POLICY ISSUE
(Notation Vote)

November 13, 2018 SECY-18-0113

FOR: The Commissioners

FROM: Margaret M. Doane
Executive Director for Operations

SUBJECT: RECOMMENDATIONS FOR MODIFYING THE REACTOR OVERSIGHT PROCESS ENGINEERING INSPECTIONS

PURPOSE:

This paper requests Commission approval of the U.S. Nuclear Regulatory Commission (NRC) staff's recommendations for improving the effectiveness and efficiency of the NRC engineering inspections currently being conducted in the Reactor Oversight Process (ROP).

SUMMARY:

This paper outlines the staff's recommendations to improve the effectiveness and efficiency of engineering inspections within the ROP. While the staff's efforts to improve the effectiveness and efficiency of the NRC engineering inspections pre-date the current ROP enhancement initiatives, the changes proposed in this paper result in tangible resource savings while maintaining necessary levels of reactor safety oversight. If approved for implementation by the Commission, the staff will review the effectiveness of the new engineering inspection program and will evaluate if any additional changes can be made to further improve the efficiency and effectiveness of the ROP, including the engineering inspection program, informed by the results of our review of the ROP enhancement recommendations.

In developing its recommendations, the staff reviewed the engineering inspections and evaluated different approaches, including: (1) leveraging performance indicators to reduce direct inspection, (2) improving the efficiency and effectiveness of direct inspections, and (3) integrating licensee self-assessments into the engineering inspections.

The staff also engaged in extensive communication with members of the public and the nuclear industry. Feedback from external stakeholders on the changes to the ROP engineering inspection program were generally favorable. External stakeholder feedback on the use of licensee self-assessment as a feature of the proposed engineering inspection program was mixed, with dissenting views related to the loss of NRC independence.

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Based on these efforts, the staff recommends changes to the overall approach and focus of the engineering inspections within the ROP. These changes include: (1) modification of the engineering inspections from the current 3-year to a 4-year cycle; (2) inspection consolidation, elimination of several inspection activities and the development of two new types of inspections to be performed during the 4-year cycle, the comprehensive engineering team inspection (CETI) and the focused engineering inspection (FEI); and (3) focusing inspection towards operating experience, aging management, and facility changes. The staff also plans to continue to assess, in coordination with other stakeholders, the viability of an industry initiative to develop a self-assessment approach that could be used in the future to supplement or replace selected engineering inspections.

BACKGROUND:

During the internal development of the agency's Fiscal Year 2018 and 2019 budgets and as part of agency reform 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, and/or more efficiently conducted. The SRM to COMSECY-16-0022, "Proposed Criteria for Reactor Oversight Changes Requiring Commission Approval and Notification," directs that staff should notify the Commission of certain ROP changes prior to implementation, including significant changes to the implementation of existing ROP programs. This paper describes proposed changes to the ROP engineering inspection program and provides options for periodicity of the inspections.

Implementation of the ROP for operating light water reactors relies on the completion of a number of baseline engineering inspection procedures (IPs). The NRC designed engineering inspections to verify that licensee engineering activities did not inadvertently introduce latent conditions (e.g., unknown design deficiencies) into structure, system, or component (SSC) designs 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 engineering inspections remains unchanged, inspection 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. Engineering inspections have evolved as the NRC gained insights through actual events and inspection findings. The staff also recognized that plant designs were not static and developed new inspections as needed. The enclosure provides a brief history of engineering inspections.

As part of the continuing evolution of the NRC's engineering inspections, in calendar year (CY) 2015, the Division of Inspection and Regional Support (DIRS) in the Office of Nuclear Reactor Regulation (NRR) informed public stakeholders of its intention to revise the Component Design Bases inspection (CDBI) to include inspection of licensee's implementation of key engineering areas. This change was in response to an internal NRC lessons learned report, which was performed in response to a high safety significance (Red) inspection finding at Browns Ferry. The report recommended that periodic inspection of the licensee's implementation of important engineering areas be considered as part of the ROP baseline inspection program. Nuclear industry representatives also provided feedback that the total length of the CDBI inspections took too much of their staff resources at one time to support. After extensive stakeholder engagement, NRC management decided to split the CDBI procedure into two separate IPs: IP 71111.21M, "Component Design Bases Inspection (Teams)," and IP 71111.21N, "Component Design Bases Inspection (Programs)" in order to implement this lessons learned recommendation. Splitting the CDBI inspection procedure into two inspection activities performed in different years allowed a more manageable inspection program for both the NRC and the licensees. Additionally, the development of IP 71111.21N allowed the addition of periodic inspection of licensee's implementation of key engineering areas as part of the ROP baseline inspection program. Staff selected environmental qualification as the first engineering area for inspection. The NRC conducted eight CDBI pilot inspections during CY 2015 and CY 2016 to validate their efficacy.

Regional feedback from these pilot inspections included a recommendation to add another week of onsite inspection to allow sufficient time to complete the new engineering inspection, IP 71111.21N. Staff responded to this regional recommendation by moving one week of staff inspection resources from IP 71111.17T, "Modification and Changes, Tests, and Experiments," to IP 71111.21N. Under this change, IP 71111.17T, renamed "Evaluation of Changes, Tests, and Experiments," only reviewed licensee evaluations, screenings, and/or applicability determinations for changes allowed under Title 10 of the *Code of Federal Regulations* (10 CFR) 50.59, "Changes, tests, and experiments." The CDBI procedure was also renamed to "Design Bases Assurance Inspection," to recognize that its inspection emphasis had changed to inspection of changes or modifications being made to safety systems.

Based on regional feedback received that inspection of licensee's modifications and their implementation of the 10 CFR 50.59 regulation using two inspection procedures reduced the effectiveness of the engineering inspection program, the staff created the Engineering Inspection Working Group (EIWG) in 2017 to review and reassess the effectiveness and efficiency of all ROP engineering inspections. The EIWG was led by an executive sponsor and comprised of branch chiefs from each region and a senior reactor operations engineer from NRR/DIRS. The group also included a team member from NRR's Division of Risk Assessment to ensure that the EIWG considered risk insights and incorporated them into its recommendations. The EIWG reviewed selected procedures in the 71111 series of engineering inspection procedures with the objective of eliminating redundancies and identifying gaps in the inspection program.

