Innovative Safety Solutions, Inc., noted that the cROP provides for inspectors to increase or reduce inspection activities based on program results, which provides flexibility.

> The WG agrees that future construction inspection programs should consider flexibility in inspection sampling methodology. Challenges with this specific example can occur when non-ITAAC common activities have different contractors or are not safety related and, as a result, the non-ITAAC construction activities are not equivalent to ITAAC activities. For example, welding inspections attributes for the AP1000 reactor coolant system (RCS) are not equivalent or representative of welding performed on structural modules. Specifically, RCS welding conformed to the requirements of the American Society of Mechanical Engineers (ASME) Code, Class I. The structural modules welding was performed to the requirements of the American Welding Society Structural Welding Code D 1.1 (for carbon steel) and D1.6 (for stainless steel). Additionally, the RCS welding was performed by subsidiaries of the nuclear steam supply system vendor, and the structural modules were fabricated by subsidiaries of the architecture engineering vendor, each performing activities under separate quality assurance programs. (R.3)

Further, SNC recommended forecasting indirect hours, along with direct hours, to aid budgeting. The NEI recommended posting forecast and actual direct and indirect hours on the NRC's website to improve transparency. Kozak Innovative Safety Solutions, Inc., also noted that resource estimates did not include indirect inspection hours, which were observed to be approximately three times greater than direct hours; they should be included in resource estimates for future projects.

> The WG agrees that all fee-billable charges, direct and indirect, should be transparent to the plants under construction to support better resource estimation. The section "Transparency in Resource Estimating and Use" discusses this topic in more detail, and it is captured under recommendation R.8.

Finally, during the September 2022 public meeting, the staff and SNC discussed how the construction inspection process might be adapted to situations with greater vendor fabrication of reactor plant SSCs off site (i.e., at a location other than that of the future nuclear power plant). SNC said that the vendor inspection program and process will not need to change for established nuclear suppliers. However, for suppliers new to the nuclear industry, SNC recommended that the NRC take a lifecycle inspection approach, particularly for circumstances where most of the plant will be built off site. This approach would begin with inspections of programs at a facility before fabrication even begins. After fabrication starts, the NRC should conduct additional inspections and base follow-up inspections on vendor performance. Last, inspections performed after delivery at the site should not duplicate inspections performed at the manufacturing facility. The NEI presented the same recommendations in the context of preparing for licensing SMRs. The NEI also recommended that, because minimal onsite construction is expected for future new reactors, the NRC should focus on vendor inspections (i.e., offsite inspections) and do less onsite inspection.

> The NRC staff is preparing the advanced reactor construction oversight program (ARCOP), which would support new nuclear facility construction techniques that may take different approaches to manufacturing than previous large light-water-reactor construction projects.

III.c. **Licensing**

The COLs for Vogtle Units 3 and 4 incorporate, by reference, the standard design in Appendix D, "Design Certification Rule for the AP1000 Design," to 10 CFR Part 52 and must comply with the requirements in that appendix. The AP1000 design control document includes Tier 1, Tier 2, and Tier 2* information and generic technical specifications (TS). Section VIII of Appendix D describes the change process for this information. The requirements in 10 CFR 52.63(b)(1), 10 CFR 52.98(f), and Section VIII.A.4 of Appendix D govern the exemptions from Tier 1 information. Section VIII.B.5.a allows licensees that reference Appendix D to depart from Tier 2 information without prior NRC approval, unless the proposed departure involves a change to Tier 1 information, Tier 2* information, or the TS, or unless it requires a license amendment under paragraphs B.5.b or B.5.c of that section, which is somewhat similar to the process in 10 CFR 50.59, "Changes, tests and experiments." Departures from Tier 2* information or the generic TS require a license amendment in accordance with 10 CFR 50.90, "Application for amendment of license, construction permit, or early site permit."

As of August 9, 2023, the NRC completed a total of 222 licensing actions (including 195 total LARs) for Vogtle Units 3 and 4:

- 9 exemptions
- 18 code alternatives
- 195 LARs
  - 91 requests for only a license amendment
  - 103 LARs that included an exemption to Tier 1 information
  - 1 LAR that included an exemption to Tier 1 information and a code alternative

Additionally, the staff reviewed and verified 398 ICNs for Vogtle Unit 3 and 364 ICNs for Vogtle Unit 4. The lessons learned and recommended best practices described below allow licensing activities to support and not unnecessarily hinder construction activities.

Effective and Timely Communication

A key success was scheduling regularly occurring external interactions with the licensee, such as the Thursday weekly public meetings and construction schedule coordination meetings, to provide frequent opportunities to quickly address emerging issues related to licensing actions and ITAAC notifications. Weekly public meetings were useful in addressing emerging licensing or ITAAC closure issues as they were identified. These meetings were noticed within the 10-day notice requirement with a generic agenda and were updated to list specific topics and times as they were identified, thereby increasing flexibility because the staff and licensee could add topics as late as a day before the meeting. Having the public meeting scheduled for the same day and time each week was also beneficial because the NRC and licensee staffs could readily reserve that time on their calendars. Establishing regularly scheduled public meetings in this fashion promotes a more efficient means to present or resolve licensing issues than trying to schedule meetings each time an issue arises. During VRG meetings, the NRC staff and the licensee also discussed the status of licensing actions, scheduling issues, and future licensing actions and to identify any new issues. Attendees included NRC managers, project managers, and key technical staff and licensee management and project leads. In accordance with the NRC's principle of openness, if a topic was identified that required discussion during a public meeting, it was scheduled during one of the weekly meetings described above. (R.6)

Resources and Priorities

The review time of an LAR was defined as the number of days between completion of the acceptance review and issuance of the amendment(s). Figure 1 shows the number of LAR reviews completed for each fiscal year and the average review time to complete them.

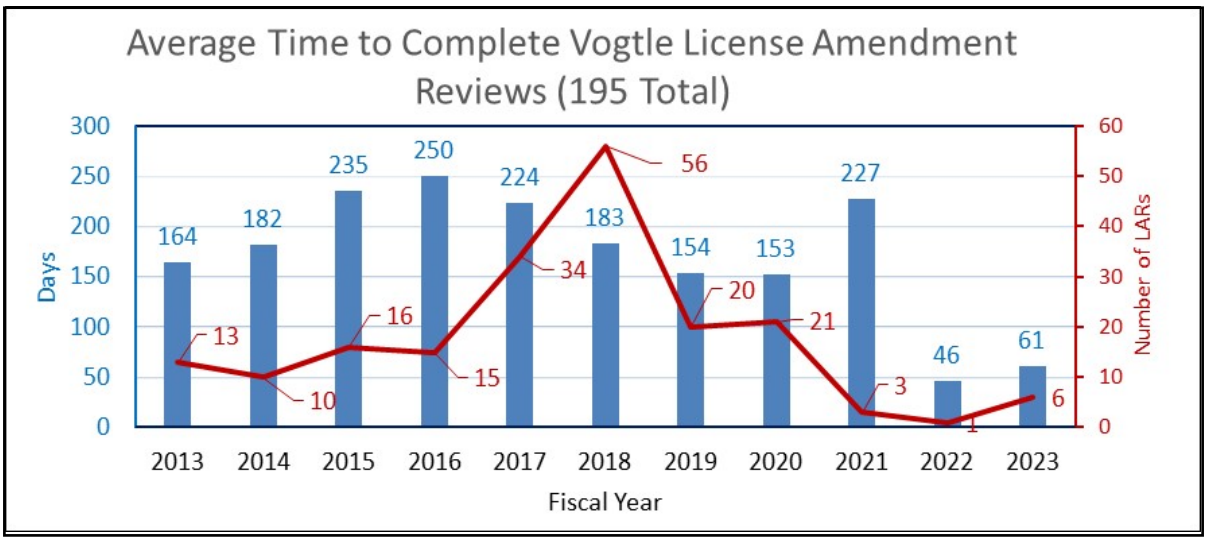

Figure 1 Annual number of LARs and average days in review

From 2013 to 2016, the average review time of a Vogtle LAR steadily increased from 164 to 250 days. In 2017, senior management in the former NRO set office goals for Vogtle Unit 3 and 4 LARs and clearly communicated them to all staff involved in the reviews. These goals included completing 90 percent of the acceptance reviews within 30 days, publishing 90 percent of the initial *Federal Register* notices within 60 days of acceptance, and completing 90 percent of the reviews within 180 days of acceptance. These licensing metrics were discussed during management meetings (e.g., the "Goals and Priorities" meetings held in NRO), along with the progress of, and any issues with, licensing actions currently under review. Timeliness improved after these goals were established and the priorities communicated to the staff. (R.7)

