



POLICY ISSUE

(Notation Vote)

June 7, 2022

SECY-22-0053

FOR: The Commissioners

FROM: Daniel H. Dorman
Executive Director for Operations

SUBJECT: RECOMMENDATION FOR MODIFYING THE PERIODICITY OF REACTOR
OVERSIGHT PROCESS ENGINEERING INSPECTIONS

PURPOSE:

This paper requests Commission approval of the U.S. Nuclear Regulatory Commission (NRC) staff's recommendation for improving the effectiveness and efficiency of the NRC engineering inspections currently being conducted as part of the Reactor Oversight Process (ROP) by transitioning to a quadrennial inspection cycle comprising one comprehensive engineering team inspection (CETI) and three focused engineering inspections (FEIs).

SUMMARY:

This paper outlines the NRC staff's recommendation to improve the effectiveness and efficiency of engineering inspections within the ROP by transitioning to a quadrennial inspection cycle. The paper is the product of a comprehensive, multiyear staff assessment of NRC engineering inspection activities conducted at reactor plant sites. If the Commission approves the change in the inspection cycle, then the staff will review the effectiveness of this change and evaluate whether the agency should make any additional changes to the engineering inspection program to further improve the effectiveness of the ROP consistent with the requirements outlined in Inspection Manual Chapter 0307, "Reactor Oversight Process Self-Assessment Program."

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In developing this recommendation, the staff reviewed the current engineering inspection process and evaluated different approaches, including leveraging performance indicators to reduce the number of direct inspections and improving the effectiveness of direct inspections.

The staff also communicated extensively with members of the public and the nuclear industry. Feedback from external stakeholders on potential changes to the ROP engineering inspection program was generally favorable.

Before submitting this paper, the staff evaluated the same information used to develop SECY-18-0113, "Recommendations for Modifying the Reactor Oversight Process Engineering Inspections," dated November 13, 2018 (approval for withdrawal granted August 5, 2021). In SECY-18-0113, the staff recommended (1) modifying engineering inspection frequency from a 3-year cycle to a 4-year cycle, (2) consolidating or eliminating several inspection activities and creating new inspection activities, and (3) focusing inspections on operating experience, aging management, and facility changes. The staff examined findings and operational experience gathered in the 3 years since development of SECY-18-0113. The staff also reengaged the industry and public on the topic of this paper during monthly ROP public meetings. Based on these efforts, the staff continues to recommend changing the engineering inspections from the current 3-year cycle to a 4-year cycle that was originally outlined and recommended in SECY-18-0113.

BACKGROUND:

Implementation of the ROP for operating light-water reactors relies on the completion of a number of baseline engineering inspection procedures (IPs). NRC engineering inspections are designed, in part, to verify that licensee engineering activities do not inadvertently introduce latent conditions (e.g., unknown design deficiencies) into structures, systems, or components (SSCs) that are important to safety. In certain instances, latent conditions are not readily identifiable through routine operations or testing but could adversely impact SSCs during design-basis accidents. While the primary focus of NRC engineering inspections remains unchanged, inspections have evolved as the NRC has gained insights through actual events and inspection findings. As a result, sample selection has shifted since the 1990s from verifying compliance with the original plant design bases to inspecting licensee performance in maintaining risk-significant equipment in accordance with the design bases and consistent with assumptions in probabilistic risk models. As needed, the staff has developed new inspections as plant designs and plant operational philosophies changed. The enclosure provides a brief history of engineering inspections at the NRC.

During the internal development of the agency's fiscal year (FY) 2018 and FY 2019 budgets and as part of agency transformation initiatives, the Commission supported the staff's proposal to evaluate existing inspection focus areas to determine whether any inspection activities could be eliminated, better prioritized, more effectively conducted, or changed through a combination of these activities. One result of these efforts was the proposals outlined in SECY-18-0113. Later, in July 2019, the industry and the NRC ceased the initiative outlined in SECY-18-0113 to develop a licensee self-assessment approach to supplement or replace selected engineering inspections, and the staff subsequently stopped any activities to consider that approach. The staff formally communicated this decision to the Commission in December 2019. On August 5, 2021, the Commission approved the staff's request to withdraw SECY-18-0113 based on new information and additional staff activities (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21217A284).

