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SUBJECT: PROPOSED TRANSFORMATIONAL CHANGES TO NUCLEAR REGULATORY COMMISSION ENGINEERING INSPECTIONS

This memorandum forwards the recommendations from the U.S. Nuclear Regulatory Commission (NRC) Engineering Inspection Working Group (EIWG). Our focus was to improve the effectiveness and efficiency of the NRC's engineering inspections in the Reactor Oversight Process (ROP). The EIWG was established in March 2017 and consisted of experienced NRC engineering inspection leaders from across the agency. The EIWG Charter can be found in the NRC's Library (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17176A620). The attached report is the culmination of extensive communications between the NRC staff, members of the public and public organizations, and the nuclear industry.

The EIWG addressed a number of key topics, including (1) clearly defining the purpose of conducting NRC engineering inspections, (2) considering performance indicators (PIs) as a replacement of engineering inspections, (3) considering licensee self-assessments as an element of future ROP engineering inspections, and (4) determining how to improve the effectiveness and efficiency of the NRC's engineering inspection program. The sections below summarize the EIWG's results.

Purpose of Engineering Inspections

The implementation of the ROP for operating light-water reactors relies on the implementation of a number of baseline engineering inspection procedures (IPs). The suite of engineering inspections was designed to focus on the identification of latent conditions (e.g., unknown design deficiencies) that could result in structure, system, and component failures during design-basis accidents. Although the primary focus of engineering inspections remains unchanged, inspection sample selection has shifted since the 1990s from verifying original plant design adequacy to increasingly inspecting the licensee's capability of maintaining equipment to meet its design and licensing-basis function.

Performance Indicators

Where possible, the ROP uses PIs to measure key attributes in each of the ROP cornerstones. A baseline was developed for areas (1) where a PI could not be identified, (2) where a PI was identified but was not sufficiently comprehensive, or (3) when a PI provided no insight on potential latent conditions. The working group explored several industry proposals in an effort to determine whether PIs could be leveraged to improve the efficiency of NRC oversight of licensee's engineering performance. The working group concluded that none of the industry proposals provided direct insights into the introduction or the identification of latent design issues.

Self-Assessments

Discussion in the area of licensee self-assessments resulted in the greatest engagement by both the public and the industry. Initial conversations between the EIWG and external stakeholders ranged from giving significant credit to giving no credit in the ROP for licensee self-assessments. The EIWG quickly aligned on the basic premise that the NRC needed to conduct independent engineering inspections annually. After several public discussions on the topic, the EIWG and stakeholders concluded that the use of industry self-assessments in conjunction with baseline engineering inspections could, if done properly, result in some improvements in both effectiveness and efficiency of NRC oversight with no loss of safety assurance. The industry has not yet provided a written guidance document on the use of industry self-assessments. If the industry were to develop a standard, the NRC would need to review and assess the industry standard, develop program guidance, and conduct a project demonstration to ensure that the standard addressed key areas of concern before it could be adopted as an integral element of the ROP. NRC guidance would need to consider key aspects, including defining the threshold for when a licensee could get credit in the ROP for a self-assessment, describing how the focus of the self-assessment is selected, describing how findings identified during a licensee self-assessment are treated, addressing transparency of self-assessment reports, and addressing NRC oversight of the self-assessment.

Effectiveness and Efficiency

The EIWG concluded that the current suite of engineering inspections were effective in identifying safety issues. The EIWG also recognized the need to address the current challenges facing the nuclear industry. Therefore, the EIWG concluded that the adoption of a more flexible inspection strategy that can be modified periodically to address current regulatory challenges facing the industry was beneficial.

In making these recommendations, the EIWG was cognizant of the importance of retaining the current ROP engineering inspection program features, which contribute significantly to reactor safety. The EIWG concluded that the recommended changes to the current ROP engineering inspection program reflect the appropriate level of engineering inspection that should be completed at each site, based on the following factors:

- the NRC's validation of each licensee's adherence to its licensing basis through the completion of engineering inspections over the last 18 years

- recognition of the need to create a more agile engineering inspection program that would allow the inspection of areas that challenge an aging nuclear fleet

- recognition of the benefits that can be derived from inspection of areas that are topics of operating experience or generic industry issues

The EIWG identified a number of changes that would result in notable efficiency improvements, such as eliminating the standalone heat sink engineering inspection and including heat sinks as a potential sample to be selected. Additionally, elements of Title 10 of the *Code of Federal Regulations* (10 CFR) 50.59, "Change, Tests and Experiments"; modification; and design-basis assurance inspections could be combined into a comprehensive engineering team inspection (CETI). Finally, the engineering inspection program could be expanded to cover a 4-year cycle. Combining elements of existing inspections into a CETI takes advantage of the synergy of inspecting an engineering design change throughout the modification process. The CETI would be conducted on a quadrennial interval, which would provide the inspection team with a sufficient pool of samples to select for inspection.

The EIWG identified multiple existing engineering IPs for which sampling methodologies could be improved to more effectively focus the inspection effort on risk-significant elements. The NRC could improve the effectiveness of its engineering inspection program in areas such as the following:

- improving the inservice IP to include a 10-year verification of the licensee's implementation of its inservice inspection program

- improving sample selection criteria to increase focus of engineering inspections on safety-related plant modifications and on other challenges that occur at a plant that is operating beyond its initial 40-year license period

Additionally, the EIWG found that the NRC engineering inspection program should have the flexibility to focus on risk-significant areas of a facility's engineering or on areas where operating experience might indicate a need. In addition, the EIWG determined that the engineering focus areas should have a level of acceptable regulatory certainty to allow for consistent and predictable inspection outcomes. The enclosure discusses options on how best to implement the concept of increased agility. The EIWG weighed the advantages and benefits of incorporating flexibility into the NRC engineering inspection program. The EIWG concluded that a certain amount of preplanning, including training to help inspectors understand the regulatory bases and technical requirements for the focus area and the development of finding threshold guidance, would facilitate implementation of the NRC Principles of Good Regulation.

Accordingly, the EIWG developed the concept of implementing focused engineering inspections (FEIs) each year during the interval between the quadrennial CETIs. The combination of the quadrennial CETI complemented by FEIs during the intervening years results in an annual opportunity for the NRC to assess licensee performance in the area of engineering. Through the use of this complementary combination of inspections, the EIWG group concluded that extending the cycle length to 4 years would not affect the ability of the inspection program to provide objective evidence that risk- or safety-significant structures remain capable of performing their intended safety functions.

Specific Recommendations

The working group recommends that the NRC do the following:

- Shift the frequency of the engineering inspections to a quadrennial cycle, with an engineering inspection every year at each site.

- Combine the 10 CFR 50.59, modification, and design-basis assurance inspection into one new CETI to be conducted on a quadrennial basis.

- Develop and implement FEIs during the intervening years.

- Eliminate the current standalone heat sink performance IP and include aspects of heat sink design as a potential inspection sample for the new CETI. Retain the resident inspector portion of the heat sink inspection.

- Retain the inservice inspection activities procedure, with some revisions to improve effectiveness.

- 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.

- 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. After industry development and NRC approval of self-assessment implementation guidance, conduct a demonstration of the project.

- Finally, implement a similar effort to improve the effectiveness and efficiency of the remaining baseline inspections in the ROP.

A. Gody

SUBJECT: PROPOSED TRANSFORMATIONAL CHANGES TO NRC ENGINEERING INSPECTIONS

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TABLE OF CONTENTS

I. PURPOSE

This enclosure documents the Engineering Inspection Working Group (EIWG) assessments of Reactor Oversight Process (ROP) engineering inspections and proposes recommendations for improvement of the ROP engineering inspection program effectiveness and efficiency.