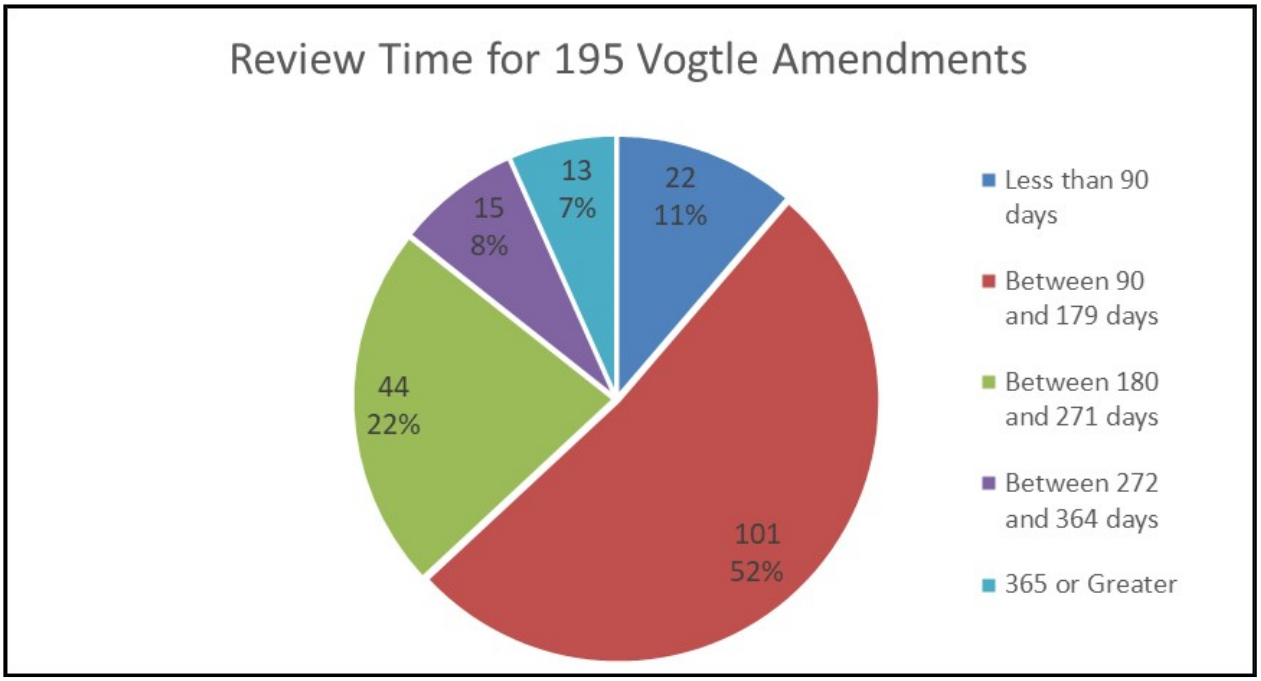

Figure 2 Review time for Vogtle LARs

As shown in figure 2, 63 percent of the LARs had a review time of less than 180 days. Even though the office goals were not always met, in most cases, the NRC approved LARs on or before the date requested by the licensee.

The WG also considered how future scenarios may differ from the experience with Vogtle Units 3 and 4 and V.C. Summer Units 2 and 3. These units were based on the AP1000 standard design, and the NRC and licensees were able to leverage the benefits of the standard design for reviews of requested licensing actions submitted by both licensees. Additionally, after 2017, the only nuclear power plants that were under construction were Vogtle Units 3 and 4. In the future, the NRC is anticipating multiple nuclear power facilities of different designs may be undergoing construction simultaneously. Also, some of these designs may be constructed under a 10 CFR Part 50 construction permit, which has historically been issued based on a preliminary design that is not finalized until an operating license application is submitted. In that situation, establishing priorities for the staff will likely not be as simple or straightforward as it was for these plants. The NRC will need to identify strategies to ensure resources can be allocated to multiple construction projects as well as other high-priority work that may be occurring at the same time (e.g., core review teams). (R.7)

Improvements to the Licensing Action Review Process

The staff also adapted some efficiencies to promote faster review times. For example, the staff developed an expedited LAR process that could be used for low-complexity ITAAC compliance issues. The staff used this new process for LAR-21-001 (Clarification of ITAAC Regarding In-Vessel Components) and LAR-22-003 (Unit 4 Electrical ITAAC Optimization) and completed these reviews in 46 and 63 days, respectively. Under this process, VPO prepared the safety evaluation report and provided it to the NRC technical staff for review and concurrence. This expedited review process could be used to process nonexigent LARs in as few as 35 days; this includes the 30-day public comment period required by 10 CFR 50.91, “Notice for public comment; State consultation,” and 5 days to issue an individual *Federal Register* notice after receiving the LAR.

The staff also established a process for reviewing a high-complexity LAR. A high complexity LAR has a high level of technical detail with significant engineering work to complete; will potentially depart from NRC-accepted industry standards; will potentially set industry standards or will go outside of existing regulatory guidance; will contain extensive changes or will involve three or more NRC branches; will potentially require review by the Advisory Committee on Reactor Safeguards (ACRS); or will call for a greater amount of communication with the NRC staff. As soon as the licensee identified a high-complexity LAR, the NRC assigned a review team consisting of the project manager, the technical staff needed to complete the review, and an attorney. The NRC held a public presubmittal meeting with the licensee. Following the meeting, the staff developed an acceptance criteria document providing the background, regulatory basis, and expected review acceptance criteria for the high-complexity LAR. These acceptance criteria were then shared verbally with the licensee during another public presubmittal meeting, so it was aware of the staff’s expectations. This process allowed the applicant to submit a higher quality application, and the staff was better prepared to review the LAR.

The processes that were established to provide the resources needed to efficiently and effectively review both low- and high-complexity LARs are identified as best practices as part of R.7.

Careful Selection of Tier 2* Information

As described above, any departure from Tier 2* information requires a license amendment to be submitted to the NRC for prior review and approval. The AP1000 design certification contained a significant amount of Tier 2* information, more than would be identified should the process be repeated today. The construction experience at Vogtle Units 3 and 4 showed that, in some cases, LARs were needed to change Tier 2* information that had minimal if any safety significance (e.g., to make edits to a bibliography in a document that was identified as Tier 2* information in its entirety). In these cases, submittal of an LAR to change the information resulted in an inefficient use of resources for both the licensee and the NRC staff. Through LAR-17-037, the NRC approved the addition of license conditions that would implement a criteria-based evaluation process to determine whether a departure from Tier 2* information in the updated FSAR requires prior NRC approval. The use of Tier 2* designations should be consistent with the approaches described in SECY-17-0075, "Planned Improvements in Design Certification Tiered Information Designations," issued July 24, 2017 (ML16196A321) and SECY-19-0034, "Improving Design Certification Content," issued April 2019 (ML19080A032). When this designation is used, the Tier 2* information should be carefully selected to minimize the potential to require LARs for non-safety-significant changes to this information. (S.22)

Reviews of ITAAC Notifications

The Vogtle Unit 3 COL originally had 875 ITAAC, but this was reduced to 398 by deletion and consolidation of ITAAC through LARs. The consolidation included combining ITAAC with similar aspects. The overall ICN review times were expected to remain equal to the cumulative sum of the individual inspections, tests, and analyses of each consolidated ITAAC. The original estimates were from 4 to 40 hours, depending on the complexity of the ITAAC. The actual review times of these complex, consolidated ICNs were commensurate with ICNs of much smaller and simpler ITAAC before consolidation.

The staff attributed these low ICN review times largely to the success of the UIN pilot project completed in 2016. The pilot project exercised the NRC staff's review of UINs that would be submitted earlier than the deadline in 10 CFR 52.99(c)(3) of 225 days before scheduled initial fuel load. Benefits of the "early" review of UINs included a reduction in the staff's review time, which would be especially important for a potential surge of ICNs late in construction, and earlier availability of public information on the licensee's ITAAC closure plans. The pilot project also allowed the NRC to identify potential ITAAC closure issues earlier in the construction process. With the acceptance of the early UINs, the majority of ICNs aligned with the scope and content of the UINs. The early UIN reviews contributed to the low ICN review times of even large, consolidated ITAAC. Accordingly, the review of all UINs in advance of the required submission time in 10 CFR 52.99(c)(3) is a best practice that the NRC should consider for future 10 CFR Part 52 construction projects. (S.4)

ITAAC Demonstrations

Throughout the Vogtle and early V.C. Summer construction schedules, the staff proactively exercised its internal processes to find efficiencies that would remove bottlenecks to the time to complete required actions. In 2017, the staff completed demonstration projects to evaluate the readiness and reliability of the ITAAC inspection and verification processes. The first demonstration project reviewed existing NRC processes for ITAAC inspection and ICN closure verification to identify enhancements and develop peak workload scenarios to test the procedures for reliability, efficiency, and the ability to meet the ITAAC closure demands. The

final report package (ML17135A415) documents the processes that were tested to further enhance the NRC's capacity, agility, and decision-making when implementing the first-of-a-kind ITAAC closure processes. A second demonstration project provided a status of the first ITAAC demonstration project actions, exercised the NRC's ITAAC review and inspection processes focusing on complex ITAAC, and engaged the steps associated with the staff's 10 CFR 52.103(g) finding. The demonstration projects, public meetings, and tabletop exercises for ITAAC closure and processing the 10 CFR 52.103(g) finding proved valuable in refining and focusing efforts to complete these first-of-a-kind processes. Therefore, it is suggested that demonstration projects or exercises be promoted for future construction projects that will implement complex first-of-a-kind processes. (S.9)

As an extension to the demonstration projects to ensure that the agency's internal processes would not unnecessarily impede a 10 CFR 52.103(g) finding, the NRC assembled and trained an expanded group of ITAAC notification reviewers to process the surge of ITAAC notifications that were expected at the end of construction. Ultimately, the large surge of ICNs for Vogtle Units 3 and 4 did not materialize, but the staff was prepared to handle it, had it occurred.