In developing this paper, the staff reconsidered the various changes to the NRC engineering inspection program recommended in the “Discussion” section of SECY-18-0113. These included (1) changing the engineering inspections from the current 3-year cycle to a 4-year cycle, (2) consolidating inspections by eliminating several inspection activities and combining them into two new types of inspections, a CETI and an FEI, and (3) focusing inspection on operating experience, aging management, and facility changes. This paper presents the results of the staff reevaluation of the 4-year inspection cycle recommendation in SECY-18-0113 and reflects the latest status of staff activities.

Because the staff has determined that changing the periodicity of ROP engineering inspections is a significant change, in accordance with Section II.I of the Handbook for Management Directive (MD) 8.13, “Reactor Oversight Process,” dated January 16, 2018, the staff is presenting this ROP change to the Commission for approval before implementation.

The CETIs represent the latest iteration of design-focused engineering inspections that the staff has performed at nuclear power plant sites since the first Safety System Functional Inspection efforts that began in 1985. Although engineering inspection attributes have changed in response to industry events, operating experience, and insights from probabilistic risk assessments, the staff continues to believe that periodic design reviews of safety systems and their supporting components are needed to verify that the assumptions contained in plant final safety analysis reports and technical specifications are adequately maintained.

The FEIs represent a family of inspections that are focused on current licensee activities while incorporating reviews of aging management, operating experience, changes, and risk insights. These inspections are used to verify that safety objectives and regulatory requirements are implemented in risk-significant technical areas by a licensee and would not be full reviews of an approved licensee program. The FEIs are not programmatic inspections; rather, they are intended to verify the licensee’s implementation of their engineering programs. Before implementation, specific technical and regulatory training is provided to NRC inspectors, including licensing and design-basis considerations, to ensure reliable and consistent implementation of each new type of FEI. The FEIs allow the NRC to perform risk-informed inspections of other engineering areas based on operating experience, risk significance, and the period of time that has passed since an area was last inspected.

The staff provided further information on its overall evaluation of these proposed changes in SECY-18-0113. The 2018 paper discussed the staff’s assessment and consideration of performance indicators in regard to the ROP and discussed in detail recommended changes to engineering inspections themselves, specifically the transition to the CETI that combines IP 71111.21M, “Design Bases Assurance Inspection (Team),” dated December 8, 2016; IP 71111.17T, “Evaluations of Changes, Tests, and Experiments,” dated December 8, 2016; and IP 71111.07, “Heat Exchanger/Sink Performance,” dated December 8, 2016 (triennial heat exchanger inspections portion only). Although this combination of inspections maintains the same inputs into the ROP, it is considered a major IP change. As such, the staff will inform the Commission of this change through a Note to Commissioners’ Assistants 14 days before implementation, in accordance with Section I.2 of MD 8.13. The staff also plans to change the name of IP 71111.21N, “Design Bases Assurance Inspection (Programs),” dated February 5, 2019, to “Focused Engineering Inspection,” as discussed in SECY-18-0113. The staff plans on implementing these changes in the inspection cycle beginning in January 2023.

DISCUSSION:

The primary engineering inspection, the Design Bases Assurance Inspection (Teams) (IP 71111.21M) and its predecessors, focuses on high-risk components, using standardized plant analyses risk models as well as any other risk insights to select samples. As such, over the past 20 years, inspectors have inspected most of the highest risk components at sites multiple times.