II. BACKGROUND

In 2010, the management and staff of the U.S. Nuclear Regulatory Commission's (NRC's) Office of Nuclear Reactor Regulation (NRR), Division of Inspection and Regional Support (DIRS), determined that the effectiveness of the ROP should be reviewed 10 years after the initial ROP implementation. Shortly thereafter, in Staff Requirements Memorandum (SRM)-SECY-12-0081, "Staff Requirements—SECY-12-0081— Risk-Informed Regulatory Framework for New Reactors," dated October 22, 2012, the Commission directed the staff to perform such a review. The staff undertook two distinct activities in response to the SRM. One activity resulted in the ROP independent assessment report in 2013 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14035A571), and the other activity resulted in the ROP enhancement project in 2014 (ADAMS Accession No. ML14017A338 (package)).

NRR/DIRS changed the component design-basis inspection (CDBI) procedure to reflect the recommendations made in the ROP enhancement project. These changes were made after extensive external stakeholder engagement and resulted in the bifurcation of the old CDBI procedure into two separate inspection procedures (IPs): IP 71111.21M, "Design Bases Assurance Inspection (Teams)," and IP 71111.21N, "Design Bases Assurance Inspection (Programs)." The NRC conducted eight pilot inspections during calendar year (CY) 2015 and CY 2016. In CY 2017, the staff implemented the revised CDBI inspections, now referred to as design-basis assurance inspections (DBAIs) instead of CDBI.

The changes that were made resulted in less-efficient inspections for modifications and Title 10 of the *Code of Federal Regulations* (10 CFR) 50.59, "Change, Tests and Experiments" (IP 71111.17T, "Evaluations of Changes, Tests and Experiments"). The feedback received from the NRC regions following the change prompted NRR/DIRS management to sponsor the EIWG to review and reassess the effectiveness and efficiency of all ROP engineering inspections and, based on the assessment, recommend additional improvements.

In March 2017, the EIWG was formed and was composed of four Branch Chiefs, one from each region, and a senior reactor operations engineer from DIRS, overseen by the Division Director of the Region II Division of Reactor Safety. A team leader from the Division of Risk Assessment was added to ensure that the EIWG considered risk insights and incorporated them into its recommendations. The EIWG held a series of face-to-face meetings, teleconference meetings, and four public meetings associated with the development of the various options on the EIWG-proposed changes to the engineering inspection program.

A. Charter

One of the first tasks assigned to the EIWG was to develop a charter to set the parameters for the working group's purpose and tasking assignments (ADAMS Accession No. ML17172A620). The main purpose of the charter was to improve effectiveness and efficiency of the engineering inspections while ensuring that the safety of each nuclear plant was maintained. The charter did not contain an established goal concerning the reduction of inspection resources. As a result, the EIWG developed recommended changes to the engineering inspections that reduced overlap, with the focus on identifying and reducing aging management effects, recent design changes, operating experience, risk perspectives, and identification of latent conditions.

B. Use of Internal/External Feedback

The EIWG took comments from both internal and external stakeholders, which included members of the public. Each of the regional Branch Chiefs solicited feedback from the regional engineering inspectors and senior managers, including the Regional Administrators, the NRR Office Director, and the Deputy Executive Director for Reactor and Preparedness Programs. In addition, during each of the face-to-face meetings, engineering inspectors and Branch Chiefs who were not part of the EIWG attended the meetings and gave their perspectives to the EIWG. For external stakeholders, a series of three public meeting took place to discuss the progress of the engineering inspection review and to get input from industry and other external stakeholders. In addition, the working group received e-mails and written correspondence from various members of the public that contained recommendations, and many expressed concerns about allowing licensees to conduct self-assessment (SA) inspections.

C. Briefing and Discussions with Senior Managers

Throughout the entire process, senior managers were periodically briefed on the EIWG's progress and on the ideas that were under discussion by the group. Their feedback and suggestions were evaluated and changes were incorporated throughout the process. Some of these periodic briefings included biweekly NRC direct reports briefings (Executive Director for Operations (EDO), NRR Office Director, and the Regional Administrators), formal briefings to senior NRC managers, including the EDO, and briefings at the January 2018 Division Directors Counterpart Meeting and the February 2018 Direct Reports meeting.

III. DISCUSSION

This section of the EIWG recommendation paper summarizes the many discussions held on a variety of topics related to this effort among the EIWG members. EIWG met face to face to conduct these discussions during CY 2017 and CY 2018. The first meeting was held in February 2017, and the last meeting was held in February 2018. Each meeting had an area of focus, and meeting discussions were influenced by internal and external feedback, which was being communicated to the EIWG throughout CY 2017. The EIWG recommendation incorporated, as appropriate, many of these views reflected through either written or verbal feedback. This section does not present these topics chronologically but based on areas that were discussed, debated, and deliberated to develop the EIWG final recommendation for transforming the ROP engineering program.

In one of its first meetings, the EIWG evaluated the gaps and overlaps in the NRC's current ROP engineering inspection program. Section III.A discusses the results of this discussion in detail. In the next several meetings, the EIWG discussed and developed all the different ways, or options, that the agency could use to implement the new ROP engineering inspection program.

The EIWG developed about 10 different options that the NRC could consider for the new ROP engineering program. For each of these options, the EIWG also discussed and developed the advantages and disadvantages associated with each option. After all the options were developed, each region and NRR member obtained feedback from his or her management and inspectors on each of these options. After considering the feedback from the regional managers and inspectors and from NRR management on the initial set of options, the EIWG developed the top three options and presented these options to NRC managers and inspectors as a possible replacement for the current ROP engineering inspection program. Section III.B.2 discusses this topic in more detail. In order to more fully critically examine and be able to support the basis for each of the three options, the EIWG discussed the merits of each of the key option attributes, as discussed in Section III.B.3. During these discussions, the working group found that using a focused engineering inspection (FEI) approach could lead to a more agile engineering inspection program, which could be changed periodically to meet the challenges facing the industry and the NRC. Therefore, the EIWG began to support one of the top three options, which contained three FEIs as a feature, as the group realized that use of these FEIs could address the gaps in the current ROP engineering program. Section III.B.3.c reflects the development of this viewpoint.

The EIWG recommends that fire protection, power-operated valves, and external events be the three FEIs for the first cycle starting in CY 2020. The EIWG further recommends that all regions perform each of the recommended FEIs. Additionally, the EIWG discussed and developed a possible library approach to conducting FEIs to allow some variation of FEIs being performed in each region after completion of the initial quadrennial inspection cycle. Section III.B.3.d discusses the library approach in more detail.

Other attributes that the EIWG discussed and deliberated on included the use of performance indicators (IPs) and licensee SAs and the appropriate length of an inspection cycle in the proposed ROP engineering inspection program. Section III.B.3 discusses these topics.

Finally, the EIWG initially presented its recommendation for the ROP engineering program to members of the public on February 22, 2018, after briefing and obtaining approval from NRC senior management. The group recommended that an ROP engineering inspection be performed on a quadrennial cycle, with one comprehensive FEI and three FEIs. Inservice inspection would continue with some changes. Additionally, licensees' SAs would not initially be part of this change but could be in the future based on continuing work between the NRC, industry, and members of the public.

The EIWG also discussed the NRC Principles of Good Regulation and how it used risk during the discussions and deliberations. Although these two topics were not a focus area for discussion, the EIWG discussed them in each of its meetings, and all group members agreed to the concepts in Sections III.B.1.a and III.B.1.b; therefore, this paper includes these topics. In addition, a senior risk analyst with regional experience was brought into the group in the latter half of the EIWG meetings to facilitate and verify that the working group had appropriately considered the use of risk in the development of the ROP engineering inspection program.