Issuance of the 10 CFR 52.103(g) Finding

In 2019, the staff held two public meetings to identify ways to safely reduce the time required by the NRC to determine whether it could make the 10 CFR 52.103(g) finding following receipt of an "All ITAAC Complete" notification. During the first meeting, the staff presented a best case stretch goal processing timeline that could be achieved if certain conditions or prerequisites by the licensee were met (ML19224A924). These prerequisites were not regulatory requirements but were best practices that, if voluntarily implemented by the licensee, would facilitate the NRC staff determination whether the 10 CFR 52.103(g) finding is appropriate. These prerequisites were related to advance notice of issues that could impact the last ICNs and the "All ITAAC Complete" notification. During the second meeting, the staff presented draft notifications to be submitted as well as different scenarios that could affect the expected time for making the 10 CFR 52.103(g) finding if the NRC determined that all acceptance criteria are met (ML19259A065). A summary memorandum (ML20006D963) discusses how the NRC would prioritize safely reducing the administrative processing time for making the 10 CFR 52.103(g) finding to the minimum time necessary, which could vary from the best case stretch goal timeline to up to 17 days (14 calendar days for the NRC staff to finalize the supporting documents and issue the final memorandum to the Commission, followed by 3 calendar days for Commission review), as described in Office of Nuclear Reactor Regulation (NRR)-LIC-114/NRO Office Instruction NRO-REG-106, "Title 10 of the *Code of Federal Regulations* (10 CFR) Section 52.103(g) Finding and Communication Process," issued January 2019 (ML18267A001), depending on the degree to which the prerequisites would be satisfied.

The NRC received the "All ITAAC Complete" notification for Vogtle Unit 3 on July 29, 2022. The NRC staff issued the final Commission memorandum for Vogtle Unit 3 on August 1, 2022, and made the 10 CFR 52.103(g) finding on August 3, 2022. For Vogtle Unit 4, the NRC received the "All ITAAC Complete" notification on July 20, 2023, and the NRC staff signed the final Commission memorandum on July 25, 2023. The NRC made the 10 CFR 52.103(g) finding for Vogtle Unit 4 on July 28, 2023.

Several factors allowed the staff to make the finding for each unit faster than the timeliness goal in NRR-LIC-114 without compromising safety.

- The staff conducted prereviews of the documents described above well before receipt of the "All ITAAC Complete" notification. These reviews were performed by the licensing assistant, the technical editor, the Office of the General Counsel (OGC) attorneys, and NRC management up to and including the Executive Director for Operations (EDO). The comments incorporated during these prereviews were minimized because the documents were based on the NRR-LIC-114 templates already approved by management. These documents were maintained on a SharePoint site to allow the NRR and DCO staffs to update them as inspections, ITAAC notification reviews, and licensing activities were completed. After the NRC received the "All ITAAC Complete" notification, the updates needed to finalize the documents were minimal. The NRC management and OGC staff conducted the formal review of and concurrence on the final versions of the documents by focusing on only those changes made since the prereview. There was not a significant surge in ICNs submitted by the licensee near the time of the "All ITAAC Complete" notification. Therefore, the staff was able to review ICNs and complete inspections well ahead of the timeframes assumed in NRR-LIC-114.

- The NRC staff and the licensee participated in standing calls to discuss the schedule for submission of ICNs so the staff could be better prepared to conduct inspections and review the notifications. The frequency of these calls increased from biweekly to weekly as the date for submittal of the "All ITAAC Complete" notification approached. Thus, the staff was aware of when the "All ITAAC Complete" notification would be submitted and was prepared to work evenings and weekends to complete the necessary reviews and support the concurrence process.

- The staff conducted three Office-of-the-EDO briefings to familiarize the EDO and Deputy EDO with the documents associated with the 10 CFR 52.103(g) finding.

- No late-arising issues material to ITAAC completion were identified for either unit following receipt of the "All ITAAC Complete" notification.

- Only a minimal number of inspections were needed once the NRC received the "All ITAAC Complete" notification because of the extensive planning and coordination by the staff to inspect ITAAC as the licensee completed them towards the end of construction.

Accordingly, the time to issuance of the 10 CFR 52.103(g) finding was a success, and the NRC should maintain the process in NRR-LIC-114. (S.23)

Technical Specifications for Plant Startup

Adhering to certain TS after initial fuel load but before initial criticality could cause additional burdens on the licensee and the NRC staff to process LARs through emergency or exigent conditions. For example, for Vogtle Unit 3, after the initial fuel load and while in Mode 3, maintenance and other issues with leaks or vibrations in the piping lines were identified and could not be fixed without entering Modes 4, 5 or 6 as required by TS. This would have resulted in delays and additional testing to return to Mode 3. Since the TS that applied to these situations were based on accident analysis worst case scenarios (full core having operated at full power), the TS requirements to enter Modes 4, 5 or 6 were not necessary for the safety of a reactor prior to initial criticality. The following exigent and emergency license amendments were needed to conduct the repairs without changing plant modes:

- "Issuance of Amendment: Technical Specification Exceptions for in-containment Refueling Water Storage Tank Operability Prior to Initial Criticality (Exigent Circumstances)" (LAR-23-004), issued February 2023 (ML23037A082)

- "Issuance of Amendment Regarding License Amendment Request: Technical Specification [TS] [Limiting Conditions for Operation (LCO) 3.4.11, 3.4.12, and 3.4.13] Operability Requirements for Automatic Depressurization System [ADS] Stage 4 (Emergency Circumstances)" (LAR-23-002), issued January 2023 (ML23013A214)

Based on lessons learned from the emergency and exigent LARs for Vogtle Unit 3, the licensee submitted LAR-23-005, "Timing of Unit 4 Technical Specifications Effectiveness Prior to Initial Criticality," dated July 19, 2023 (ML23158A205), for Vogtle Unit 4 to effectively create a set of startup TS. Feedback from the licensee indicated that approval of this LAR has been beneficial during startup testing for Vogtle Unit 4. The staff and NRC applicants should consider whether it would be appropriate to identify "startup TS" that become effective only after achieving initial criticality, recognizing the reduced hazard presented by a core that has not gone critical. (S.24)

External Stakeholder Feedback on Licensing Activities

One of the top three recommendations from SNC and the NEI was to develop an expedited and more efficient process for reviewing licensing actions with minimal safety significance. SNC highlighted its experience of needing to submit licensing actions with minimal safety significance (e.g., to make administrative and "consistency" changes to Tier 1 and Tier 2* information). The NEI emphasized focusing Tier 1 and ITAAC during the design certification application on safety-significant SSCs and making them succinct to avoid LARs during construction. The NEI also recommended creating a process for a licensee to proceed at risk for modifying Tier 1 information before NRC approval by a "10 CFR 50.59-like" process, on the basis that "there is no radiological danger to the public prior to fuel loading."

> The WG notes that the staff did develop an expedited LAR process and also recognizes that there is an ongoing discussion between the NRC staff and the industry on the use of Tier 1 and Tier 2* information. The staff position on possible changes to the application of Tier 1 and Tier 2* information is documented in SECY-22-0052, "Proposed Rule: Alignment of Licensing Processes and Lessons Learned from New Reactor Licensing," issued June 2022 (ML21159A055). The WG also notes the Preliminary Amendment Request (PAR) process described in interim staff guidance (ISG) COL-ISG-025, "Interim Staff Guidance for Changes during Construction under 10 CFR Part 52," preserves the licensing basis configuration while avoiding unnecessary delays in construction. The PAR process allows licensees to submit a request to the NRC asking whether the NRC objects to a construction change before the NRC's review of the associated LAR is complete. If the NRC had no objection to this request, the licensee could proceed with the construction change but would be required to return the facility to its current licensing basis should the associated LAR be withdrawn or denied.

Another of the top three SNC and NEI recommendations was to create a mechanism to enable the agency to pilot new approaches or processes for the first licensee as unintended challenges are identified. SNC suggested operator licensing as an activity that would benefit from a tabletop discussion between the NRC and licensee staffs of each step in the process. The NEI also recommended that the staff apply lessons from first-time licensing processes in real time through an interim staff guidance, RIS, or other mechanisms.

> The WG recognizes that the efforts made early in the Vogtle and V.C. Summer projects with periodic workshops and demonstration projects greatly helped with working through new approaches and processes. This, in turn, created a collaborative environment to work with the licensees on the first-of-a-kind activities encountered during the 10 CFR Part 52 construction. The agency's intent is to carry this theme forward with increased periodicity for future construction projects because of the success of the numerous tabletops, workshops, and demonstration projects (see R.6).