When originally developing the engineering inspection approach recommended in SECY-18-0113, the staff looked for internal and external feedback on engineering inspections and asked, “How can we reduce the amount of engineering inspection resources needed by licensees and the NRC to support the engineering inspections while still maintaining the necessary levels of reactor safety oversight?” Based on that feedback, the staff concluded that combining various engineering inspections into the CETI should result in more effective and efficient engineering inspections. The proposed CETI will maintain essentially the same amount of inspection activities while eliminating unnecessary indirect inspection-related activities, such as inspectors taking multiple trips to a site to conduct three separate and potentially overlapping inspection activities. At times, these indirect activities can be very resource intensive, especially for sites that are located far from regional offices. All three options presented in this paper will ensure effective NRC oversight of licensee engineering programs by performing one engineering inspection per year,¹ either a CETI or an FEI.

After assessing various alternatives, the staff determined that increasing the interval between design bases assurance team inspections will allow more time to implement modifications or other changes to systems that affect high-risk components, and thus will broaden the range of opportunities to assess licensee engineering program performance. The extra year in the proposed cycle would also provide an opportunity for the NRC to inspect another specific engineering program area by adding an additional FEI.

Stakeholder Interaction

The staff conducted broad outreach on the engineering inspection program while developing SECY-18-0113. After withdrawing that paper, the staff reengaged the industry and public during monthly ROP public meetings in September 23, 2021 (ADAMS Accession No. ML21266A116), and December 2, 2021 (ADAMS Accession No. ML21334A516), to discuss the proposed submittal of this paper. During the December ROP public meeting, the industry recommended eliminating triennial fire protection inspections (IP 71111.21N.05, “Fire Protection Team Inspection (FPTI),” dated June 12, 2019). After evaluating the proposal, the staff concluded that the NRC did not have compelling information to eliminate or reduce the scope of engineering inspection activities due to the risk significance of fire events. Accordingly, the staff determined FPTIs would continue to be performed as FEI activities, unless there was a compelling reason to defer the inspections, such as risk considerations. Otherwise, the industry and public were supportive or silent on the staff’s proposed recommendations.

The staff also interacted with internal stakeholders from the regions and technical divisions within NRC Headquarters, soliciting specific feedback throughout the past 3 years as well as holding an engineering inspection counterpart meeting in December 2021. Although some

¹ The staff recommends conducting one engineering inspection per year; however, some variability may occur due to outage scheduling and resource availability.

internal feedback recommended no changes to the current inspection program, overall there was broad support for the planned changes to the engineering inspection program and the recommendations below.

Increasing Effectiveness and Efficiency of Engineering Inspections

As discussed previously in SECY-18-0113, engineering inspections serve an important role in the ROP. In particular, engineering inspections enable the NRC to verify safety system capability under accident conditions that do not reveal themselves through routine testing or plant operation; performance indicators do not serve as a substitute for engineering inspections because they do not lend themselves to measuring licensee performance under accident conditions. To increase effectiveness, the staff took the following steps to develop potential options for the new ROP engineering inspections:

- It identified licensee activities that affect the capability of SSCs.
- It verified engineering areas that the NRC should be inspecting based on plant risk and operating experience.
- It reviewed selected engineering IPs listed in the Engineering Inspection Working Group (EIWG) charter (ADAMS Accession No. ML17172A620) to evaluate why the agency performs each inspection and to identify both areas for increased emphasis and areas where there are overlaps in the current engineering inspections.

The staff reviewed not only the scope of engineering activities but also the periodicity with which they are conducted to determine whether the inspections occur at an appropriate frequency.

The staff developed the three options described below for Commission consideration for the periodicity of the revised ROP engineering inspection program. Each option incorporated the new CETI and FEI procedures with planned implementation in the inspection cycle beginning in calendar year (CY) 2023 and only varied the length of the engineering inspection cycle (3–5 years). When developing options, the staff did not consider the possibility of conducting FEI inspections less frequently than annually. The staff considered it important to continue annual engineering inspections at each site in order to have opportunities for more timely assessment of current licensee performance. In addition, based on public interactions, the EIWG found that the annual engineering inspection feature of the ROP was very important to public stakeholders. The staff also incorporated continued inservice inspection activities to be performed at each reactor unit during each refueling outage. This remains unchanged and is not impacted by any of the three options for the engineering inspection cycle.