A. Evaluation of Gaps and Overlap in the Current Inspection Program

As part of the approved charter, dated August 7, 2017, for improving the effectiveness and efficiency of engineering inspections, the working group was tasked with making recommendations on improving the suite of engineering inspections within the ROP. This task included a review of the following eight engineering-related IPs to search for gaps and areas of overlap or redundancy within this suite of procedures:

- IP 71111.05T, “Fire Protection (Triennial),” or IP 71111.05XT, “Fire Protection—NFPA 805 (Triennial)”

- IP 71111.07, “Heat Sink Performance”

- IP 71111.08, “Inservice Inspection Activities”

- IP 71111.12, “Maintenance Effectiveness”

- IP 71111.17T

- IP 71111.18, “Plant Modifications”

- IP 71111.21M

- IP 71111.21N

Many procedures had some degree of overlap. However, the team determined that some overlap was acceptable. For example, each inspection area should review corrective action program aspects of identification, evaluation, and resolution because this is a fundamental part of the ROP. Another example is that the engineering team inspection may review past engineering issues that the resident inspectors may have already inspected. Although the resident inspectors typically focus on the impact that an identified deficient condition may have on plant operations, the engineering team would focus on the acceptability of the analysis that the licensee performed to evaluate the deficient condition. Therefore, the following discussion for each procedure only describes the key overlap areas of concern. The discussion of the basis associated with each IP below briefly details why each inspection is done. Attachment 2, “Technical Basis for Inspection Program,” to Inspection Manual Chapter 0308, “Reactor Oversight Process Basis Document,” discusses this topic in more detail.

1. IP 71111.05T, “Fire Protection (Triennial),” or IP 71111.05XT, “Fire Protection-NFPA 805 (Triennial)”

   Basis: Plant-specific evaluations have shown that internal fires are high contributors to risk at some plants because of the potential for damage to redundant systems and multiple control circuits and the adverse effect on operator mitigation strategies. Fires continue to occur at nuclear power plants at a fairly constant rate; therefore, fire protection remains an important safety feature that needs to be maintained and inspected.

   Gaps: Aging-related failures (degradation of piping and cables), which result in fires at plants, are not explicitly inspected (fires at the Quad Cities Nuclear Power Station and Dresden Nuclear Power Station). Consider inspecting the impact of plant modifications on the initiation of fires or on fire protection features (i.e., a modification inspection may need to address this aspect).

Overlap: Maintenance activities

Recommendations:

- The NRC has inspected licensees' implementation of this program many times under the ROP. Extend the inspection periodicity of this IP beyond every 3 years and reduce samples and hours.

- Separate out the B.5.b mitigation strategy inspection requirements and relocate them to another IP.

- Consider conducting an inspection for the aging of piping and electrical cables, elastomers, seals, and hoses (Sections XI.M26, "Fire Protection," and XI.M27, "Fire Water System," of NUREG-1801, "Generic Aging Lessons Learned (GALL) Report").

2. IP 71111.07, "Heat Sink Performance"

   Basis: Degradation in heat exchangers and heat sinks required to remove decay heat can result in the failure to meet system success criteria and lead to increased risk primarily resulting from common-cause failures. This inspectable area verifies aspects of the associated cornerstones for which there are no indicators to measure performance. Industry experience has shown that many plants have experienced significant problems with repeated loss of heat sink and degraded performance of heat exchangers caused by corrosion, silting, and fouling.

   Gaps: No gaps were identified.

   Overlap: Because of the small population of heat exchangers/sinks, inspectors routinely inspect the same four or five heat exchangers/sinks every 3 years.

   Recommendations:

- Eliminate the triennial inspection.
- Add an optional heat exchanger sample to IP 71111.21M.
- Maintain the resident inspector portion (annual review).

3. IP 71111.08, "Inservice Inspection Activities"

   Basis: The inspection activities are intended to ensure that the licensee has an effective program for monitoring degradation of the reactor coolant system boundary, including steam generator tubes; controlling noncode repairs to American Society of Mechanical Engineers components; and performing the required periodic examinations. Degradation of these components would result in a significant increase in risk. Inservice inspection activities are necessary to ensure that the licensee has an effective program to ensure that risk-significant degradation of the reactor coolant system boundary is identified and is promptly and appropriately corrected.

Gaps: Currently, the NRC does not review the adequacy of licensee's inservice inspection program implementation. Specifically, no inspection requirement currently exists to verify the adequacy of the licensee's revision to its inservice inspection program, which is updated every 10 years.

Overlap: None

Recommendations:

- Continue to perform inservice inspection activities based on material flaws and failures resulting from aging effects.

- Eliminate the inspection of boric acid corrosion control (IP 71111.08, Section 02.03) but maintain the boric acid inspection of the reactor head (IP 71111.08, Section 02.02).

- Maintain the current recommended resource estimate and add an inspection requirement to review the implementation of changes to the licensee's inservice inspection program once every 10 years, preferably near the start of each new 10-year interval.

4. IP 71111.12, "Maintenance Effectiveness"

   Basis: Proper monitoring and implementation of the requirements in 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants" (the Maintenance Rule), should ensure that there is a proper balance that optimizes availability and reliability when removing equipment from service for preventive maintenance. Proper work practices, corrective actions, and a reduction in potential common-cause failures will also ensure that the structures, systems, and components (SSCs) are capable of fulfilling their intended safety functions.

   Gaps: None

   Overlap: There is some overlap with the other engineering IPs; however, the overlap is acceptable because resident inspectors implement this IP to ensure timely identification and correction to deficient maintenance practices, thereby minimizing the potential for common-cause failures of SSCs important to safety.

   Recommendations: No changes are recommended.

5. IP 71111.17T, "Evaluations of Changes, Tests and Experiments"

   Basis: Inspection of permanent modifications monitors the licensee's performance to ensure that the licensee has maintained the design bases for risk-significant SSCs and that the changes have not adversely affected the licensing and design bases and safety functions of the SSCs. Modifications may introduce changes to the assumptions and models used in plant-specific probabilistic risk assessments (PRAs). Modifications to one system may affect the design bases and functioning of other interfacing systems. In addition, similar modifications to several systems could introduce the potential for common-cause failures that affect plant risk.

Gaps: None

Overlap: Both IP 71111.21M and IP 71111.17T review aspects of licensee's implementation of its 10 CFR 50.59 program. During a DBAI, the inspectors review the 10 CFR 50.59 evaluations conducted by the licensee as part of its modification package, whereas inspectors use IP 71111.17T to review evaluations and screenings associated with the 10 CFR 50.59 program.

Recommendations:

- Review both modifications and the 10 CFR 50.59 process together. This recommendation is based on feedback from inspectors currently performing inspections using this IP.

- Options for this IP include the following:

    - Combine the IP into a DBAI and make it 3-week inspection.

    - Recreate the old modification/10 CFR 50.59 inspection.

    - Combine the 10 CFR 50.59 inspection into a DBAI and add another inspection. This option would eliminate the current IP 71111.17T inspection and would allow flexibility in performing more modification/10 CFR 50.59 sample inspections at sites where there are insufficient samples of safety-related modifications available.

6. IP 71111.18, "Plant Modifications"

Basis: Modifications to risk-significant SSCs can adversely affect their availability, reliability, or functional capability. Modifications to one system may also affect the design bases and functioning of interfacing systems. Similar modifications to several systems could introduce the potential for common-cause failures that affect plant risk. A temporary modification may result in a departure from the design basis and system success criteria. Modifications performed during increased risk configurations could place the plant in an unsafe condition.