Additionally, SNC and the NEI recommended the NRC reassess reporting requirements and milestones cited in various regulations to align with the appropriate risk profile change at the site (e.g., implementation at 10 CFR 52.103(g) versus initial loading of fuel, initial criticality, or commercial operations), and apply consistent implementation criteria across all regulations. The NEI also recommended using an NRC-licensee information exchange method, rather than requiring the licensee to submit (1) schedules for operational program implementation, as required by license conditions (as discussed in SECY-05-197, "Review of Operational Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria" (ML052770257), and its associated staff requirements memorandum (ML060530316)) and (2) its schedule for completing the ITAAC, as required by 10 CFR 52.99(a).

> The WG agrees that modernization of information sharing will benefit both the agency and all stakeholders by providing faster means of accessing and transmitting information, such as using an electronic portal for regularly scheduled submittals. With modern data retrievability and regular use of internal and external dashboards, future projects will have increased transparency and speed of information sharing. However, the WG did not identify a reason to eliminate the need and requirement for the information to be submitted to the NRC staff. Additionally, SECY-22-0052 proposes revisions to certain milestones (e.g., related to physical security and fitness for duty program implementation) and requirements in 10 CFR 52.99(a) related to the licensee's schedule for completing the ITAAC based on lessons learned with Vogtle Units 3 and 4. Therefore, the WG is not recommending any additional changes at this time to requirements for information or reports to be provided to the NRC. However, for future projects, the WG recommends that licensees and the NRC staff should discuss how required information can be submitted efficiently and effectively and select a method to do so. (S.25)

SNC also noted that dedicated office support for licensing actions (e.g., VPO) facilitated clear communication and understanding in a quickly changing environment. Agreement on licensing action complexity, with the staff aiding in binning and prioritizing requests, and early technical exchanges and presubmittal meetings were helpful, particularly for high-complexity licensing actions.

> Recommendation R.7 recognizes the benefits as described by SNC.

Kozak Innovative Safety Solutions, Inc., recommended that the staff identify best practices from making the 10 CFR 52.103(g) finding.

> The NRC staff began preparations for the first ever 10 CFR 52.103(g) finding far in advance of the first "All ITAAC Complete" notification submittal that notifies the staff that the licensee has completed all ITAAC in its COL. In addition to training the expanded group of ITAAC reviewers and anticipating a surge in ICN submittals, the staff exercised other actions, such as preparing the basis document and memoranda for internal

circulation and review. This was planned in advance to avoid any bottlenecks and expedite the 10 CFR 52.103(g) finding. S.23 captures the suggestion to maintain the process in NRR LIC 114.

III.d. **Overall Program**

Engagement with External Stakeholders

Starting in 2007, the staff proactively engaged stakeholders in the initial development of the construction inspection program as well as the cROP. The NRC engaged in workshops, regularly scheduled at 5-week intervals, to discuss issues such as diverse lead organizations for inspection activities, levels of detail to be included in ITAAC notifications, and the mechanics and methodology of ITAAC maintenance. These frequent workshops played a key role in enhancing and gaining alignment on program developments early in their inception. It is highly recommended that any future construction oversight process, such as for advanced reactors, include regular interactions with stakeholders to gain early agreement and provide a regular path to resolve issues encountered during development. The early alignment on issues that evolve through the development of an oversight process is a fundamental element in providing timely and effective implementation during actual plant construction. (R.6)

Evaluation of Resource Use and Performance

The WG reviewed NRC resources to determine whether they were expended efficiently and within the established goals. It also considered the level of direct inspection compared to the original estimated values. From the start of construction on Vogtle Unit 3, direct inspection hours were tracked against established goals. Direct inspection are those hours that an inspector could charge performing the inspection, witnessing a test, or reviewing ITAAC completion documents from the licensee. Indirect hours are those charged for licensing and inspection project management, resident oversight for plant status, preparation, travel, or documentation of the inspection efforts. The indirect hours were difficult to identify during the early years, starting in 2012, but more records were available through the middle and end of construction for Vogtle Units 3 and 4, primarily due to a focused effort for more transparency in the agency's billing practices. The section "Transparency in Resource Estimating and Use" discusses this topic in more detail, and it is captured under recommendation R.8.

The cROP construction resource reports that the NRC regularly posted on its public webpages for Vogtle Units 3 and 4 showed actual hours compared to the estimated hours listed in IMC 2506, "Construction Reactor Oversight Process General Guidance and Basis Document," issued in 2020.

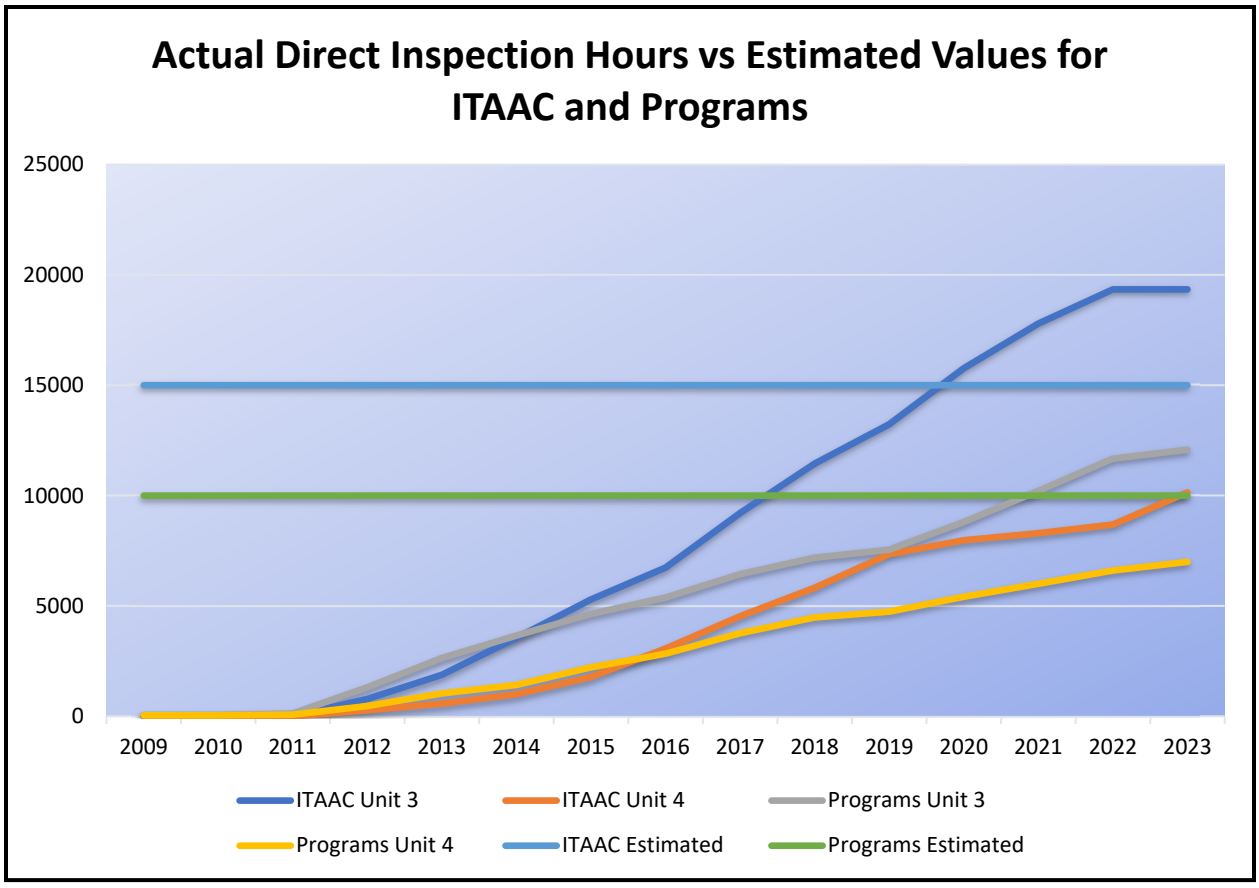

Figure 3 Vogtle direct inspection hours vs. estimated values

At the time of the 10 CFR 52.103(g) finding for Unit 3 in 2022, actual ITAAC direct inspection hours for Unit 3 were 29 percent over the estimated 15,000 hours, and actual program direct inspection hours for Unit 3 were 22 percent over the estimate of 10,000 hours. Throughout construction, Vogtle Unit 3 trended higher for ITAAC and programmatic direct inspection activities, while Vogtle Unit 4 trended lower. At the time of the Vogtle Unit 4 10 CFR 52.103(g) finding in 2023, direct ITAAC inspection hours for Unit 4 were 32 percent under the 15,000 hours estimate, and actual program direct inspection hours for Unit 4 were 30 percent under the estimate of 10,000 hours. Also, for Unit 3, the actual reactive and allegation inspection hours were less than 15 percent of the estimated 5,000 hours, and technical support of inspections was 45 percent of the estimated 5,000 hours. The Unit 4 actual reactive and allegation inspection hours were less than 12 percent of the estimated 5,000 hours, and technical support of inspections was 28 percent of the estimated 5,000 hours.