Options for Engineering Inspection Cycle

For the first cycle, under each option, the staff intends to conduct a fixed approach to the engineering inspection program. This means that each site would receive one CETI and the same FEIs throughout the 3, 4, or 5-year cycle. Figures 1 through 3 show the three options considered. “BI” stands for baseline inspection, and the number associated with BI is an estimate of inspection hours needed to complete the inspection. The BI does not include the inspection hours associated with preparing for inspections or documenting inspection results. The BI hours to accomplish the CETI have changed significantly from the staff’s description in

SECY-18-0113 because of a transition away from using contractors to using NRC inspectors. The BI is now estimated to be 490 hours.²

For efficiency in scheduling resources, the staff will conduct a CETI and the appropriate number of FEIs in a rotating manner, as illustrated for a 3-year cycle in Table 1.

Table 1 Rotation of CETI and FEI Inspections

Location	Year 1	Year 2	Year 3
Site A	CETI	FEI #2	FEI #1
Site B	FEI #1	CETI	FEI #2
Site C	FEI #2	FEI #1	CETI

Option 1: The staff would maintain the engineering inspection cycle at 3 years, with one engineering inspection performed each year. The three inspections would include one CETI and two different FEIs.

Option 1 reflects an annual overall resource savings of approximately 8.1 percent to conduct engineering inspections due to efficiencies gained in adjustments in the types of inspections upon transition to the new CETI and FEI procedures planned to begin in 2023. Figure 1 shows Option 1.



Figure 1 Graphical representation of a triennial ROP engineering inspection program

Option 2: The staff would increase the engineering inspection cycle to 4 years, with one engineering inspection performed each year. The four inspections would include one CETI and three different FEIs over the 4-year inspection cycle.

² In 2019, NRC management decided to transition from the use of contractor inspectors during routine IP 71111.21M inspections. Historically, during each IP 71111.21M inspection, each inspection team was supplemented with two contract inspectors, a mechanical expert, and an electrical expert. The BI hours described in the IP did not count the inspection hours for these contractors. With two NRC inspectors replacing the two contractors, the accounting for BI hours will indicate an increase of 140 hours, although actual inspection resources needed to conduct an IP 71111.21M did not change. Similarly, with the proposed CETI, BI hours will increase to 490 hours, with no actual change in inspection resources needed to conduct the inspection.

Option 2 reflects an annual inspection resource savings of approximately 15.2 percent, due to efficiencies gained in adjustments in the types of inspections and due to an additional year with a less resource-intensive FEI before the next CETI. Figure 2 shows Option 2.

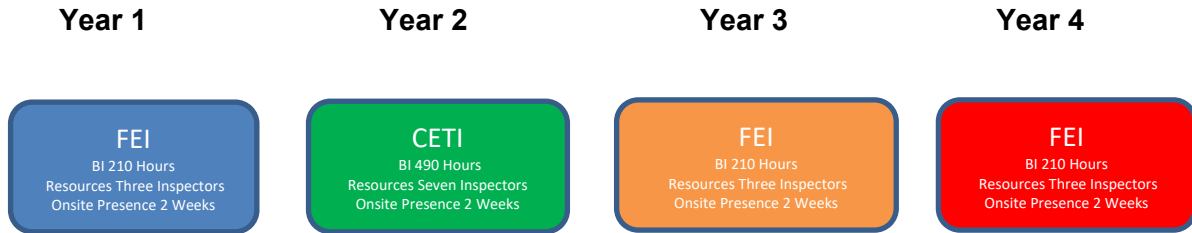


Figure 2 Graphical representation of a quadrennial ROP engineering inspection program

Option 3: The staff would increase the engineering inspection cycle to 5 years, with one engineering inspection performed each year. The five inspections would include one CETI and four different FEIs during the 5-year inspection cycle.

Option 3 is the industry’s recommendation for future ROP engineering inspections and results in an annual inspection resource savings of approximately 19.4 percent, due to efficiencies gained in adjustments in the types of inspections and due to an additional 2 years with less resource-intensive FEIs before the next CETI. Figure 3 shows Option 3.