Gaps: None

Overlap: IP 71111.18 is redundant with both DBAIs. However, real-time observations of the implementation and testing of the modifications are necessary.

Recommendations: Reduce the sample size and inspection hours. The recommended sample size would be 2 to 4, and the recommended inspection hours would be 20 to 28 hours based on the limited number of temporary modifications that are available for inspection and the modifications that have already been through DBAIs.

7. IP 71111.21M, "Design Bases Assurance Inspection (Team)"

Basis: Inspection of safety system design and performance verifies the initial design and subsequent modifications and provides monitoring of the capability of the selected system to perform its design-basis functions. The inspection should focus on the design and functional capability of components that are not validated by in-plant testing. Engineering inspections are important because they can identify latent conditions that may only manifest themselves during events and may not be evident during normal operations and testing.

Gaps: Focus on age-related degradation and modifications instead of historical design.

Overlap: IP 71111.21M is redundant with IP 71111.18 and IP 71111.17T.

Recommendations:

- Consider adding options to inspect the heat exchanger design if the heat sink IP is eliminated.

- Consider adding the requirements of 10 CFR 50.59 into risk-significant samples and eliminate the IP 71111.17T inspection. (An additional inspector would be required.)

- Change the level of effort such that the primary focus of the inspection is age-related degradation and changes to SSCs while incorporating operating experience and risk insights.

8. IP 71111.21N, “Design Bases Assurance Inspection (Program)”

Basis: The inspection of the licensee’s implementation of engineering activities that affect the quality of risk-significant SSCs provides reasonable assurance that those SSCs can adequately perform their design-basis function. This inspection is intended to assess the effectiveness of the licensee’s ability to provide oversight of those activities in selected engineering areas.

Basis for Environmental Qualification (EQ) Inspection: EQ components are important to safety, and they must be able to perform their safety function throughout their installed life. These components must withstand design-basis events that could affect the integrity of the reactor coolant pressure boundary, safe shutdown, or the capability to prevent or mitigate accidents. Licensees have made changes to EQ SSCs and programs over the years as plants run into periods of extended operation and as qualified replacement components are no longer available. Additionally, normal maintenance and surveillance activities do not predict failures of EQ components to perform their function at accident levels of radiation, temperature, and moisture.

Important attributes of the EQ program, processes, and procedures are examined to provide a reasonable level of assurance that components and systems throughout the plant will function as designed during design-basis events and that common-mode failures of components are prevented.

Gaps: The NRC has not performed EQ inspections of this detailed nature since the 1980s, when licensees documented their approach to meet the EQ requirements in 10 CFR 50.49, “Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants.”

Overlap: IP 71111.21N is redundant with IP 71111.18 and IP 71111.17T.

Recommendations: Add other engineering areas for inspection.

B. Discussion of Potential Effectiveness and Efficiency Improvements

1. Guiding Principles Used by the Engineering Inspection Working Group

a. Principles of Good Regulation

Members of the EIWG used the following principles to guide their review of the current ROP engineering inspections to improve their effectiveness and efficiency:

- Maintain the NRC's capability as independent regulators.
- Identify deficient conditions that would not normally be readily identifiable through routine plant activities (e.g., surveillances).
- Allow inspections that are focused on changes that are occurring at an older and more mature U.S. operating fleet.

Being an independent regulator means that the NRC maintains a cadre of inspectors who have both inspection skills and knowledge of the engineering areas in which they are performing an inspection. This level of proficiency requires a stable inspection staff that greatly contributes to the quality of the inspection and a trained inspection staff that has both the regulatory and technical knowledge associated with the area in which it is performing an inspection. The EIWG recognized the impact and challenges of having a longer inspection cycle length on each region's ability to possess a skilled and knowledgeable inspection staff that can perform inspections on a specific regulatory area.

The EIWG also concluded that the current suite of engineering inspections is effective in identifying safety issues. The EIWG found that one of the attributes of the current ROP engineering program that added value to reactor safety was its ability to identify latent conditions that would not manifest themselves through routine plant surveillance activities. This attribute would assist the NRC inspection staff in identifying components before they failed. Although NRC inspection reports would categorize many of these identified conditions as performance deficiencies of low safety significance (Green), some of these deficiencies would have become more risk significant (i.e., greater than Green) if the NRC had not identified the performance deficiency before component failure. Therefore, the EIWG recommended retaining inspections that contributed to the identification of latent conditions.

The EIWG decided that it was beneficial to adopt a more flexible inspection strategy that can be modified periodically to address current regulatory challenges facing the U.S. nuclear fleet. This recognition of the changing environment led to the recommendation of the FEIs, which can be performed based on current industry challenges or inspections of areas that have not been inspected for some period of time.

In all of these EIWG-recommended changes, the working group was cognizant of the importance of retaining the current ROP engineering program features, which were providing valuable contributions to reactor safety. The EIWG concluded that the recommended changes to the current ROP engineering inspection program reflected the appropriate level of engineering inspection that would be completed at each site. This conclusion is based on (1) the validation of each licensee's adherence to its licensing basis through the completion of engineering inspections over the last 18 years, (2) a desire to create a more flexible inspection program that would allow for the inspection of areas that are causing challenges to an older nuclear fleet, and (3) recognition of the benefit derived from the inspection of areas that were topics of past NRC generic communications. These considerations led to the EIWG's recommendation of an engineering inspection program that would include one comprehensive engineering team inspection (CETI), three FEIs, and the retention of the current inservice inspection over a 4-year time period. In addition, these recommended changes result in an inspection resource savings of about 16 percent annually.

b. Use of Risk in Reactor Oversight Process Engineering Inspections

Any changes to the ROP's engineering inspections should align with the Commission's direction on the use of PRA.[1] Specifically, changes should adhere to the following key principles:

- The objective of any risk-informed inspection program is to focus inspection resources on aspects of plant design and operation that are of the greatest safety significance.

- Risk information should be used to the extent supported by the state of the art in PRA methods and data. The state of the art has evolved since the inception of the ROP in several areas such as external events PRA (e.g., fire, seismic).

- Decisions about how and what to inspect should be made using the best available risk information, including the NRC's standardized plant analysis risk models and information provided by licensees.

- The use of risk information should not be limited to selecting which SSCs to inspect. Engineering inspections should focus on the specific characteristics or functions of an SSC that drive the risk results.[2]

- PRAs typically assume that plants are designed and constructed in accordance with applicable codes and standards. In certain cases, it may be useful for inspections to verify that such underlying assumptions are valid.

- In general, traditional PRA importance measures (e.g., Fussell-Vesely, Risk Achievement Worth, Risk Reduction Worth, and Birmbaum) should be used to identify risk-significant SSCs; however, inspectors and risk analysts should work collaboratively to identify inspection targets that involve latent conditions that are safety significant but that a PRA may not directly model. Examples include

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[1] See the Commission's 1995 Policy Statement on PRA and SRM-SECY-98-144, "Staff Requirements—SECY-98-0144—White Paper on Risk-Informed and Performance-Based Regulation," dated March 1, 1999.

[2] For example, the ability of a valve to open may be risk significant, whereas its ability to close may not be risk significant.

conditions that would increase common-cause failures across systems and low-margin/cliff-edge effects.

- The objective of all inspections is to monitor and evaluate licensee performance and to identify safety issues if they exist. A licensee's performance is ultimately measured by inputs to the Action Matrix, and these inputs include an evaluation of the change in risk for some cornerstones through the significance determination process that occurs from a performance deficiency.