Most of the decreases in Vogtle Unit 4 inspection hours can be attributed to the construction experience and lessons learned from Unit 3, which enabled more focused attention for inspectors on Unit 4 construction. Unit 4 also exhibited lower rates of rework than Unit 3, requiring less overall inspection hours. Interestingly, combining the actual direct inspection hours shows the overall hours to be less than the estimated values in IMC 2506 multiplied by two units. Combined, direct ITAAC inspection hours were less than 2 percent under 30,000 hours, and actual program direct inspection hours were less than 5 percent under the estimated at 20,000 hours.

In summary, resource use was generally within the established targets. The combined efforts to inspect Vogtle Units 3 and 4 were near equal to the total hours estimated for the combined units. The analyses and recommendations offered below highlight areas of improvement for future construction projects as their construction timeframes are estimated to be minimal compared to Vogtle Units 3 and 4.

Transparency in Resource Estimating and Use

The cost of regulatory construction oversight for any licensee constructing a nuclear facility is made up of hourly fees associated with 10 CFR Part 170, “Fees for Facilities, Materials, Import and Export Licenses, and Other Regulatory Services under the Atomic Energy Act of 1954, as Amended,” as licensees are billed for staff hours and contract costs incurred for licensing and oversight services. The hourly fees are for direct services to licensees and billed as hours expended at the NRC’s professional hourly rate. These include direct and indirect inspection hours and other activities, such as licensing activities that are directly associated with a licensee. Annual fees associated with 10 CFR Part 171, “Annual Fees for Reactor Licenses and Fuel Cycle Licenses and Materials Licenses, Including Holders of Certificates of Compliance, Registrations, and Quality Assurance Program Approvals and Government Agencies Licensed by the NRC,” are not assessed until the licensee notifies the NRC that it has successfully completed startup testing for the reactor. Actual fee amounts appear in the Final Fee Rule as published in the *Federal Register*.

A key industry recommendation was to track and monitor indirect as well as direct inspection hours. As shown in figure 4, the time devoted to indirect inspection activities can be greater than the time spent in direct inspection.

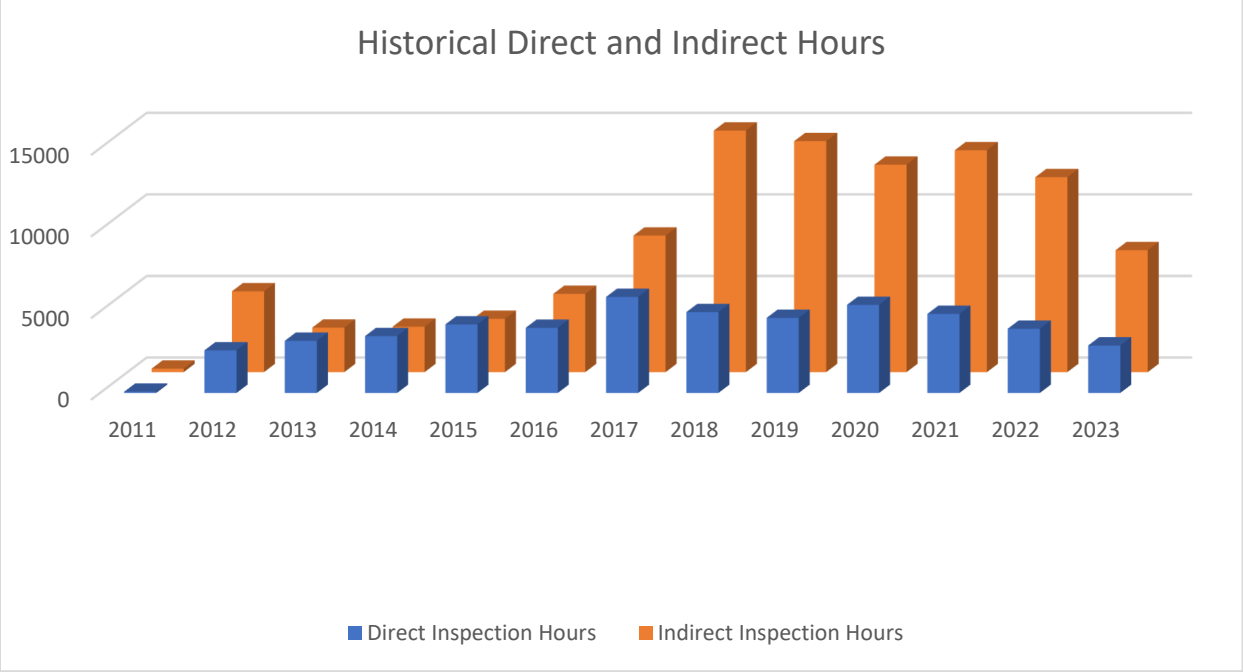

Figure 4 Historical direct and indirect charges for Vogtle Units 3 and 4

Figure 4 shows the approximate total indirect and direct hours charged during the Vogtle Units 3 and 4 construction from 2011 through mid-2023. From 2016 on, increases shown for indirect hours charged are attributable to several factors. Increases in the overall number of completed SSCs and construction activities and rework over time provided NRC direct inspection opportunities; however, project management time also increased to track an aggressive and dynamic licensee construction schedule that hindered planned ITAAC inspections. This greatly contributed to the increase of indirect versus direct inspection hours. As ITAAC inspections were planned by using an aggressive schedule that was often unrealized, the rate of delays for these inspection opportunities increased.

Also, the methodology used for tracking indirect fee-billable inspection hours early in the project made assessing the history of charges difficult. At the beginning of the construction projects, the NRC's labor hour reporting system did not provide many details on hours charged by the staff. Beginning in the fiscal year 2018, the NRC developed and implemented a standardized fee data structure to increase transparency and improve tracking/reporting of fee billable charges. As part of these changes, the NRC developed standardized cost activity codes and implemented the use of enterprise project identifiers to record and track fee-billable charges that could be assigned to specific licensing and inspection activities and were designed to be directly reflected in the licensee's invoices to provide a higher level of detail for work performed. A recommendation for future nuclear power plant construction is to establish all charge codes in advance and create a mechanism to monitor indirect and direct fee-billable hours with specific criteria by which inspectors and program staff should charge them. This preparation will lead to a readily available and continuous analysis of hours charged to the project. Thresholds should be established so that, as they are approached, managers can investigate any unanticipated resource utilization and assess whether to provide additional resources. (R.8)

Per 10 CFR Part 170.12, fees will be assessed to recover full cost for each resident inspector and senior resident inspector assigned to a specific site. This includes time spent on technical and non-technical training, attending agencywide meetings and other indirect activities. A recommendation for future construction inspection programs is to verify how many resident inspectors, if any, are needed for construction projects by considering the full-time equivalent needed to complete the inspection program and other aspects of the project, such as site location and ongoing site activities (S.26). An additional recommendation is to engage OCFO early in the project to ensure an equal focus on and awareness of the financial aspects of construction oversight. (R.9)

While some of the limited early resource data can be attributed to a lack of defined charge codes early in the project, the inspection procedures themselves allowed variances in how inspectors should charge their time. Procedures were written to provide leeway for choosing the same attributes of an inspection in different procedures. Although this allowed flexibility, it did not provide detail on when to exit the procedure. Inspection charges may have been allocated to focused areas at the choice of the inspector. Normally, inspection procedures are correlated with charge codes for inspector time-keeping practices. When using the inspection procedures for 10 CFR Part 52 construction, inspectors had multiple ways to charge, depending on what aspects of inspection they were completing. This led to anomalies in the number of hours charged for specific inspection procedures. Although the total number of hours charged was accurate, more detail would need to be collected for the number of hours clearly associated with implementing a specific inspection procedure and subsequent tracking to verify when an inspection procedure and focus area should be completed. Additionally, IMCs and inspection procedures developed for new projects should focus on clear, descriptive criteria for using a procedure. (S.11)

To assess the overall expenditure of resources for regulatory construction oversight for Vogtle Units 3 and 4, the staff analyzed the hours charged to specific charge codes set up to track fee-billable and non-fee-billable work from 2011 through mid-2023. The NRC analyzed fee-billable charges, direct and indirect inspection hours, and non-inspection-related hours for the Vogtle Unit 3 and 4 dockets, not including invoicing adjustments if any (noninspection fee-billable hours include licensing activities performed by the staff).

The staff also analyzed the cumulative, non-fee-billable charges related to programmatic and administrative activities within the agency for vendor inspection, construction inspection, and construction oversight. As a caveat, it is noted that the cumulative non-fee-billable hours were calculated by selecting the charge code descriptions that would have likely been charged for agency work supporting the Vogtle project. But there is less confidence that all the hours charged to these selected codes are fully applicable to the Vogtle project. Given these uncertainties, as of September 9, 2023, the total fee-billable hours (hourly fees paid by SNC) were approximately 320,000 (nonadjusted), and the total non-fee-billable hours (recovered through annual fees paid by operating reactor licensees) were approximately 1,080,000.