Figure 3 Graphical representation of a quinquennial ROP engineering inspection program

Evaluation of Options for Timing of Engineering Inspections

The major difference between the three options is how often inspectors perform each type of inspection (i.e., the cycle length). As part of its assessment, the staff considered possible advantages and disadvantages of extended cycle lengths. As discussed below, the staff recommends Option 2 as representing the optimum balance between effectiveness and efficiency gains. Representatives from nongovernmental organizations recommended that the current suite of ROP engineering inspections should not change.

Option 1 Evaluation: This option represents no change to the planned ROP engineering inspection program periodicity.

Performing the CETI procedure once every 3 years would allow the inspectors to focus on the most recent plant performance, which some inspection staff noted as a benefit. However, feedback from some inspection staff has identified that there are fewer risk-significant activities available to the sample in a 3-year period as compared to longer periods. Therefore, the staff does not recommend Option 1, because the scope and frequency of the changes being made to safety-related SSCs did not appear to warrant continuance of the current triennial CETI frequency.

Option 2 Evaluation: The staff concluded that extending the cycle length to 4 years is the preferred method for validating licensee compliance with NRC requirements in the engineering area. Industry performance over the past 21 years of ROP implementation indicates that the change to the inspection cycle length could be implemented without adversely affecting the NRC's ability to independently validate licensee engineering performance. Specifically, as the inspection focus has shifted from verifying the licensee's adherence to its approved original plant design to inspecting the licensee's performance in maintaining equipment to meet design- and licensing-basis functions, it is no longer necessary to perform comprehensive inspection activities every 3 years. Moreover, by increasing the inspection cycle to 4 years, the inspectors are anticipated to have a greater population of inspection samples available for selection during comprehensive CETIs.

In regard to the timely assessment of licensee performance, the staff determined that the format for the engineering inspections, in combination with an extended inspection cycle, would enhance the effectiveness of the overall engineering inspection program. The staff determined that through the completion of annual onsite engineering inspections (i.e., a CETI or an FEI) and the opportunity for the NRC to inspect another specific engineering program area by adding an additional FEI, extending the cycle length would not have an impact on the ability of the ROP to provide objective evidence that risk- or safety-significant SSCs would remain capable of performing their intended safety functions. This option would also result in a more efficient overall engineering inspection program, allowing for an additional approximately 7-percent savings in inspection effort over the efficiencies gained from implementing Option 1. As a result, the staff recommends implementing Option 2.

Option 3 Evaluation: Extending the engineering inspection cycle to 5 years would result in an additional approximately 4-percent reduction in inspection effort over the efficiencies gained from implementing Option 2. The staff identified two areas that could be affected as a result of extending the inspection cycle to 5 years. Extending the cycle length beyond 4 years would make it more challenging to ensure that a sufficient number of inspectors have received specialized training in the four different focus areas. Additionally, through interactions with both internal and external stakeholders, the staff concluded that extending the periodicity between CETI inspections to once in 5 years would challenge the staff's ability to identify potentially declining engineering performance in a timely fashion. As a result, the staff does not recommend Option 3.

Table 2 summarizes the effects of the three options.

Table 2 Comparison of Options¹

Item Description	Option 1	Option 2	Option 3
ROP Engineering Program Impact	Minimal	Moderate	High
Percentage Change in Direct Inspection Resources	8.1-Percent Decrease	15.2-Percent Decrease	19.4-Percent Decrease
Changes to Full-Time Equivalent (FTE)	1 FTE Decrease	2 FTE Decrease	2+ FTE Decrease
Sample Availability	No Change	Improved	Improved
NRC Staff Impact	Minimal	Minimal	Minimal

¹ Change comparing option to legacy inspection program (before transition to CETI/FEI). In 2019, NRC management decided to transition from the use of contractor inspectors during routine IP 71111.21M inspections. Historically, during each IP 71111.21M inspection, each inspection team was supplemented with two contract inspectors, a mechanical expert and an electrical expert. The direct inspection hours described in the IP does not count the resources for these contractors, but the calculation for change in resources and FTE was adjusted to include inspection hours accomplished by contractors.