2. Development of Potential Options

During several of the initial EIWG meetings, before the working group discussed and made various changes to the engineering inspection program, it accomplished the following tasks during the development of options:

- defined the overall purpose of the NRC engineering inspections

- identified licensee activities that affect the capability of SSCs

- reviewed each engineering IP listed in the charter to determine why each inspection was performed and looked for gaps, overlaps, and options to reduce, add to, or eliminate the procedure

- reviewed engineering areas that the NRC should inspect

Based on the results of the above tasks, the EIWG initially developed various options for the engineering inspection program. The EIWG solicited input from engineering inspectors, resident inspectors, and management to develop innovative and potentially transformational ideas to meet the intent of the inspection of engineering areas. The team considered gaps and overlaps in the current program, team sizes, duration of inspections, frequency of performing inspections, and specific expertise needed. The EIWG considered some of the following initial options:

- Make no changes to the inspection program.

- Make minimal changes to the inspection program (e.g., incorporate feedback on the recent changes to the CDBI and IP 71111.17T).

- Identify PIs in lieu of engineering inspections (i.e., eliminate engineering inspections).

- Increase the team size of engineering inspections to conduct larger inspections each year.

- Focus only on changes to engineering design areas and fire protection areas and decrease the inspection cycle to every 2 years.

- Focus strongly on the corrective actions for engineering discrepancies identified either from operating experience, the licensee's corrective program, or previously identified violations.

- Incorporate SAs into the engineering inspections.

- Return to the previous format of the 3-week CDBI and the 2-week inspection for IP 71111.17T (i.e., modification/10 CFR 50.59 inspections).

- Increase the cycle frequency but keep the same inspections that were currently being performed.

After the EIWG further developed the various proposed options to include pros, cons, resources impact, and impact on regional capabilities, all working group members discussed each option at length to ensure that they all understood the proposed changes and impacts. The EIWG discussed these options with NRC Headquarters, regional senior management, and engineering inspectors and obtained additional comments and feedback that the working group incorporated into the final three options:

(1) Maintain the engineering inspection cycle at 3 years; however, only performing one engineering inspection each year (with the exception of the inservice inspection IP, which would remain at the same frequency). The three inspections would include an FEI, a CETI, and a fire protection inspection. The basis for this option was to allow further run time on recent changes to the CDBI and IP 71111.17T while incorporating immediate inspector and external stakeholder feedback on the changes.

(2) Increase the engineering inspection cycle to 4 years and performing one engineering inspection each year (with the exception of IP 71111.08, which would remain at the same frequency). The four inspections would include three FEIs and one CETI over the 4-year inspection cycle. The basis for this option was to incorporate internal and external feedback on the lack of inspection activities in engineering areas that have not been assessed in several decades while also shifting the emphasis of engineering inspections to become more risk informed and focused on recent changes, operating experience, and aging management.

(3) Increase the engineering inspection cycle to 4 years, perform one engineering inspection each year, continue with the inservice inspections at the same frequency, and allow the licensee to perform an SA in one of the FEI areas with some limited independent NRC oversight. This option would still have four inspections, including three FEIs and one CETI over the 4-year inspection cycle; however, this option would allow eligible licensees to voluntarily elect to perform an SA in one of the FEI areas. The basis for this option was to incorporate feedback from both internal and external stakeholders that licensees' SAs could improve the effectiveness and efficiency of engineering inspections.

The EIWG reviewed each of the three options against the Principles of Good Regulation and evaluated specific key attributes to determine the best option to increase the effectiveness and efficiency of engineering inspections.

3. Evaluation of Key Option Attributes

   a. Performance Indicators

When the ROP was established, the NRC developed a task group to determine which of the PIs 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. Where possible, the ROP task group sought to identify PIs as a means of measuring the performance of key attributes in each of the cornerstone areas. The group proposed "complementary" inspection activities for areas where it could not identify a PI. The group proposed "supplementary" inspection activities for areas where it identified a PI that was not sufficiently comprehensive.

The ROP task group noted that engineering and design do not lend themselves to objective safety outcome indicators. Therefore, the task group determined that these areas are best measured using audits, SAs, and inspections (see SECY-99-007, "Recommendations for Reactor Oversight Process Improvements," dated January 8, 1999). As a result, the task group was unable to develop PIs that would correlate to the identification of latent design issues; therefore, the engineering suite of inspections was developed to identify these design issues.

With more than 18 years of experience with the ROP, the EIWG reevaluated whether PIs could be developed to identify latent design issues. The EIWG held discussions with internal and external stakeholders to consider how a PI could measure adherence to design and licensing bases and codes and standards and to determine how to quantify the quality of the PIs.

The EIWG attempted to identify quantifiable measurable indicators that could be used. For example, the EIWG compared the number of design-related findings documented during engineering inspections to the following:

- 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)

- number of changes performed (i.e., comparing the total number of changes to the facility that the licensee made in a given triennial cycle to the number of engineering findings identified during the subsequent triennial cycles)

- emergency alternating-current power unavailability (i.e., comparing the number of engineering findings for a site to a ratio of the hours that the site had a train/system unavailable to perform its intended function as result of planned, unplanned, and fault exposure unavailability)

- safety system functional failures (i.e., 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, remove residual heat, control the release of radioactive material, or mitigate the consequences of an accident)

The EIWG was tasked with identifying (1) the linkage between the measured data, (2) latent design issues (i.e., could the data be correlated to leading indicators before inspectors identified a failure or made a finding), and (3) either direct or indirect indicators (e.g., problem identification and resolution performance as compared to engineering findings). Overall, the EIWG was unable to identify indicators that could be correlated to identifying latent design issues. Therefore, the working group recommends continuing the performance of engineering inspections to identify latent design issues.

b. Inspection Cycle Length

Along with its efforts focused on improving effectiveness, the working group identified opportunities to focus resources by adjusting the cycle length or period for completion of the suite of engineering inspections. The group considered extending the cycle length as a viable method for achieving increased efficiency. Industry performance over the past 18 years of ROP implementation indicated that this change to the cycle length could be implemented without substantial adverse impacts to the agency's performance goals to (1) maintain safety, (2) assure openness, (3) make NRC activities and decisions more effective, efficient, and realistic, and (4) reduce unnecessary regulatory burden in a manner that is risk informed, objective, predictable, and understandable.

Before moving forward, the working group thoughtfully considered possible advantages and disadvantages of extended cycle lengths. The review placed particular emphasis on maintaining annual touch points for the timely assessment of licensee safety performance, assuring that the NRC remained agile to cope with a changing industry, and retaining qualified inspection expertise to implement the baseline program inspections and respond effectively to emerging issues or trends.

With regard to the timely assessment of licensee performance, the working group noted that the proposed format for the suite of inspections in combination with an extended inspection cycle is not expected to negatively influence the effectiveness of the inspections. By retaining the opportunity to complete annual onsite engineering inspections (a CETI or FEI) and the confidence that the associated inspection results will be indicative of licensee performance, the working group determined that extending the cycle length would not impact the ability of the program to provide objective evidence that risk- or safety-significant SSCs remain capable of performing their intended safety functions consistent with their design and licensing bases (i.e., SSCs will operate within their safety limits, and limiting conditions for operation will be met).

However, the working group noted that a 4-year cycle appears to have the greatest efficiency gain. Extending the cycle length beyond 4 years will introduce some inefficiencies associated with the training of inspectors. Of specific concern was the potential that an extended cycle length beyond 4 years could adversely impact organizational readiness or agility. Specific concerns were related to the inefficiencies that may result from increased staffing to accommodate a potentially broader and more diverse range of FEIs implemented over a longer cycle, increased training costs caused by staff turnover and attrition, increased costs associated with training in specialty areas, and loss of inspector proficiency. These factors are expected to adversely impact the NRC's efforts to remain agile and efficient.