The EIWG held a series of public meetings to obtain stakeholder input to support the development of the various options on the EIWG's proposed changes to the engineering inspection program. The detailed results of the EIWG efforts and the bases for the recommendations for this paper can be found in a Memo from J. Isom to A. Gody, "Proposed Transformational Changes to Nuclear Regulatory Commission Engineering Inspections," dated May 24, 2018 (ADAMS Accession No. ML18103A174)[1]. The recommendations of the

[1] In the EIWG Memo, the working group recommends that the NRC do the following: (1) shift the frequency of the engineering inspections to a quadrennial cycle, with an engineering inspection every year at each site; (2) combine the 10 CFR 50.59, modification, and design-basis assurance inspection into one new CETI to be conducted on a quadrennial basis; (3) develop and implement FEIs during the intervening years; (4) eliminate the current standalone heat sink performance IP and include aspects of heat sink design as a potential inspection sample for the new CETI, but retain the resident inspector portion of the heat sink inspection; (5) retain the inservice inspection activities procedure, with some revisions to improve effectiveness; (6) begin the new engineering inspection program in calendar year 2020 to allow the agency to complete the current engineering inspection program, develop new engineering IPs, and train NRC inspectors to implement the new engineering IPs; (7) continue working with the industry in parallel with the implementation of the aforementioned recommendations to develop industry guidance on the use of licensee self-assessments in place of one of the three FEIs, and, after industry development and NRC approval of self-assessment implementation guidance, conduct a

EIWG form the basis of the proposed revisions to the engineering inspection program described later in this paper.

Engineering Inspections and Performance Indicators in the Reactor Oversight Process

The NRC reviews and assesses nuclear plant performance by conducting inspections and monitoring performance indicators (PI). The inspection program verifies the accuracy of PI data and assesses performance that is not directly measured by the PI data. Engineering inspections are a subset of the broader range of inspections in the ROP.

Engineering inspections performed as part of the ROP: (1) verify that plant components are maintained within their design basis; and (2) verify the capability of selected components and expected operator actions to perform their design bases functions. Engineering inspections play an important role in verifying that safety systems are capable of performing their intended safety functions under accident conditions.

For example, a particular safety-significant pump may fall within the scope of different types of NRC inspections such as maintenance effectiveness, surveillance testing, and engineering inspections. Although the pump could fall within the scope of different inspections, the inspections verify different aspects of safety compliance and may require different NRC inspection expertise. The maintenance effectiveness inspection verifies that the licensee appropriately addresses the pump's actual demonstrated performance or conditions that challenge performance. The surveillance testing inspection verifies that the pump's surveillance testing results provide objective evidence that the pump remains capable of performing its intended safety functions and maintains its operational readiness. During routine surveillance testing conducted by the licensee, the pump may be tested with relatively cool room temperatures and may be moving relatively cool water. However, under accident conditions, the pump may have to operate with room temperatures that are elevated and move water at elevated temperatures. The conclusions reached during surveillance testing activities regarding the pump's ability to perform its safety functions during actual accident conditions rely upon the adequacy of the licensee's engineering analysis and associated calculations. During an engineering inspection, the inspector will confirm that the licensee has maintained the NRC approved SSC design parameters through review of analyses and calculations, pump modifications, the appropriateness of design assumptions, boundary conditions, and models associated with the pump; review outstanding design issues to identify any instances of when and why the pump may have been operated out of its normal configuration; and verify that operator actions can be accomplished in accordance with the licensee's design basis or probabilistic risk assessment (PRA) analysis. In accomplishing these activities, engineering inspections verify that test results and observations that are acceptable during non-accident conditions support the operability of SSCs in all modes of operation.

As discussed in section III.B.3.a.,"Performance Indicators," of the enclosure to the EIWG memo, when the ROP was established, the NRC used an ROP Task Group to identify PIs that could adequately measure the performance of key attributes in each of the cornerstone areas and determine whether an inspection or other information sources were needed to supplement the PIs. The ROP Task Group initially attempted to identify quantifiable indicators that could be used to identify latent conditions (indicative of ineffective engineering) in lieu of independent inspections. However at the time (i.e., in 1999), the ROP Task Group concluded that

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demonstration of the project; and (8) implement a similar effort to improve the effectiveness and efficiency of the remaining baseline inspections in the ROP.

engineering and design activities are best measured using audits and independent inspections; the ROP Task Group was unable to develop PIs that would correlate to the identification of latent design issues.

DISCUSSION:

While looking at various internal and external feedback on engineering inspections, staff asked the question "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?" All three proposed options in this paper ensure that reactor safety is maintained by performing one engineering inspection a year, either the CETI or an FEI. As part of the EIWG effort, the staff conducted an evaluation of the current engineering inspections, inspection practices, inspection results and performance indicators. The following guidelines were used to direct the review of the current ROP engineering inspections:

- Maintain risk-informed focus.
- Identify deficient conditions that would not normally be readily identifiable through routine plant activities or performance indicators (e.g., monitoring during normal operation or surveillance tests).
- Allow inspections that are focused on recent plant changes and operating experience.
- Maintain the NRC's role as an independent regulator.

As a result of the evaluation, the staff recommended developing options to conduct these independent inspections while making improvements in the current engineering inspection program to gain efficiency.

Stakeholder Interactions

While considering options for changes to the engineering inspection program and performance indicators, the staff sought comments from both internal and external stakeholders, which included members of the public. The staff solicited specific feedback from the regional engineering inspectors and their managers, as well as agency senior leaders, including the Regional Administrators, the NRR Office Director, and the Deputy Executive Director for Reactor and Preparedness Programs.

With respect to external stakeholder interactions, the staff held a series of public meetings (June 6, 2017; October 11, 2017; December 12, 2017; and February 22, 2018), to discuss the progress of the engineering inspection review and to obtain industry and other external stakeholders' input. The minutes from these public meetings are provided in ADAMS (ADAMS Accession Nos. ML17208A613, ML17297B761, ML18024A636, and ML18081A589, respectively). In addition, the staff received emails and written correspondence from various members of the public that contained recommendations and feedback, which were considered by the staff in developing this paper. Furthermore, the staff developed and maintained a dedicated page on the NRC's public website at https://www.nrc.gov/reactors/operating/oversight/rop-design-insp-review.html.