Adjusting to Changes to the Licensee's Construction Schedule

The reliability of the actual schedule proposed by the licensee is a significant factor in providing the correct inspection coverage. Toward the end of construction when an aggressive fuel load date for Vogtle Unit 3 was regularly updated and extended, the NRC staffed the inspection program to be ready to handle the NRC workload that would result from the construction schedule proposed by the Vogtle licensee. The delays in the actual construction schedule required agency management to reallocate inspection resources to other assignments in short timeframes. The WG acknowledges that a construction schedule for the first-of-a-kind nuclear facility will not have the relative certainty of familiar construction. Until there is adequate experience for constructing these new facilitates, it is challenging to rely on these new schedules for inspection planning purposes. Therefore, to assist in reducing overhead resources and oversight costs, it is highly recommended that licensees and applicants devise, review, and approve more realistic construction schedules before the agency commits resources for future construction projects. (S.27) Additionally, the combination of direct and indirect hours should be expected to increase as construction project timelines increase (for example, due to staff preparing for an inspection and then not being able to complete it as planned due to the construction activity being delayed).

To help alleviate conditions such as the overstaffing for changing construction schedules, there is significant benefit in having cross-trained inspectors. This could help optimize the time spent on site because, if certain activities are unavailable for inspection, these inspectors could be reassigned to inspect other available areas. For example, if valves are not ready to be inspected during a certain week, an inspector who is cross-trained for electrical cable installation could review separation requirements that are related to an ITAAC. Having inspectors cross-trained in more than one specialty area would increase the likelihood that an inspection would be completed efficiently, given the dynamic nature of reactor construction schedules. In the NRC's experience, as construction schedule changes occurred, the work that included a planned NRC inspection could be delayed, which led to resource inefficiencies. More accurate anticipation for the schedule dynamics could lead to better use of the staff (i.e., having cross-trained inspectors available for alternative inspections when planned inspections cannot be completed). A revision to the inspector qualification process to promote cross-disciplinary development would support a

more diverse inspection organization and improve inspection program agility and efficiency in an environment with dynamic construction schedules. (S.28)
Early during construction, potentially due to construction delays and scheduling issues, a considerable number of inspection hours were spent on construction activities with similar attributes, such as structural modules and concrete placement. With the available staff on hand, inspection opportunities led to increased efforts in these areas as significant contractor efforts were expended in those same areas. The increase in inspection hours may not have been proportional to an increase in risk or to the safety significance of the work being performed. Some inspections were completed early in this period, but field and construction changes resulted in the need for more inspections for the rework. In addition, most of these duplicative inspections that did result in actual findings were of low safety value and had no safety consequences. It is recommended that the agency plan inspection staffing levels commensurate with the available inspection activities and avoid overstaffing early for speculative construction schedules. (S.26)

A contributing factor for the conservatively high staffing at the beginning of the V.C. Summer and Vogtle projects was the agency's expectation of a "nuclear renaissance" with industry intentions to build 22 new reactors. In addition, the 10 CFR Part 52 construction process was a first-of-a-kind environment. This, combined with an agencywide effort to fully staff these important projects with quality talent, increased staffing levels that, in retrospect, could have been lower. It is recommended to plan when certain skill sets are needed for specific inspections and schedule when that work would likely occur. (S.29) For example, if onsite electrical cables are likely to be installed and tested more towards the latter part of a project, hiring could be staged, rather than engaging all disciplines at the beginning.

NRC Organizational Structure

A key success relates to the organizational structure the NRC developed to ensure regulatory activities were conducted effectively and efficiently. The NRO Division of Construction Inspection Programs (DCIP), which became VPO in NRR following the merger of NRO and NRR, was the program office for the cROP and was also responsible for licensing activities, including the review of UINs and ICNs, for Vogtle Units 3 and 4. Region II DCO implemented the cROP inspection program. Additionally, the NRC established the VRG to help better coordinate NRC activities associated with construction oversight, consistent with "Watts Bar Nuclear Plant Unit 2 Construction Lessons Learned," dated October 31, 2017 (ML17356A269), and Recommendation 10 of the "ITAAC Closure and Verification Demonstration Final Report," dated June 1, 2017 (ML17135A415). In accordance with its original charter (ML18059A273), the members of the VRG included NRO, Region II, NRR, the Office of Nuclear Security and Incident Response, and OGC. The VRG responsibilities included project plan review; NRC office coordination; communications during construction, preoperational, hot functional, and startup testing; and transition to the ROP after the initial fuel load for Vogtle Units 3 and 4. The agency revised the VRG charter in May 2019 to reflect the organizational change resulting from the merger of NRO and NRR, and again in January 2023 (ML22355A032) following the 10 CFR 52.103(g) finding on Vogtle Unit 3. This revision expanded its responsibilities to include overseeing a successful transition of both Units 3 and 4 from construction to operations.

The VRG promoted frequent and timely communication with VPO, DCO, the Office of Nuclear Security and Incident Response, and OGC about regulatory activities related to Vogtle Units 3 and 4. Many of the VRG meetings provided the inspectors' insights, which helped inform the staff's planning to ensure the right skillset inspecting the most risk-significant components at the

right time. When faced with unique challenges, such as interpreting ITAAC language, the staff used the VRG to build consensus and make risk-informed decisions. For example, when challenged with issues on cable separation that occurred in early 2021, the VRG guided a revised technical assistance request process to gain agreement on a path forward with all internal stakeholders that was both legally defensible and provided a solid regulatory basis.

One of the VRG goals was to ensure the timely resolution of complex issues and the effective communication of status across NRC offices and to NRC management, the Commission, the licensee, and other external stakeholders. To support the agency's schedule to complete certain licensing actions, and avoid perceived unnecessary delays, the NRC found that staff and management alignment are needed upfront for new reactor construction priorities. The VRG successfully promoted this position among the various NRC offices. Done "up-front," this creates an efficient method for making sure that the right technical staff is available when needed. To effectively prioritize the technical staff workload during an accelerated schedule for completing a review, the responsible senior management should clearly and repeatedly communicate to all staff the high priority for supporting licensing activities for a future plant under construction.

Additionally, in 2018, NRO/DCIP, which later evolved into VPO, and Region II DCO developed the Integrated Project Plan (IPP) as a method to status and track major construction, licensing, and inspection milestones for the newly formed VRG. Before 2018, the regulatory requirement milestones were tracked at an office level through the Transition to Operations Working Group, established in 2013. Examples of these milestones included the NRC's readiness to issue new operator licenses and provide emergency response. It was based upon the construction schedules updated by the licensee. The IPP ensured the staff proactively completed actions that were on the path leading to the 10 CFR Part 52.103(g) finding. The IPP identified critical path items where the VRG could focus resources and manage completion of those critical activities. The IPP proved successful in tracking these multiple stages. As project activities were completed, emphasis shifted to the remaining activities, and those activities were regularly reported to the VRG. This provided an up-to-date overview of the project status, allowing the VRG to successfully manage the workflow. As project milestones were achieved, continuous reporting using the IPP was no longer beneficial to the VRG and, in late 2021, with fewer items in the critical path, the staff archived and discontinued it. However, the IPP served a very important role in providing the schedule overview of numerous critical-path items. Project management tools (e.g., an IPP) should be used for key milestones and actions, then scaled back as the project nears completion. (S.30)

The WG also evaluated the effects of centralizing NRC construction inspectors in DCO in Region II. This proved to be beneficial, as it allowed NRC staff resources to readily increase or decrease as construction changed, such as when V.C. Summer ceased construction. For the Vogtle and V.C. Summer projects, having NRC's construction oversight resources centralized in one regional office versus multiple regions or offices limited staffing constraints related to allocating inspection resources to accommodate the dynamic construction schedule to only one region/office instead of spreading these challenges to multiple offices. This approach was also beneficial in ensuring consistent inspection implementation because the organization was able to fully concentrate on the construction inspection program for these units. Having a single agency point of contact for construction inspections effectively maintained the required senior management attention on emergent issues as well as facilitated stakeholder interactions. Additionally, centralization of the inspection program for Vogtle and V.C. Summer promoted knowledge transfer among inspectors, adapting lessons learned, training for new inspectors, and attracting inspectors with specialized skills that were able to support construction as well as

other essential Region II work. For future construction projects, the model of centralizing construction inspection program resources should be considered as an option (S.31).