Because the 4-year cycle appeared to have the most significant efficiency gain and the potential for introducing inefficiencies as a result of longer cycle times, the working group recommends a 4-year cycle.

c. Identified Gaps/Achievement of Agility in the Engineering Inspection Program

The EIWG's review of the current inspection program identified the following gaps:

- The focus on aging-related degradation and modifications for the fire protection inspections and the design-basis assurance inspection (teams) was limited.

- The adequacy of the licensee's overall implementation of its inservice inspection program had not been reviewed (i.e., specifically, the process for selecting specific components (i.e., weld nondestructive examinations) for evaluation and assessment).

- Some engineering areas have not been reviewed in detail for an extended period.

The gaps associated with the fire protection and design basis assurance inspection (teams) will be addressed through revision of the fire protection inspection procedure as part of transition to a focused engineering inspection and development of the new comprehensive engineering team inspection procedure. These activities are described in other sections of this document. The inservice inspection gaps will be addressed through its revision. The final gap, associated with the existing procedure, design basis assurance inspection (programs), will be discussed in further detail.

The current IP 71111.21N is designed to assess the effectiveness of the implementation of licensee programs that provide control over activities that affect the quality of the identified SSCs. Based on prior engineering inspection activities and experience gained from recent reviews of inspection area gaps, the EIWG concluded that the effective and efficient review of engineering includes in-depth inspections into the implementation of specific aspects of the licensee's engineering activities. The EIWG recommends development of a new FEI procedure that uses aspects in IP 71111.21N but clarifies that the basis is to inspect the licensees' control over activities that affect the quality of risk-significant SSCs to provide reasonable assurance that those SSCs can adequately perform their design-basis function. This inspection is intended to assess the effectiveness of licensees' implementation of these engineering activities in selected areas. The inspection is focused on current activities while incorporating reviews of the impact of aging management, operating experience, changes, and risk insights. The FEIs will focus on the licensee's implementation of key engineering activities; such inspections are not intended to be an engineering program review.

The FEIs would enable the NRC to focus its engineering inspection resources on areas that the agency has not recently reviewed, that have some risk significance, or that have recent industry operating experience. The ability to review multiple focus areas during each inspection cycle and to address new areas the following cycle increases the NRC's inspection effectiveness and flexibility. The EIWG selected the following criteria for the focused engineering areas:

- risk significance
- operating experience
- potential for unidentified latent conditions
- engineering challenges

Risk significance includes PRA insights, the potential for common-cause failures, and "cliff-edge" effects. A cliff-edge effect would be a sharp increase in the consequence of an event caused by a small change in the event initiator. For example, the Near-Term Task Force, which conducted the NRC's review of the Fukushima Daiichi nuclear event, defined the cliff-edge effect in a flooding event as the safety consequence of an event that increases sharply with a small increase in the flooding level. Operating experience includes recent industry performance trends in SSC failures and insights from NRC inspections. The potential for unidentified latent conditions is focused on engineering aspects that would not normally be identified during normal surveillance testing and had not been subject to a recent detailed NRC review. Engineering challenges include changing conditions such as aging effects, the impact of life extension, significant modifications, or regulatory changes.

The following discussion describes how the EIWG determined these criteria. The original basis for the current heat sink inspection was a result of the potential for common-cause failures (risk significance), historical industry issues (operating experience), and no PIs or inspections (potential for unidentified latent conditions). The working group evaluated this inspection and concluded that, although risk significance remains due to the potential for common-cause failures, improvements by the industry have significantly reduced heat sink events and challenges (operating experience). In addition, the NRC has conducted extensive reviews of this area to reduce the potential for unidentified latent conditions, and recent changes at the sites would not likely result in engineering challenges to the heat sink equipment performance. Therefore, the EIWG concluded that the heat sink inspection was not needed as a standalone IP or a separate FEI.

The EIWG developed the following list of potential engineering areas based on input from regional inspectors and evaluated these areas against the criteria given above:

- fire protection
- motor-operated valves (MOVs)/air-operated valves (AOVs)
- the Maintenance Rule (balancing reliability/availability and implementing a preventive maintenance program)
- commercial-grade dedication
- external hazards (flooding, seismic, or other external hazards and aspects of flexible coping strategies (FLEX) and 10 CFR 50.54(hh))
- station blackout
- operator actions
- setpoints/acceptance criteria
- snubbers/structural analysis
- heat sink
- aging management (focusing on passive components)

- gas accumulation management
- implementation of inservice testing
- focus of the corrective action program on engineering and operating experience
- containment (coatings/debris and leakage testing)
- risk initiatives (10 CFR 50.69, “Risk-Informed Categorization and Treatment of Structures, Systems and Components for Nuclear Power Reactors”; surveillance frequency control; and limiting conditions for operation control)
- ventilation system program (control room and filter testing)
- power uprate
- fuel management (shutdown margin, fuel loading, and spent fuel pool)
- electrical components (e.g., solenoids, breakers, transformers)

This list is not inclusive of all potential areas considered. Using the criteria above, the EIWG recommended the following FEIs for the next inspection cycle:

- fire protection
- power-operated valves (MOVs and AOVs)
- external hazards (flooding, seismic, or other external hazards and aspects of FLEX and 10 CFR 50.54(hh))

The EIWG chose these three areas based on their contribution to plant risk, past operating experience issues identified in these areas, and the potential for the existence of unidentified latent conditions that could result in unexpected engineering challenges.

For example, a fire has remained a significant contributor to plant risk. In many cases, the risk posed by fires is comparable to or exceeds the risk from internal events. The fire protection program shall extend the concept of defense in depth to fire protection in plant areas important to safety by accomplishing the following:

- preventing fires from starting
- rapidly detecting, controlling, and extinguishing fires that do occur
- providing protection for SSCs important to safety so that a fire that is not promptly extinguished by fire suppression activities will not prevent essential plant safety functions from being performed

Fire protection inspections can be accomplished as follows:

- Perform traditional fire protection inspections in accordance with the requirements of Appendix R, “Fire Protection Program for Nuclear Power Facilities Operating Prior to

January 1, 1979," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities,"

- Use risk-informed, performance-based fire protection based on established goals, objectives, and performance criteria against which the fire protection program is measured.

Currently, the EIWG recommends that fire protection inspections be accomplished as one of the three FEI samples starting in the revised engineering inspection program. This would be reevaluated for the subsequent inspection cycle based on risk significance, operating experience, and other factors.

Based on industry progress with addressing past fire protection concerns and significant NRC inspections of fire protection programs, the EIWG recommends changes to the triennial fire protection procedure. The IP should be revised to focus more on the implementation of the fire protection programs, changes to fire protection features (e.g., replacing obsolete detection systems and replacing suppression systems resulting from the phase out of Halon production), and aging management of fire protection features. The B.5.b portion should also be relocated to one of the proposed FEIs.

The basis for conducting periodic fire protection inspections remains as internal fires continue to be high contributors to risk at plants due to the potential for damage to redundant systems and multiple control circuits and the adverse effect on operator mitigation strategies. Fires continue to occur at nuclear power plants at a relatively constant rate; therefore, fire protection remains an important safety feature that facilities need to maintain and that the NRC needs to review on some periodicity.

The new inspection would have a reduced scope. The number of inspectors would be reduced from 4 inspectors for 2 weeks to 3 inspectors for 2 weeks, and the inspection frequency would be reduced from once every 3 years to once every 4 years. This would be incorporated as one of the FEIs and would be reevaluated at the end of the next inspection cycle.

d. Selection and Implementation of Focused Engineering Inspections

The EIWG assessed two methods for the selection and implementation of the FEIs: (1) a "fixed" approach and (2) a "library" approach. In the fixed approach, all four regions would conduct the same FEIs at each nuclear site during an inspection cycle. The specific FEI areas would be selected before the beginning of the inspection cycle using the criteria listed above. The "fixed" approach has the advantages of (1) being predictable, (2) improving regional consistency in the performance of the FEIs, (3) leveraging the knowledge and experience of inspectors by sharing them between regions, conducting periodic discussions, and vetting inspection findings between the regions, (4) providing a more effective and efficient training process with common instructors and training sessions given to all inspectors, and (5) improving support from NRR technical staff to address unresolved items identified through the FEIs. Table 1 depicts this fixed approach.