Industry provided feedback that the NRC should 1) adjust inspection cycle and rebaseline ROP inspection hours; 2) retire inspections which have served their purpose; 3) reduce overlap and duplication of focused inspections areas; and 4) allow inspection credit for licensee self-assessments. Feedback from a non-government organization (NGO) recommended that the Agency preserve the current framework for engineering inspections. Feedback from other public stakeholders (e.g., Union of Concerned Scientists, Pilgrim Watch and The Town of Duxbury Nuclear Advisory Committee, and other interested public citizens) recommended that the Agency not allow licensee use of self-assessments in lieu of NRC inspections. Additionally, a number of inspectors provided feedback that they were not in favor of replacing FEIs with licensee self-assements.

Consideration of Performance Indicators

With almost two decades of experience with the ROP, the EIWG reevaluated whether PIs could now be developed to identify latent conditions so that the PIs could be used to replace engineering inspections. As part of the reevaluation, the EIWG considered how a PI might measure adherence to design and licensing bases and codes and standards. Specifically, the staff attempted to identify quantifiable measurable indicators that could be used. For example, the staff compared the number of design-related findings documented during engineering inspections to the following:

- the number of temporary modifications performed (i.e., comparing the total number of installed temporary modifications in a given triennial cycle to the number of engineering findings identified during the same triennial cycle);
- the number of changes performed (i.e., comparing the total number of changes to the facility the licensee performed in a given triennial cycle to the number of engineering findings identified during the subsequent triennial cycles);
- the unavailability of emergency alternating current power (i.e., comparing the number of engineering findings for a site to a ratio of the hours a train/system at the site was unavailable to perform its intended function because of planned, unplanned, and fault exposure unavailability); and
- safety system functional failures (i.e., assessing the number of events or conditions that prevented, or could have prevented, the fulfillment of the safety function of structures or systems that are needed: to shut down the reactor and maintain it in a safe shutdown condition, to remove residual heat, to control the release of radioactive material, or to mitigate the consequences of an accident).

The staff did not identify any linkage between the measured data and engineering performance to identify latent issues. Overall, the staff was unable to identify indicators that could be correlated to engineering performance. Representatives from the nuclear industry agreed with the staff's assessment regarding the inability of performance indicators to identify latent engineering design issues. The inability to identify a viable engineering design performance indicator forms, in part, the basis of the staff's recommendation to continue performing independent engineering inspections.

Recommendations for Engineering Inspections

Engineering inspections play an important role in the ROP. They enable the NRC to verify safety system capability under accident conditions that do not reveal themselves through testing or plant operation, and performance indicators do not lend themselves to measuring licensee performance in this regard. To increase effectiveness, the staff used the following steps to develop various potential options for the new ROP engineering inspections:

- Identify licensee activities that affect the capability of SSCs.
- Verify engineering areas that the NRC should be inspecting based on plant risk and operating experience.
- Review selected engineering inspection procedures listed in the EIWG charter to evaluate why the agency performs each inspection and to identify both areas for increased emphasis and overlaps in the current engineering inspections.

In summary, the staff recommends a shift from the existing engineering procedures to inspections centered on the CETI and FEI procedures as described below. This shift would result in efficiency gains and improve the overall effectiveness of the engineering inspection program.

The staff developed the three options for periodicity of the recommended revised ROP engineering inspection program. Each option incorporates the new CETI and FEI procedures and only varies in the length of the engineering inspection cycle (3 to 5 years). The staff did not consider the possibility of conducting FEI inspections on less than an annual basis (i.e., every other year) when developing options. Staff considered it important to maintain annual engineering inspections at each site in order to have opportunities for more timely assessment of licensee performance. In addition, based on public interactions, the EIWG found that annual engineering inspection feature of the ROP was very important to public stakeholders.

Comprehensive Engineering Team Inspections

The CETI will be the next generation team engineering inspection focused on changes made to SSC design bases. The primary purpose of the CETI is to verify the ability of plant SSCs to perform their licensing basis function following changes and modifications. Areas reviewed in the CETI will include design, operations, maintenance, testing, problem identification and resolution, and modifications made to SSCs. Additionally, the CETI will incorporate key elements of IP 71111.07, "Heat Sink Performance," and IP 71111.17T, "Evaluation of Changes, Tests and Experiments (10 CFR 50.59)" inspection procedures.

Approval of the CETI inspection procedure would allow the staff to eliminate the 10 CFR 50.59 and heat sink performance team inspections as separate inspections. To accommodate this change, one additional inspector was added to the CETI to provide additional inspection resources to sample the most important and risk significant aspects of the heat sink and 10 CFR 50.59 areas. Although the number of inspection hours for the CETI increases slightly from the current Design Basis Assurance Team inspection procedure, the totality of the changes presented in this paper results in a net overall reduction in engineering inspection hours due to the proposed elimination of the standalone heat sink and 10 CFR 50.59 team inspection procedures. The proposed changes to these inspections procedures (DBA, Heat Sink Performance and 10 CFR 50.59) is anticipated to result in direct inspection resource savings of several thousand hours annually for the NRC without compromising safety, thereby improving the efficiency and effectiveness of the ROP (see Table 2). It also accomplishes the goal of having less total team inspections, which reduces licensee effort to prepare for separate inspections.

Some industry representatives stated that a CETI may not be necessary based on the relatively small amounts of modifications made to safety-related SSCs. Representatives from a NGO stated that the reduction in scope to the current ROP engineering inspection program may result in declines in licensee performance in the engineering area.

Focused Engineering Inspections

The need to develop FEIs as a feature of the new ROP engineering inspection program was a result of the desire to extend the engineering inspection cycle to four years and the importance of maintaining annual engineering inspections (touch points). The recommended four year engineering inspection cycle features a CETI and three other engineering inspections to allow for annual engineering inspections. The staff concluded that these three other engineering inspections could be accomplished using FEIs. The staff's concept for these FEIs would be that their inspection objectives would be more narrowly focused than the CETI in the engineering area inspected. Because of their more narrowly focused inspection of licensee's engineering areas, the staff determined that the FEI could be accomplished using a staffing structure similar to the current IP 71111.21N. The staff's review of the current inspection program identified several potential areas for increased emphasis for these FEIs. These new FEIs would allow the Agency to inspect other engineering areas based on operating experience, risk significance, and the period of time that has passed since an area was last inspected.