Sharing Information with External Stakeholders

The NRC used its public website pages for the Vogtle project at https://www.nrc.gov/reactors/new-reactors/large-lwr/col-holder/vog3.html and https://www.nrc.gov/reactors/new-reactors/large-lwr/col-holder/vog4.html throughout construction to offer as much licensee and stakeholder access to information as practicable. This included ITAAC information, key licensing documents, NRC staff contact information, and other related information sources. Although the staff was diligent in maintaining the website, stakeholders expressed interest in having better access to, and more transparency on, use of indirect hours for resources expended by the staff, as well as the status of licensing actions. Within the broad landscape of advanced reactor construction, today's information-sharing capability should rely more on dashboard-style website pages that offer more real time information. These updates should reflect the theme of the August 29, 2023, Commission memorandum, "Measuring NRC Success" (ML23241B013). Such dashboards for the public website could post performance metrics and milestone schedules that measure performance on effectiveness, efficiency, and timeliness. It is also important that metrics the NRC develops to evaluate its performance not include sensitive or proprietary information. For example, the NRC should select metrics that focus on its performance, such as completion of inspections and licensing actions, rather than on the licensee's construction milestones. (S.32)

III.e. **Considerations for Future Rulemaking**

This section addresses four potential areas for future rulemaking that were encountered during AP1000 construction. Proposed rules related to three of the four areas are included in SECY-22-0052. For the area below that is not addressed in SECY-22-0052 (i.e., decommissioning funding assurance requirements), the WG recommends that it be considered in future rulemaking and/or NRC staff guidance development efforts. (S.33)

Evaluation of Milestones

Milestones within the regulations occur when certain activities are tied to regulatory requirements. Some milestones that appear in the regulations had implementation issues. For example, 10 CFR 26.3(a) requires, in part, after the Commission has made the 10 CFR 52.103(g) finding, that licensees comply with the requirements of 10 CFR Part 26, "Fitness for Duty Programs," except Subpart K, "FFD [Fitness for Duty] Programs for Construction," and implement the FFD program no later than receipt of special nuclear material (SNM) in the form of fuel assemblies. By letter dated November 5, 2021 (ML21309A545), as supplemented by letter dated November 12, 2021 (ML21316A254), SNC requested a schedular exemption from the requirements of 10 CFR 26.3(a) to allow SNC to begin implementing an FFD program that meets all 10 CFR Part 26 requirements, except for those requirements in Subpart K, for each unit, at a point after the Commission makes its finding under 10 CFR 52.103(g) and prior to the start of that unit's initial fuel load into the reactor, and a schedular exemption from 10 CFR 26.3(c)(2) to allow SNC to implement the construction FFD program after the 10 CFR 52.103(g) finding for each unit and before the start of that unit's initial fuel load into the reactor. The NRC staff approved the exemption (ML21334A417) on December 21, 2021. Additionally, as discussed in SECY-22-0052, the NRC staff proposes to amend 10 CFR 26.3(a) and (c) and 26.4(e)(1) to permit a licensee to delay the implementation of an FFD program that meets all Part 26 requirements except those in Subparts I and K before

initial fuel load into the reactor because this operational milestone corresponds more closely to the start of NRC-licensed activities that could result in consequences adverse to public health and safety or the common defense and security than does the receipt of nuclear fuel onsite.

Emergency Preparedness Exercises

Requirements in 10 CFR Part 50, Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities," Section IV.F.2.a, can be improved to gain efficiency when a new reactor is being licensed at a site that includes one or more operating reactor(s). In SECY-22-0052, the staff proposes changes that would eliminate the requirement in IV.F.2.a.(iii) for licensees to conduct emergency planning exercises for each new reactor constructed on a site that has an operating reactor if they have the same emergency plan features, capabilities, and resources (e.g., same reactor technology, equipment, facilities, emergency response organizations and procedures). This revision would enhance the regulations such that the exemption that was issued for Vogtle Unit 4 (ML20126G294) would not have been necessary.

Decommissioning Funding Assurance Requirements

Decommissioning funding assurance requirements are in 10 CFR 50.75, "Reporting and recordkeeping for decommissioning planning." One of the methods of providing financial assurance for decommissioning is through an external sinking fund, which is defined in 10 CFR 50.75(e)(1)(ii) as "a fund established and maintained by setting funds aside periodically in which the total amount of funds would be sufficient to pay decommissioning costs." In part, 10 CFR 50.75(e)(3) states the following (emphasis added):

> No later than 30 days after the Commission publishes notice in the *Federal Register* under 10 CFR 52.103(a), the licensee shall submit a report containing a certification that financial assurance for decommissioning **is being provided** in an amount specified in the licensee's most recent updated certification, including a copy of the financial instrument obtained to satisfy the requirements of paragraph (e) of this section.

On March 3, 2020, SNC, on behalf of itself and the co-owners, submitted "Vogtle, Units 3 and 4 - Financial Assurance Requirements for Decommissioning" (ML20099E527) to comply with 10 CFR 50.75(e)(3). Following submittal of SNC's report, the staff issued a request for additional information (RAI) to SNC (ML22336A167). The RAI requested that each owner provide a schedule of future contributions to the external sinking funds for Vogtle Units 3 and 4 that would meet the minimum funding amounts defined in 10 CFR 50.75, and that licensees confirm that initial contributions have been made to the external sinking funds for each unit. If the external sinking funds maintained a zero balance, the RAI requested formal commitments from the rate-setting authority to fund the external sinking funds. In the absence of a formal commitment, the RAI requested a detailed discussion regarding the process and timeline for each owner's interaction with the rate-setting authority to obtain official commitments to fund the external sinking funds. SNC's response to the RAI (ML23030B913) provided the requested information but also stated, "SNC's position is that an initial deposit and/or regulator-approved collection schedule prior to fuel load and commercial operations is not required by NRC regulations." Accordingly, there is an opportunity to clarify what licensees need to provide to meet 10 CFR 50.75(e)(3).

The NRC states, in 10 CFR 50.75(f)(1), that biennial reports that provide a schedule of contributions are required starting after the 10 CFR 52.103(g) finding. 10 CFR 50.75(f)(1) goes on to specify the minimum amount of information that must be included in these biennial reports:

> The information in this report must include, at a minimum, the amount of decommissioning funds estimated to be required pursuant to 10 CFR 50.75(b) and (c); the amount of decommissioning funds accumulated to the end of the calendar year preceding the date of the report; a schedule of the annual amounts remaining to be collected; the assumptions used regarding rates of escalation in decommissioning costs, rates of earnings on decommissioning funds, and rates of other factors used in funding projections; any contracts upon which the licensee is relying pursuant to paragraph (e)(1)(v) of this section; any modifications occurring to a licensee's current method of providing financial assurance since the last submitted report; and any material changes to trust agreements. If any of the preceding items is not applicable, the licensee should so state in its report.

To provide better clarity on the information required to meet 10 CFR 50.75(e)(3), the staff should evaluate whether rulemaking or revisions to NRC guidance is needed (e.g., by revising 10 CFR 50.75(e)(3) to specify the minimum information needed, similar to that in 10 CFR 50.75(f)(1)).

Establishing the Protected Area at the Plant

Following multiple inquiries from SNC and SCE&G regarding the possible timing for establishing an operational protected area (i.e., implementation of the security requirements of 10 CFR 73.55, "Requirements for physical protection of licensed activities in nuclear power reactors against radiological sabotage") to protect reactor fuel received onsite before the 10 CFR 52.103(g) finding, the NRC sent a letter on April 13, 2017 (ML17074A370), to provide clarification. The NRC's position was that licensees may declare the protected area as operable before the 10 CFR 52.103(g) finding; to do so, however, licensees need to (1) ensure that all the elements of their security plans required by 10 CFR 73.55 are implemented or that compensatory measures that meet the requirements of 10 CFR 73.55(o) have been implemented, (2) ensure all the SSCs necessary to meet the 10 CFR 73.55 requirements are in operable condition, and (3) satisfy the physical security ITAAC related to the physical protection program and submit the ITAAC closure notifications for those ITAAC.

The NRC's April 13, 2017, letter states that an alternative option would be to implement the site's plan in 10 CFR 73.67, "Licensee fixed site and in-transit requirements for the physical protection of special nuclear material of moderate and low strategic significance"; however, the protected area would have to be declared as operable when the 10 CFR 52.103(g) finding is made. SNC requested a public meeting to further discuss the topic, as its position was that licensees could establish an operational protected area after the 10 CFR 52.103(g) finding but before initial fuel load. The NRC staff did not agree that SNC could delay implementation of 10 CFR 73.55 requirements after the 10 CFR 52.103(g) finding is made without an exemption request. After several discussions on the topic, SNC submitted an exemption request (ML21305B797) that was approved in November 2021 (ML21320A041). As discussed in SECY-22-0052, the NRC staff has proposed revising 10 CFR 73.55(a)(4) to require implementation of the regulatory requirements of 10 CFR 73.55 (i.e., declaration of the protected area) prior to initial fuel load.

IV. SUMMARY OF RECOMMENDATIONS AND SUGGESTIONS

The potential improvements (i.e., recommendations and suggestions) presented in this report aim to promote a smarter and more efficient construction inspection program for future applications. Recommendations are intended for actions that the working group identified as more important to the success of future construction oversight activities. Suggestions represent additional enhancements intended to support the recommendations. The table below summarizes the recommendations and suggestions.