The library approach develops a number of FEIs and selects an FEI at a site during end-of-cycle meetings. The selection would be based on current licensee performance challenges and site-specific risk insights. The fixed approach provides more predictability across the industry on inspections and assessments. The main advantage of the library approach is that it provides additional flexibility to further customize the baseline inspections based on the NRC's assessment of licensees' performance. This would allow the NRC to adjust the inspection activities using site-specific information while remaining consistent with the overall ROP framework. The EIWG concluded that, although the library approach could have additional benefits during the second quadrennial inspection cycle, a fixed approach is the only feasible option during the first quadrennial cycle because of the significant resources needed to develop, train, and execute each new inspection area. The EIWG recommends revisiting this issue before the second quadrennial inspection cycle (CY 2022). Table 2 depicts this library approach.

Table 1 Fixed Approach

Site	Year 1	Year 2	Year 3	Year 4
1	FEI No. 1 (Fire Protection)	CETI	FEI No. 2 (External Hazards)	FEI No. 3 (MOVs/AOVs)
2	CETI	FEI No. 3 (MOVs/AOVs)	FEI No. 1 (Fire Protection)	FEI No. 2 (External Hazards)
3	FEI No. 2 (External Hazards)	FEI No. 1 (Fire Protection)	FEI No. 3 (MOVs/AOVs)	CETI

Table 2 Library Approach

Site	Year 1	Year 2	Year 3	Year 4
1	FEI No. 1 (Fire Protection)	CETI	FEI No. 2 (External Hazards)	FEI No. 3 (MOVs/AOVs)
2	CETI	FEI No. 4 (Commercial-Grade Dedication)	FEI No. 1 (Fire Protection)	FEI No. 2 (External Hazards)
3	FEI No. 5 (the Maintenance Rule)	FEI No. 6 (Inservice Testing Implementation)	FEI No. 3 (MOVs/AOVs)	CETI

Overall, the EIWG concluded that a series of FEI would improve the effectiveness, efficiency, and agility of the engineering inspection program.

e. Licensee Self-Assessments

The working group considered whether safety benefits and efficiency gains could be realized by modifying the NRC ROP to include provisions for the use of licensees' SAs to supplement independent NRC engineering inspections. The working group approached this subject with the NRC's safety mission and the Principles of Good Regulation as guiding standards. The group focused on proposals with the goal to improve safety or, if such a goal is not achieved, to be "safety neutral" at a minimum while accruing efficiency gains.

The group reviewed the NRC's experience with licensees' SAs, considered stakeholder input, and applied the group's experience and judgement to develop essential elements of a proposal consistent with the NRC's safety mission and Principles of Good Regulation. The working group's proposals include recommendations for a demonstration project as part of the nearer term steps.

History of Licensee Self-Assessments in the NRC's Inspection Program

The use of licensees' SAs to supplement the NRC's inspection is not a new concept. Before transitioning to the ROP, the NRC's oversight process for the systematic assessment of licensees' performance included provisions for licensees' SAs to supplement the NRC's independent engineering inspection. The goal at the time was to "minimize regulatory impact and more effectively utilize NRC resources for certain inspections" (i.e., typically, the service water system operational performance inspection). NRC Administrative Letter 94-03, "Announcing an NRC Inspection Procedure on Licensee Self-Assessment Programs for NRC Area-of-Emphasis Inspections," dated March 17, 1994, described this process and announced the incorporation of NRC IP-40501, "Licensee Self-Assessments Related to Area-of-Emphasis Inspections" (ADAMS Accession No. ML031200409), into the inspection manual in 1994. The procedure introduced a new pilot program that allowed the NRC to evaluate licensee proposals to perform SAs and to determine whether the scope of the SAs warranted reduced NRC inspection. The NRC anticipated that the use of SAs would allow the NRC to expend approximately 25 percent of the normally expected preparation and inspection effort. In review of these documents, the working group determined that the NRC entertained proposals from licensees for specific SAs, evaluated whether a licensee was "recognized as a good performer," considered whether a licensee had sufficient staff with technical capability and independence, and approved reduced scope inspections on a case-by-case basis. The process included the NRC inspector's onsite observation of licensee SA activities, the review of final results, and the issuance of publicly available NRC inspection reports.

The NRC staff assessed this process in 2000 and developed lessons from reviewing 23 SAs with reduced NRC inspection in several staff-level documents (ADAMS Accession Nos. ML012360277, ML012350128, and ML012350113). The working group's review of these documents distilled the information into two overall conclusions. First, the efficiency that the NRC gained was less than expected (between 25 to 50 percent of the normally expected effort). Second, the process was found qualitatively to be beneficial "due to licensee ownership of findings and corrective actions." The working group further observed that aspects of NRC IP-40501 reflected the Principles of Good Regulation and recommended the inclusion of these principles in its proposal. These aspects involved consideration of the licensee's performance, independence in licensee team reporting and oversight, inclusion of onsite NRC inspector observation and review, and issuance of an NRC public report. The working group recognized that these aspects may reduce efficiency gains but that they must comport with the Principles of Good Regulation.

The working group also noted that the NRC staff revisited the role of licensees' SAs and the NRC's engineering inspection scope in 2004 as part of an effort to improve the effectiveness of the agency's engineering inspections. This effort ultimately resulted in the CDBI (see SECY-04-0071, "Proposed Program To Improve the Effectiveness of the Nuclear Regulatory Commission Inspections of Design Issues," dated April 29, 2004 (ADAMS Accession No. ML040970328). To better understand the degree to which NRC inspections and licensee's SA efforts were effective in identifying design issues, the NRC staff reviewed data from 3 years to identify 17 greater-than-Green findings related to engineering or fire protection issues. The NRC identified 11 of the 17 findings. Of the 11 findings, 7 involved issues previously recognized by the licensee's staff; however, the licensee had not recognized the significance of these findings. The NRC staff concluded that the results highlighted the need for "aggressive licensee self-assessments in the design area and effective corrective action programs that can evaluate and resolve the identified issues in a timely manner." In addition, SECY-04-0071 describes the staff's interactions with industry representatives on a proposal to allow NRC inspection credit for licensees' SAs in the design area and references draft industry guidance under development. A follow-up Commission paper (SECY-05-0118, "Results of the Pilot Program To Improve the Effectiveness of Nuclear Regulatory Commission Inspections of Engineering and Design Issues," dated July 1, 2005 (ADAMS Accession No. ML051390465)) indicated that the NRC staff intended to consider reduced scope CDBI inspections based on performance and to develop guidance for allowing credit for licensees' SAs. However, the working group's review did not identify any further staff and stakeholder interactions in this regard.

Consistent with the agency's experience in the 1990s, the group considered adjustments to the NRC's oversight process that allowed for the incorporation of licensees' SAs and took into account licensee performance and crediting of NRC inspections and reviews as a "backstop" to reasonably address the range of licensee corrective action program performances.