As a result, the staff is recommending the development of a new inspection, the FEI, to maintain an annual inspection and also to improve the agency's ability to inspect selected engineering areas. FEIs would represent a family of inspections, focused on current licensee activities, while incorporating reviews of aging management, operating experience, changes, and risk insights. These inspections would be 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. FEIs are not programmatic inspections, but rather they are intended to verify the licensee's implementation of NRC approved engineering programs. Specific technical and regulatory training would be provided to NRC inspectors, including licensing and design basis considerations, to ensure reliable and consistent implementation of each new type of FEI. The staff is recommending that the FEI inspection areas be fixed for the inspection cycle starting in CY 2020.

Use of FEIs allow NRC to review multiple focus areas during each inspection cycle. The criteria for selection of the areas of the FEIs would include:

- risk significance, including PRA insights and common cause failure potential;
- operating experience, including past industry performance trends in SSC failures and insights from NRC inspections; and
- potential for engineering challenges, including changing conditions such as aging effects and significant modifications to safety systems, which would not be identified through other inspections.

Using the criteria above, the Division of Inspection and Regional Support in the NRR plans to work with NRR PRA analysts, NRR operating experience staff and the four regions to develop recommendations for new FEIs. The staff plans to obtain NRC management approval and share the future FEI areas for inspection with external stakeholders prior to implementing the new FEIs. Additionally, the staff plans to inform the Commission as directed by the SRM to COMSECY-16-0022, "Proposed Criteria for Reactor Oversight Changes Requiring Commission Approval and Notification," of the selected FEIs and conduct pilot inspections, if appropriate.

The recommendations regarding the use of FEIs and the need for annual touch points was based on the judgment of the EIWG members, informed by internal stakeholder input, who concluded that regularly scheduled engineering inspections were important elements needed for timely assessment of licensee safety performance. Additionally, the staff concluded that annual engineering inspection facilitated the ability of the NRC to inspect emerging issues or trends using FEIs.

However, the staff plans to review future proposed FEI inspectable areas, informed by the ongoing ROP enhancement initiatives, and engage with external stakeholders during the next inspection cycle, which begins in CY 2020. The staff will determine whether annual engineering touch points should remain a feature of the subsequent engineering inspection cycles based on plant risk and emergent engineering challenges.

During public interactions with external stakeholders, the staff obtained feedback regarding use of FEIs. NGO representatives stated that the inspection process would be improved through the use of FEIs because the NRC would have the ability to perform inspections in new engineering areas. Industry recommended a five year engineering cycle consisting of one CETI and four FEIs. Also, the Industry is recommending that one of the four FEIs could be accomplished through use of licensee self-assessments. Some questions asked by the industry on FEIs included:

- Will the entire fleet get the same focused engineering inspections?
- Will fire protection inspection be considered as one of the focused engineering inspections?

The NRC's responses to these questions generally was yes.

Inservice Inspection Program (ISI)

The staff concluded that inservice inspection activities should continue based on licensee's identification of material flaws and failures caused by aging effects. The EIWG also identified a gap in that there is no requirement to inspect implementation of changes to the licensee's ISI program when it is updated every 10 years. The staff also recommended elimination of the inspection of the boric acid corrosion control program, while maintaining the boric acid inspection of reactor vessel heads. These recommended changes to IP 71111.08, "Inservice Inspection Activities," would address the in-service inspection program implementation without the need for additional resources to conduct the inspection. In-service inspections are currently performed at each reactor unit during each refueling outage.

Options for Timing of Recommended Engineering Inspections

For the first cycle, the staff recommends a fixed approach to the engineering inspection program. This would mean that each site would receive one CETI and the same FEIs throughout the 3, 4 or 5 year cycle. For efficiency of scheduling resources, the CETI and FEI inspections would be rotated across the sites in each option, as illustrated below:

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; however, only one engineering inspection would be performed each year (with the exception of the in-service inspection procedure, which would remain at the current frequency). The three inspections

would include one CETI and two unique FEIs. "BI" stands for baseline inspections and the number associated with "BI" in Figures 1 through 3 is an estimate of inspection hours needed to complete the inspection. "BI" does not include the inspection hours associated with preparing for inspections or documenting inspection results. Option 1 would require inspection staff to be trained in the CETI and two different FEIs before the beginning of the cycle. Option 1 would result in an annual inspection resource savings of about 12 percent to conduct engineering inspections other than in-service inspections. The resources required to conduct in-service inspections are the same across the range of options and the in-service inspection diagramed below illustrates the in-service inspections performed at a single unit site only.

Option 1 is shown in Figure 1[2] below.

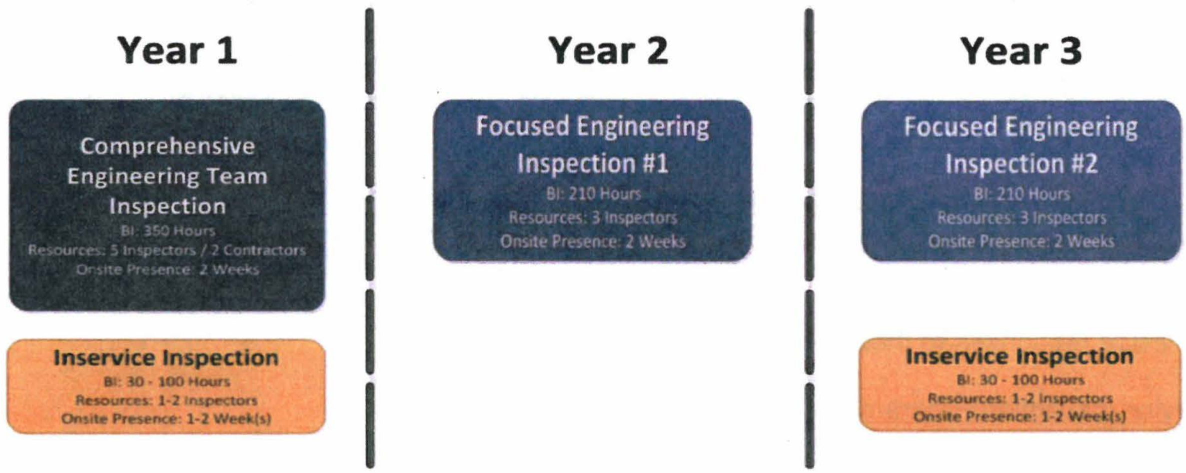

Figure 1: Graphical Representation of the Triennial ROP Engineering Inspection Program

<u>Option 2</u>: The staff would increase the engineering inspection cycle to 4 years, with one engineering inspection performed each year (with the exception of the in-service inspection procedure, which would remain at the same frequency, i.e., every refueling outage). The four inspections would include one CETI and three different FEIs over the 4-year inspection cycle. Option 2 would require inspection staff to be trained in the CETI and three new FEIs before the beginning of the cycle.