RECOMMENDATION FOR THE COMMISSION:

The staff recommends that the Commission approve the following proposed change to the engineering inspection program:

- Transition to a quadrennial inspection cycle (i.e., one CETI and three FEIs per cycle, Option 2).

The staff believes that Commission approval of the recommendation discussed in this paper is prudent for the following three reasons:

- (1) The changes will allow the staff to examine an additional engineering area based on risk significance, operating experience, and regulatory framework while still maintaining the necessary levels of safety oversight of licensee engineering program implementation.
- (2) The change will maintain, and in some areas improve, the effectiveness and efficiency of the NRC engineering inspection program by providing more risk-significant samples for the CETIs while reducing the amount of overall resources needed to implement the program.
- (3) The change has received overall broad support from both internal and external stakeholders.

If the Commission approves this change, the staff will implement the approved cycle length as part of the planned implementation of the new engineering inspection program in CY 2023. This will allow time to complete the current engineering inspection program, allow for development of the new engineering IPs, and provide time for training NRC inspectors on the new engineering IPs.

RESOURCES:

The recommended changes, which enhance program effectiveness, would result in an overall resource savings of approximately 15 percent in overall engineering inspection effort, due to efficiencies gained in adjustments in the types of inspections. This resource savings was calculated using the reduction in the average yearly inspection effort estimated for the inspection effort, as shown in Table 3, which is the resource estimate provided in each NRC baseline IP. The staff calculated the savings using the average inspection hours per year for the proposed 4-year and the current 3-year cycle, not including contractors.

The resource impact will be addressed in FY 2023 through the add/shed process. The resource impact will be addressed in FY 2024 and beyond through the planning, budget, and performance management process. The resources needed to develop and implement the new IPs are within the CY 2022 budget, and therefore no additional resources are needed in this area.

Table 3 Comparison of Proposed and Current Engineering Inspection Effort

Item Description	Current 3-Year Cycle	Proposed 3-Year Cycle	Proposed 4-Year Cycle	Proposed 5-Year Cycle
Total Number of Engineering Inspections	5	3	4	5
Average Annual Onsite Weeks ¹	2.66 weeks/year	2 weeks/year	2 weeks/year	2 weeks/year
Annualized Direct Inspection Hours per Site	330 hours	303 hours	280 hours	266 hours
Annualized Change in Direct Inspection per Site	N/A	-27 hours	-50 hours	-64 hours
Total NRC Annualized Direct Inspection Hours (Engineering IPs Only) ²	17,820 hours	16,380 hours	15,120 hours	14,364 hours
Annual NRC Direct Inspection Hours Saved	NA	1,439 hours	2,700 hours	3,456 hours

- For planning purposes, the staff assumed inspections to be 2 weeks/year. Depending upon the FEI area, the inspection could be reduced to less than 2 weeks/year.
- The staff obtained annualized direct inspection hours for the current 3-year cycle by summing the annualized inspection hours associated with fire protection; heat sink; changes, tests, and experiments; design bases assurance (team); and design bases assurance (programs) for all regions. This also includes the inspection effort in inspection hours for the contractors. The staff obtained the annualized direct inspection hours for the proposed cycles by summing the annualized inspection hours associated with the CETIs and FEIs for all regions. The estimate assumes 54 sites. It does not include inservice inspections.

COORDINATION:

This paper has been coordinated with the Office of the General Counsel, which has no legal objection.



Signed by Dorman, Dan
on 06/07/22

Daniel H. Dorman
Executive Director for
Operations

Enclosure:
History of Engineering
Team Inspections

SUBJECT: RECOMMENDATIONS FOR MODIFYING THE REACTOR ENGINEERING
INSPECTIONS PERIODICITY DATED June 7, 2022

ADAMS Accession No.: ML22060A085

SECY-012

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