Recommendations	
R.1	Those developing program requirements (e.g., the designated NRC program office) should ensure there is flexibility to select a representative sample of inspections throughout any construction area and not require preselected ITAAC to make up the baseline inspections. This will promote more agile inspection coverage for activities during construction (i.e., quality assurance during the design, fabrication, manufacture, construction, and testing of plant structures, systems, and components) while continuing to maintain reasonable assurance that facilities are built and will operate in accordance with their approved designs and licensing bases.
R.2	Ensure clarity of the scope of each ITAAC, providing clear acceptance criteria with appropriate flexibility, and defining terminology in the ITAAC will help to ensure that the licensee and the NRC have a common understanding of how the ITAAC will be met. Demonstration projects, weekly public meetings, and tabletops with the licensee; reviewing the early-submitted uncompleted ITAAC notifications; and implementing the suggestions related to ITAAC improvements will help clarify the scope of ITAAC, ensure mutual understanding of the method the licensee would use to close the ITAAC, and identify and resolve issues.
R.3	For future construction projects, the NRC staff designated to implement the construction inspection program should shift to a plan that is more focused on inspecting the safety related activities during construction. This approach does not mandate specific ITAAC inspection completion, but instead ITAAC could be selected as part of a risk informed sampling method. This will promote the efficient use of resources while continuing to maintain reasonable assurance that facilities are built and will operate in accordance with their approved designs and licensing bases.
R.4	Although it is critical to have resources available so as not to impede the licensee's construction schedule, this approach can result in fee-billable charges that are higher than expected. For future construction projects, the NRC should consider a flexible staffing model that can more readily adapt to the dynamic nature of construction. This could be achieved through inspection planning that allows a more agile approach as well as having cross-trained inspectors who can support not only multiple disciplines throughout the construction project but also other divisions.
R.5	The NRC should evaluate whether changes to fee billing requirements would be feasible, appropriate, and improve efficiency while facilities are under construction.

R.6	Considering each licensee's or applicant's needs and resources, provide methods for ensuring effective and timely communication to resolve issues. Methods should include facilitating regular stakeholder interactions, such as workshops, to incorporate external ideas into a construction oversight program.
R.7	The NRC will need to continue to identify those activities that will benefit from dedicated resources and allow resources to be assigned as priorities are adjusted. Senior management should clearly communicate priorities to the staff, particularly as priorities change, and continue to implement strategies to manage competing priorities. This will be critical for multiple projects occurring at the same time. The NRC should also continue to implement review strategies, including assignment of staff resources, to reviews of licensing actions based on their complexity and consideration of how to most efficiently conduct the reviews.
R.8	The NRC should continuously estimate and monitor the total cost to the licensee and assess the efficient use of hours (e.g., estimate licensing hours, track direct and indirect inspection hours, and use fee billing data to evaluate total costs). It is important that the cost activity codes and enterprise project identifiers are sufficiently detailed to allow managers to understand the amount of resources being used for each activity in order to provide for adequate oversight of resource use from the beginning to the end of the project. Thresholds should be established so that, as they are approached, managers can investigate any unanticipated resource utilization and assess whether to provide additional resources.
R.9	The WG acknowledges that it may not be feasible or necessary to establish a readiness group like the VRG for future nuclear power plant construction projects, particularly if there are multiple, simultaneous projects. However, the NRC should continue to proactively identify and promptly resolve licensing, inspection, or regulatory challenges or gaps that could unnecessarily impact the schedule for completion of future nuclear facilities. Mechanisms should be established, appropriate to the scale and scope of future construction projects, to ensure partner offices are engaged to facilitate the resolution of issues encountered during construction and to ensure dedicated resources and proper priority are assigned for tasks related to projects of high priority. The NRC's Office of the Chief Financial Officer should be included as a partner office to ensure an equal focus on and awareness of the financial aspects of construction oversight and as needed to effectively implement R.8.
Suggestions	
S.1	Coordinate and align ITAAC acceptance criteria with technical codes and standards, such as ensuring that those codes and standards of the FSAR are correctly reflected or cross-referenced in the ITAAC's acceptance criteria.
S.2	Continue use of minor ITAAC inspection findings to avoid having the licensing aspect and wording of the ITAAC far outweigh the safety significance of the finding.
S.3	Establish clear and well-defined terminology supporting each test and inspection in the ITAAC and ensure that an "as-built" inspection is feasible.

S.4	Encourage early UIN reviews to prepare for an ICN surge during the latter parts of construction, when simply comparing an ICN against its UIN is an efficient method to spot any notable changes. The “early” reviews of UINs provide an opportunity for the staff to review the ITAAC closure methodology and discuss it with the licensee to ensure that there is a mutual understanding of the methods used to close the ITAAC and that the methodology is acceptable to the staff.
S.5	Right-size ITAAC and eliminate redundant ITAAC during development of the ITAAC and COL issuance.
S.6	Select methods for endorsing and updating NRC guidance that can capture needed changes on a timeframe that will benefit current and future users of the guidance.
S.7	Future efforts to revise RG 1.215 or any other NRC guidance related to ITAAC should evaluate the examples resulting from this lessons learned effort for inclusion in future revisions, as appropriate.
S.8	For smaller construction projects, like SMRs, consider (1) planning inspections based on the available inspection hours per quarter and issues such as the most significant items to review during that time; (2) grouping ITAAC by common attributes and general construction areas for available inspections to promote a more flexible and risk-informed approach; and (3) not tying inspection activities to the licensee’s schedule.
S.9	Promote demonstration projects and tabletop exercises for large or complex reactor construction that will exercise complex first-of-a-kind processes and long-lead inspections, such as the demonstration conducted by the staff to test the ICN review process.
S.10	Include provisions in future construction oversight projects to enable the sampling band to more easily increase or decrease in response to licensee performance, as well as evaluate a project’s overall QA performance, while still reperforming appropriately scoped inspections if major changes in management or contractors occur during the project and additional inspections are needed to reestablish reasonable assurance in QA.
S.11	For future projects, adjust the original inspection procedure hour estimates to align with past oversight performances and provide greater clarity on when to use each inspection procedure to ensure better tracking of hours spent for each procedure.
S.12	Develop guidance to help prioritize what construction inspection activities must be conducted onsite through visual inspection (for example, by identifying attributes for consideration, such as uniqueness, first of a kind activities, and significant activities that the construction process made inaccessible), consistent with guidance that may be developed for the ROP to implement recommendations resulting from the NRC’s COVID-19 lessons learned effort.
S.13	Consider which operational program inspection procedures need implementation samples versus having the implementation portion of the inspection completed through normal ROP inspections.
S.14	Provide an SL IV example in a future revision to the Enforcement Policy (e.g., for situations where an ITAAC notification letter is submitted but does not require the NRC to reconsider a regulatory position or undertake a substantial further inquiry) to help differentiate when escalated enforcement is warranted.

S.15	Change the cSDP for determining the significance of construction findings to promote a risk-informed, safety-focused inspection and enforcement process, such that time spent by the NRC and the licensee is in proportion to the safety and risk significance of the SSC, along with the potential to have remained undetected and impact plant operations, and results in escalated enforcement only when warranted.
S.16	Closely coordinate vendor inspection and construction inspection to ensure the licensing compliance implications of vendor findings are fully understood by overall project oversight management.
S.17	Ensure adequate staffing, including tiger team structure, and training for allegation processing during new construction projects.
S.18	Provide outreach to Appendix B-approved vendors of safety-related SSCs regarding the allegations process, such as reminding them of required onsite postings promoting employee awareness, and stress that licensees are responsible for the quality assurance program, including contractor adherence to regulatory requirements passed down in purchase orders.
S.19	Future construction oversight programs should consider a system of more continuous assessment and the public communications associated with them.
S.20	Consider establishing an inspector exchange program, as applicable, with international regulators, when the same or similar types of nuclear plants are being built, to allow key lessons to be implemented in NRC IMCs, inspection procedures, inspection planning, possible credit inspections (like AP1000 FPOTs), and simulator and training development.
S.21	Explore expanding VLSSIR to potential non-ITAAC construction findings and use the risk insights from the VLSSIR process to inform the level of effort and time expended determining whether acceptance criteria are met for issues that would not be greater than green or SLIV significance.
S.22	Carefully select what information should be Tier 2* in future design certifications to reduce the number of unnecessary LARs for non-safety -significant changes.
S.23	To facilitate a timely 10 CFR 52.103(g) finding for future projects licensed under 10 CFR Part 52, follow and maintain the processes in NRR-LIC-114/NRO-REG-106.
S.24	Consider whether it would be appropriate to identify startup TS that become effective only after achieving initial criticality, recognizing the reduced hazard presented by a core that has not gone critical.
S.25	For future projects, licensees and the NRC staff should discuss how required information can be submitted efficiently and effectively and select a method to do so.
S.26	Verify the number of residents and regional inspection staff needed for a new nuclear construction project to limit overstaffing.
S.27	Recommend that licensees and applicants devise, review, and approve more realistic construction schedules before the agency commits resources for future construction projects.
S.28	Consider revising the inspector qualification process to promote cross-disciplinary development to support a more diverse inspection organization.

S.29	To avoid inefficient use of inspection resources during construction, plan for and schedule the staffing of certain skill sets for specific inspections based on when that work would most likely occur in the construction project.
S.30	Project management tools, such as the IPP, should be used for key milestones and actions, then scaled back as the project nears completion.
S.31	For future construction projects, the model of centralizing construction inspection program resources should be considered as an option.
S.32	Provide dashboards for the public website that include NRC performance metrics and milestone schedules for future construction projects.
S.33	In future rulemaking efforts and/or NRC staff guidance development, consider the suggestions related to decommissioning funding assurance requirements discussed in section IV.