Option 2 would result in an annual inspection resource savings of about 16 percent to conduct engineering inspections other than in-service inspections. Option 2 is shown in Figure 2.

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[2] Graphics are provided for illustrative purposes only, and represent a typical inspection cycle at a single-unit site with an 18 month fuel cycle.

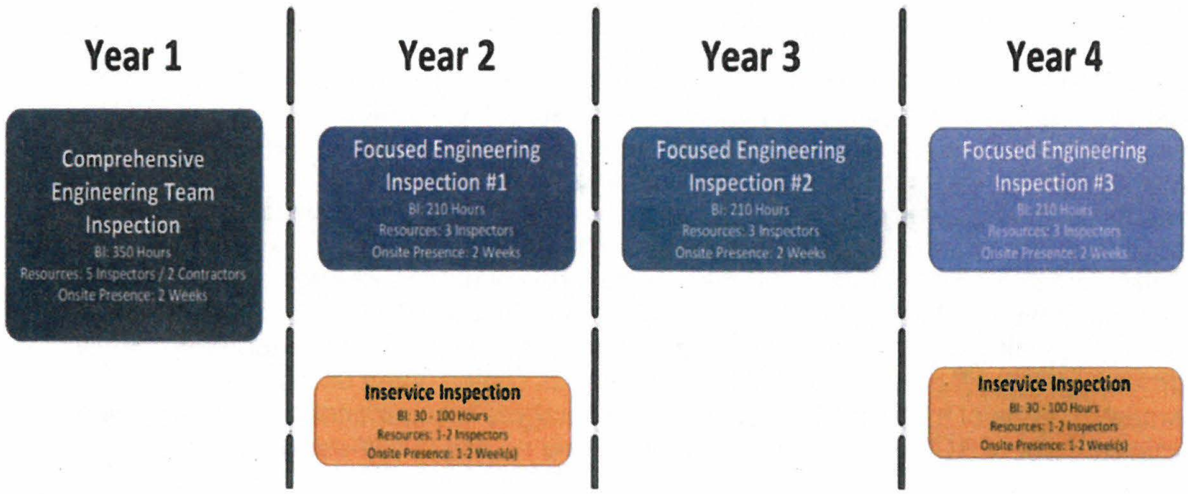

Figure 2: Graphical Representation of the Quadrennial ROP Engineering Inspection Program

<u>Option 3</u>: The staff would increase the engineering inspection cycle to 5 years, with one engineering inspection performed annually, and continue with the in-service inspections at the current frequency (i.e., every refueling outage). This option would have an inspection cycle consisting of five inspections: one CETI and four different FEIs during the 5-year inspection cycle. Option 3 requires inspection staff to be trained in the CETI and four new FEIs before the beginning of the cycle. Option 3 is the industry's recommendation for future ROP engineering inspections and results in an annual inspection resource savings of approximatly19 percent to conduct engineering inspections other than in-service inspections. Option 3 is shown in Figure 3 below.

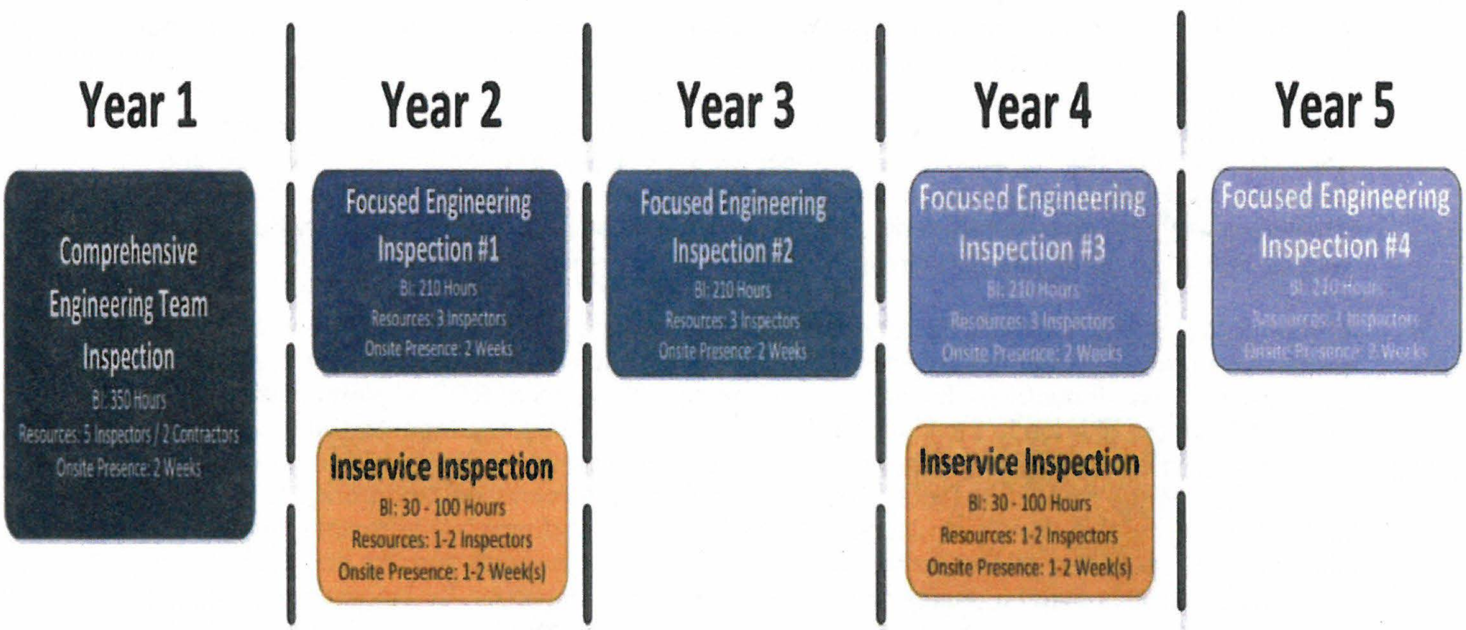

Figure 3: Graphical Representation of a Quinquennial ROP Engineering Inspection Program

Evaluation of Options for Timing of Recommended 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. The review placed particular emphasis on maintaining annual touch points for timely assessment of licensee safety performance, ensuring qualified inspection expertise was available to implement the baseline inspection program, and the ability to inspect emerging issues or trends using FEIs. Based on public interactions, the EIWG found that the maintenance of an annual engineering inspection was very important to public stakeholders. As discussed below, the staff recommends Option 2 because, in the staff's view, Option 2 represents the optimum balance between effectiveness and efficiency gains. The nuclear industry recommends Option 3 and use of licensee self-assessments for one of the four FEIs. NGO representatives recommended no change be made to the current suite of ROP engineering inspections and no use of self-assessments.

Option 1 Evaluation:. This option represents minimal change to the current ROP engineering inspection program. Specifically, this option represents an evolution in changes made in 2017 to the CDBI and 10 CFR 50.59 inspections. The inspection procedures would be modified to address inspector and industry feedback about inefficiencies introduced by the 2017 changes. Specifically, Option 1 would address the inefficiencies introduced when separating the modifications portion from the previous inspection procedure, IP 71111.17T, "Evaluation of Changes, Tests and Experiments," and allocating this part of the inspection into the new IP 71111.21M, "Design Basis Assurance Inspection (Teams)." The staff would accomplish this objective by implementing the new CETI inspection procedure, which would incorporate aspects of inspection procedures IP 71111.21M, "Design Bases Assurance Inspection (Teams)," IP 71111.17T, "Evaluation of Changes, Tests and Experiments," and the triennial portion of IP 71111.07, "Heat Sink Performance."

Additionally, the staff recognizes that performing the CETI procedure once every 3 years would allow the inspectors to focus on the most recent plant performance. However, feedback from inspection staff has identified that the sample selection in a 3-year period limits the number of risk-significant samples. Specifically, under the current engineering inspection program, the staff identified that the number of changes performed in a 3-year period could be limited and therefore, inspectors may not have many changes to select from as inspection samples. Therefore, the staff does not recommend Option 1 because the changes being made to safety-related SSCs did not appear to warrant a triennial CETI inspection frequency.

Option 2 Evaluation: The staff has concluded that extending the cycle length to 4 years is the preferred method for validation of licensee compliance with NRC requirements in the engineering area. Industry performance over the past 18 years of ROP implementation indicated 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 shifts from verifying the licensee's adherence to their approved original plant design to inspecting the licensee's performance in maintaining equipment to meet design and licensing basis functions, the need to perform comprehensive inspection activities every 3 years may not be necessary. Moreover, by increasing the inspection cycle to 4 years, the inspectors would have a greater population of inspection samples available for selection during comprehensive inspections. Option 2 contains the new CETI procedure discussed in Option 1.

Regarding the timely assessment of licensee performance, the staff determined that the proposed format for the engineering inspections, in combination with an extended inspection cycle, would not negatively influence the effectiveness of the overall engineering inspection program. Through the completion of annual onsite engineering inspections (i.e., a CETI or a FEI), the staff determined that extending the cycle length would not impact the ability of the ROP to provide objective evidence that risk- or safety-significant SSCs would remain capable of performing their intended safety functions consistent with their design and licensing bases. As a result, the staff recommends Option 2 to be implemented.

Option 3 Evaluation: Extending the engineering inspection cycle beyond 4 years would result in an approximate 3 percent reduction in inspection effort over the efficiencies gained from implementation of Option 2. The staff identified two areas that could be impacted as a result of extending the inspection cycle to 4 years. Extending the cycle length beyond 4 years makes 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 this frequency to once in 5 years challenges the staff's ability to identify potentially declining engineering performance in a timely fashion. As a result, in the staff's judgment, Option 3 is not recommended.

Table 1: Comparison of Proposed Options

	Option No. 1	Option No. 2	Option No. 3
ROP Engineering Program Impact	Minimal	Moderate	High
Efficiency Gained (not including in-service inspections)	12.5 percent	16.5 percent	18.9 percent
Changes to Full Time Equivalent (FTE)	-2.48 FTE	-3.26 FTE	-3.74 FTE
Sample Availability	No change	Improved	Improved
NRC Staff Impact	Minimal	Moderate	High

Review of Licensee Self-Assessments

Licensees routinely conduct self-assessments in advance of significant NRC engineering inspections in order to assess their readiness for the inspection. The staff received input from the Nuclear Energy Institute (NEI) on October 11, 2017, describing a proposed approach where NRC inspectors would independently validate the licensee's self-assessment quality and, if appropriate, credit the self-assessment results in lieu of conducting a separate independent FEI. The industry proposed a standardized process, which uses industry-generated checklists and templates with the intent of ensuring reliable and high-quality performance in self-assessment activities. The staff engaged with stakeholders during public meetings on this topic and posted relevant information on the NRC's public webpage at https://www.nrc.gov/reactors/operating/oversight/rop-design-insp-review.html.

During these interactions, representatives from the nuclear industry articulated the following benefits to allowing self-assessment activities to be used in lieu of full NRC inspections: (1) reduced licensee resources needed to support NRC engineering inspections, (2) enhanced licensee organizational knowledge of the inspected area, and (3) improved ability to respond to current industry trends. Some external feedback included concerns with reduced NRC inspections. Central themes associated with these concerns were (1) NRC inspection is considered more effective than self-assessments to identify design problems, (2) NRC inspection results associated with identification of latent conditions demonstrate the licensee's weakness in this area, and (3) licensee staff biases would impact their ability to conduct an effective self-assessment.

The staff determined that providing an incentive for licensees to perform their own high-quality self-assessments might improve the licensee's staff knowledge of plant design basis and critical assessment skills, which could be applied in the other areas of their work and could lead the licensees to self-identify issues. Some inspectors were concerned that replacing an FEI with a licensee self-assessment would not provide the same level of independent safety oversight. Also, performing self-assessments could improve the licensee staff's skills and abilities to identify latent conditions.

Observing one or more demonstrations of industry's proposed standardized self-assessment process may be useful in enabling the staff to evaluate the feasibility of using the results of a self-assessment to replace one of the FEIs. The staff envisions that any proposed process would need to include at least two key features:

- NRC independent assessment of the self-assessment activity guided by a new inspection procedure; and
- Open communication with the public regarding the results of licensee self-assessments and NRC conclusions.

On June 13, 2018, the industry provided NEI 18-07, "Licensee Performance Assessments Methodology for Licensee Identification of Latent Design Issues," Draft 0. The staff plans to review the draft document, coordinate questions and concerns with the industry and public stakeholders to develop inspection procedures, and observe a demonstration of two licensee self-assessments in fiscal year (FY) 2019. The staff will provide baseline inspection credit at the assessed facilities for the associated inspection, which the NRC would have otherwise performed independently.

Following the observation of the demonstration and after fully analyzing comments received from external stakeholders on the effort, the staff will provide recommendations to the Commission regarding possible full implementation of NRC observation of licensee self-assessments in lieu of one of the FEIs each cycle in a separate Commission paper.

Relationship to NRC Transformation Initiatives

The EIWG was established to improve the effectiveness and efficiency of the NRC's engineering inspections in the ROP. Following completion of the EIWG activities, the NRC received a series of ROP enhancement recommendations from internal and external stakeholders as part of the NRC Transformation Initiative, which the staff are currently reviewing.

Notwithstanding the current efforts to review ROP enhancement recommendations, the staff believes that Commission approval of the recommendations discussed in this paper is prudent because 1) the changes maintain necessary levels of safety oversight of licensee engineering program implementation, 2) the changes result in a tangible resource savings to both the NRC and licensees and, 3) the changes received broad alignment with internal and external stakeholders. During implementation of recommendations proposed in this paper, the staff will review the effectiveness of the new engineering inspection program. The staff will evaluate if any additional changes can be made to further improve the efficiency and effectiveness of the ROP, including the engineering inspection program, informed by the results of our review of the ROP enhancement recommendations.

RECOMMENDATIONS:

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

(1) Development and implementation of a CETI that incorporates aspects of the modifications, 10 CFR 50.59, and the design bases assurance inspection with a focus on operating experience, aging management, and changes to the design basis and PRA models.
(2) Development and implementation of new FEIs.
(3) Transition to a quadrennial inspection cycle, with an engineering inspection (CETI or FEI) every year at each site.
(4) If approved, the staff will remove the current standalone heat sink performance inspection procedure, IP 71111.07, "Heat Sink Performance," and include aspects of heat sink design as a potential inspection sample for the new CETI, and retain the resident inspector portion of the heat sink inspection.

If approved, the staff would begin the new engineering inspection program in CY 2020, which would allow time for completion of the current engineering inspection program, allow for development of the new engineering inspection procedures, and provide time for training of NRC inspectors on the new engineering inspection procedures.

RESOURCES:

The recommended changes would result in an annual inspection resource savings of approximately 16 percent in engineering inspection effort. Sixteen percent translates into a reduction of approximately one to two full time equivalent staff positions per region, depending on the number of sites in the region. This resource savings was calculated using the reduction in the average yearly inspection effort estimated for direct inspection effort, which is the resource estimate provided in each NRC baseline IP. The savings of 16 percent was calculated using the average inspection hours per year for the proposed 4-year and the current 3-year cycle not including in-service inspection hours, which do not change across the options.

Based upon the agency's inspection experience, licensee support for team inspections is comparable to the agency's effort in terms of staff and hours directly expended to support the inspections. While individual licensees approach support for NRC inspections differently, it is common for licensees to assign comparable numbers of staff to support the onsite portion of an NRC team inspection. Therefore, the staff anticipates that licensees would experience a similar, if not greater, resource savings as indicated in Table 2. Additionally, it is anticipated the licensees would experience an equivalent or greater resource savings given that each inspection cycle requires fewer interactions and subsequent support and preparation activities due to combining inspections. For example, in the current three year inspection cycle, licensees support five separate engineering inspections. In the three year cycle proposal, the licensee support activities would drop to three per cycle, or four in the proposed quadrennial cycle.

The resource impact will be addressed in FY 2020 through the add/shed process. The resource impact will be addressed in FY 2021 and beyond through the planning, budget, and performance management process. The resouces needed to develop and implement the new inspection procedures are within the CY 2019 budget and therefore, no additional resources are needed in this area.

Table 2: Comparison of Proposed and Current Engineering Inspection Effort

	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[3]	3.66 weeks/year	2 weeks/year	2 weeks/year	2 weeks/year
Annualize Direct Inspection Hours per Site	293 hours	257 hours	245 hours	238 hours
Annualized Direct Inspection Reduction per Site	N/A	36 hours	48 hours	55 hours
Total Agency Annualized Direct Inspection Hours (Engineering IPs only)[4]	17,600 hours	15,400 hours	14,700 hours	14,280 hours
Annual Agency Direct Inspection Hours Saved	N/A	2200 hours	2900 hours	3320 hours
Efficiency Gained (not including in-service inspections)	N/A	12.5%	16.5%	18.9%

Note: Table 2 does not include in-service inspections, which are the same across all options

COORDINATION:

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

Margaret M. Doane

Margaret M. Doane
Executive Director
for Operations

Enclosure:
History of Engineering Team Inspections

[3] For planning purposes, inspections were assumed to be two weeks/year. Depending upon the FEI area, the inspection could be reduced to less than two weeks/year.

[4] The annualized direct inspection hours for the current 3-year cycle were obtained by summing the annualized inspection hours associated with Fire Protection; Heat Sink; 10 CFR 50.59; DBA – Team; DBA – Program and ISI inspections for all regions. The annualized direct inspection hours for the proposed cycles were obtained by summing the annualized inspection hours associated with the CETI and FEI inspections for all regions.

SUBJECT: RECOMMENDATIONS FOR MODIFYING THE REACTOR ENGINEERING INSPECTIONS DATED NOVEMBER 13, 2018.

SRM-CMSY17-0024-19

ADAMS Accession No.: ML18144A567 *concurred via e-mail

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OFFICE	D:NRR	EDO			
NAME	HNieh	MDoane			
DATE	10/15/18	11/13/18			

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Commissioners' completed vote sheets/comments should be provided directly to the Office of the Secretary by COB Friday, November 30, 2018.

Commission Staff Office comments, if any, should be submitted to the Commissioners NLT Friday, November 23, 2018, with an information copy to the Office of the Secretary. If the paper is of such a nature that it requires additional review and comment, the Commissioners and the Secretariat should be apprised of when comments may be expected.

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History of Engineering Team Inspections

Timeframe	Inspection Name	Scope
1985 to 1995	Safety System Functional Inspections (SSFI) (IP 93801)	As a result of a loss of feedwater at Davis Besse, the Nuclear Regulatory Commission (NRC) created a new inspection, SSFI, which was designed to determine whether there were similar problems at other nuclear plants. The objective of this inspection was to: - Assess the operational performance capability of selected safety systems through an in-depth, multi-disciplinary engineering review to: - Verify that the selected systems were capable of performing their intended safety functions. - Ensure that generic safety significant findings were pursued across the system boundaries on a plant-wide basis.
1985 to 1988	Safety System Outage Modification Inspection (SSOMI) (IP 93803)	Developed at the same time as the SSFI, The objective of this inspection was to: - Verify the licensee had established appropriate programmatic controls for accomplishing changes, modifications, and repairs. - Verify that the licensee was conducting activities related to design changes, modifications, and repairs in accordance with established procedures, commitments, and regulatory requirements. - Verify that completed modifications had been properly designed, installed, inspected, and tested to ensure the adequate performance of the modified systems and components. - Determine that the design margins of the modified safety-related systems and components had not been reduced. - Verify that the modified systems and components were ready for safe startup and operation of the plant.
1991 to 1993	Electrical Distribution System Functional Inspection (EDSFI) (IP 93811)	During multidiscipline inspections such as SSFIs or SSOMIs, the NRC identified a number of deficiencies related to electrical distribution systems (EDS). As a result of these deficiencies, the NRC developed the EDSFI to specifically evaluate the EDS. The objective of this inspection was to: - Assess the capacity of the EDS to perform its intended functions during all plant operating and accident conditions. - Assess the capability and performance of the licensee's engineering organization in providing engineering and technical support. - Examine the interfaces between the technical disciplines internal to the engineering organization and the interfaces between the engineering organization and the technical support groups responsible for the operability of the EDS.

1993 to 1995	Service Water System Operational Performance Inspection (SWOPI) (IP 93810)	Challenges to the thermal performance capability of safety-related open cooling water system heat exchangers were a major reason the agency issued Generic Letter 89-13, "Service Water System Problems Affecting Safety Related Equipment." GL 89-13 requested that licensees and applicants ensure that their service water systems (SWSs) were in compliance and maintained in compliance with 10 CFR Part 50, Appendix A, General Design Criteria 44, "Cooling water, " 45, "Inspection of cooling water system," and 46, "Testing of cooling water system," and Appendix B, Section XI, "Test Control." The SWOPI was a specialized version of the SSFI that focused on the SWS. Some of these were licensee self-assessments that NRC credited. The objective of this inspection was to: • Verify that the SWS was capable of fulfilling its thermal and hydraulic performance requirements and was operated consistent with its design bases. • Assess the SWS operational controls, maintenance, surveillance, and other testing, and personnel training to ensure the SWS was operated and maintained so as to perform its safety-related functions.
1995 to 1998	Safety System Engineering Inspection (SSEI) (IP 93801)	The SSEI provided an enhancement to the core inspection program in the engineering functional area. The inspection was intended to improve the agency's overall ability to identify various engineering design issues which were identified through several team inspections at several nuclear facilities.
1996 to 1998	Architect Design Engineering Inspection 50.54(f)	Based on the review of licensee responses to a 50.54(f) letter (requesting reactor licensees to describe their programs and processes established to control and maintain operations within their facility's design bases in accordance with 10 CFR 50.54(f) which requires licensees to submit written statements, signed under oath or affirmation, to enable the Commission to determine whether or not the license should be modified, suspended, or revoked), the staff concluded that while licensees had established programs and processes to maintain their facilities' design bases, there was a need to implement plant-specific follow-up activities. This determination was based upon the staff having identified: (1) instances in which licensees failed to reconcile regulatory performance with their assertions that their programs and processes were effective in maintaining their design bases, or (2) that there was a need to gain a better understanding or to validate a particular aspect of a licensee's programs and processes. SECY-97-160, "Staff Review of Licensee Responses to the 10 CFR 50.54(f) Request Regarding the Adequacy and Availability of Design Bases Information," referred to the above-mentioned follow-up activities. They were to be a combination of architect-engineer design team inspections led by the Office of Nuclear Reactor Regulation and region-led inspections, such as safety system functional inspections and safety system engineering inspections.
2000 to 2004	Safety System Design and Performance Capability Inspection (SSDPC) (IP 71111.21)	This was the first time NRC-conducted SSFI type inspections at all plants on a regular basis and was performed biennially.

2005 to 2017	Component Design Basis Inspection (CDBI) (IP 71111.21)	The SSDPC was replaced with the CDBI inspection procedure based on the number of engineering-related problems identified at Davis-Besse after identification of significant boric acid-induced corrosion in the reactor head. See SECY-04-0071, "Proposed Program to Improve the Effectiveness of the Nuclear Regulatory Commission Inspection of Design Issues." This was a triennial inspection starting in 2008 (was biennial before 2008), conducted at all plants.
2017 to Present	Design Bases Assurance Inspection (IP 71111.21M, IP 71111.21N)	NRC piloted the reduced-scoped (2 vs. 3 weeks onsite inspection) Design Basis Assurance Inspection (DBAI) inspection in calendar year (CY) 2015 and 2016 to address industry feedback that the NRC had adequately verified the licensee's original design bases over previous decades and to address feedback that licensees' prep for and support of CDBIs impacted their engineering organization for about 3 months (excessive regulatory burden) • Also, piloted the new DBAI/Programs Environmental Qualification (EQ) inspection, IP 7111.21N, "Design Bases Assurance Inspection (Programs)," to address internal lessons learned action item from Browns Ferry red finding* which recommended that the NRC periodically review licensees' engineering programs. • Although the EQ inspection was new, overall inspection burden on the licensee was maintained neutral because the scope of the CDBI was reduced • Commenced using new inspections (IP 71111.21M, "Design Bases Assurance Inspection (Teams)," 71111.21N, "Design Bases Assurance Inspection (Programs)" at all sites in CY 2017

*In a letter dated May 9, 2011, "Final Significance Determination of a Red Finding, Notice of Violation, and Assessment Follow-up Letter (NRC Inspection Report No. 05000259/2011008) Browns Ferry Nuclear Plant" (Agencywide Documents Access and Manangement System Accession No. ML111290482), the Tennessee Valley Authority was issued a red finding at Brown's Ferry because the licensee failed to maintain the Unit 1 outboard low pressure coolant injection valve in an operable condition, which rendered a low pressure emergency core cooling system injection/spray subsystem (the residual heat removal loop subsystem) inoperable while Unit 1 was operating in Mode 1.