Current Review of Self-Assessments

The working group evaluated stakeholder input that it received during public meetings and posted the input on the NRC's public Web page at https://www.nrc.gov/reactors/operating/oversight/rop-design-insp-review.html). In regard to the role of licensees' SAs, the working group received input from the Nuclear Energy Institute (NEI) on October 11, 2017, describing an approach whereby licensees would conduct SAs, in lieu of full NRC inspections, using a standardized process that involved industry-generated checklists and templates with the intent to ensure reliable and high-quality performance in SA activities. The licensee's SA team would include a subject-matter expert and one staff member who is independent of the organization; the team would provide the NRC with a plan before conducting the SA. NEI asserted that this approach would benefit licensees by reducing resources to support NRC inspections, would enhance organizational learning capability, and would be more responsive to current performance trends and benefit industry. NEI asserted that the NRC would benefit from increased efficiency by focusing regulation on "behaviors and accountability" and from the reduced need for contractors. Other stakeholders provided written input that described concerns with licensees' SAs and reduced NRC inspections. Central themes were (1) NRC inspection is considered more effective than SAs in identifying design problems, (2) the results of NRC inspection in finding latent design problems show that licensee performance would not support effective SAs, and (3) the licensee staff's biases would preclude effective SA sampling selection and review.

The working group noted that the NRC's experience with licensees' SAs in the 1990s demonstrated moderate efficiency gains; however, no demonstrative safety gains could be attributed to the effort beyond a qualitative conclusion that the "licensees owned their corrective actions." These benefits were apparently not considered sufficient because the use of SAs was not included in the initial ROP framework nor pursued by the NRC staff and stakeholders when the issue was revisited in 2005.

Although experience indicates that there is wide-ranging quality in the SAs that licensees currently conduct for NRC inspections, the working group concluded that two important safety benefits may result from an appropriately designed and demonstrated NRC oversight process that defines criteria for crediting SAs in the ROP and for determining how findings and violations identified during a SA will be treated and that addresses transparency in NRC oversight of the SA reports. First, improved licensee staff skills and abilities may occur if licensees assume the primary role in completing SAs and implement industry stakeholder suggestions to develop detailed procedures that include templates, checklists, and technical standards that were not included in previous experiences. If it is demonstrated that these tools can ensure technical credibility; retain public confidence; show independence in oversight; provide stable and reliable SA quality; and reliably meet the NRC's Principles of Good Regulation (i.e., independence, openness, efficiency, clarity, and reliability and effectiveness), licensee SAs may provide an acceptable alternative to certain NRC engineering inspections. The working group also maintains that the continuation of NRC engineering inspection and review, even in a reduced state, provides an effective regulatory "backstop" to ensure reasonable assurance of safety.

Second, allowing the licensee to have an active role in the structured process to identify program areas for focused reviews may be useful in identifying those industry performance areas, systems, or equipment most deserving of additional attention. This may also influence licensees to expand their approach from the current licensee practice in which SAs are typically influenced by NRC inspection schedules and increase the use of plant performance insights to focus on other programs, processes, and areas warranting additional focus. These benefits may accrue to the degree that the licensee staff improves its plant design-basis knowledge and critical assessment skills, which can be applied in the normal course of work. Application of these skills may help identify issues that may otherwise go unnoticed.

To ensure that SAs have the quality necessary to supplement NRC inspections, the working group further considered limiting SA opportunities to licensees that demonstrate a minimum level of performance to be appropriate. The working group concluded that allowing a licensee to conduct an SA in one of the FEI areas provides the best opportunity for a consistent and a successful SA activity. It would provide licensees with clear areas for a detailed assessment and would help develop expertise across the industry. It may also enable consistent and detailed reviews by NRC inspectors to ensure that the SAs meet the NRC's standards to be considered for credit to supplement the independent NRC FEI. If incorporated, a typical ROP schedule would include one CETI, two FEIs, and one SA with an NRC review. Figure 1 provides a graphical representation of such a schedule.

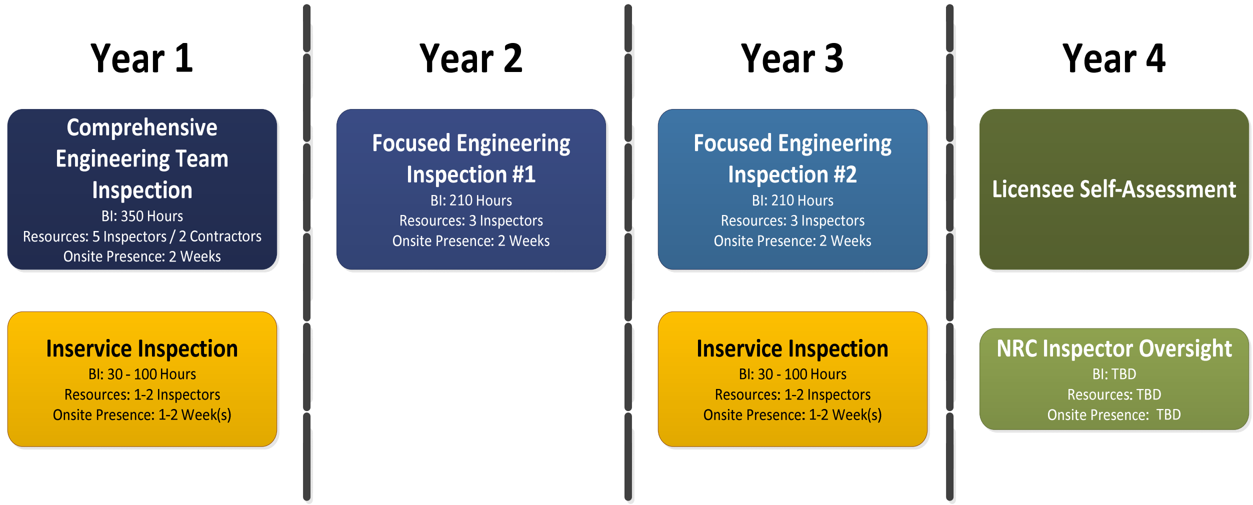

Figure 1 Graphical representation of a typical ROP schedule

The EIWG concluded that a properly developed SA program that reflects the NRC Principles of Good Regulation (i.e., independence, openness, efficiency, clarity, and reliability and effectiveness) could benefit plant safety. The EIWG could not draw any conclusions on the industry proposal because the industry had not yet submitted its written SA proposal to the NRC at the time the EIWG completed its review. However, the industry has indicated to the NRC that it intends to develop an SA process that would be acceptable for use by the NRC. Therefore, the EIWG recommended, and NRR agreed, that the NRC should proceed with its evaluation of the industry's efforts in the SA area. The NRR staff plans to provide its recommendation of the industry SA effort to the Commission after completing a review of the industry proposal and a demonstration of their initiative. The NRR staff's analysis will include a review of comments received from external public stakeholders on the industry's SA effort. In summary, significant work must still be performed before the acceptance of SAs into the ROP, including (1) the development of industry guidance on implementing SAs, (2) the development of NRC guidance on ROP implementation and review of the SAs, and (3) a project demonstration of the feasibility and effectiveness of the process.

IV. CONCLUSIONS

After obtaining additional internal and external feedback, the EIWG determined that the proposed engineering inspection option should contain the following attributes:

- ability for the NRC to inspect the licensee's engineering areas annually
- inclusion of modifications, 10 CFR 50.59, and DBAIs into one new CETI
- development of FEIs
- a change in the frequency of CETIs and FEIs to a quadrennial cycle

- retention of the current inservice inspection activity with some revisions to improve its effectiveness

- continuation of work with industry on the possible use of licensees' SAs within the scope of the proposed ROP engineering inspections

The EIWG communicated these recommended attributes to both NRC management and external stakeholders and received no major objections. The EIWG used these attributes to recommend Option 2 (see Figure 2) from the top three recommended options for adoption in the new ROP engineering inspection program.

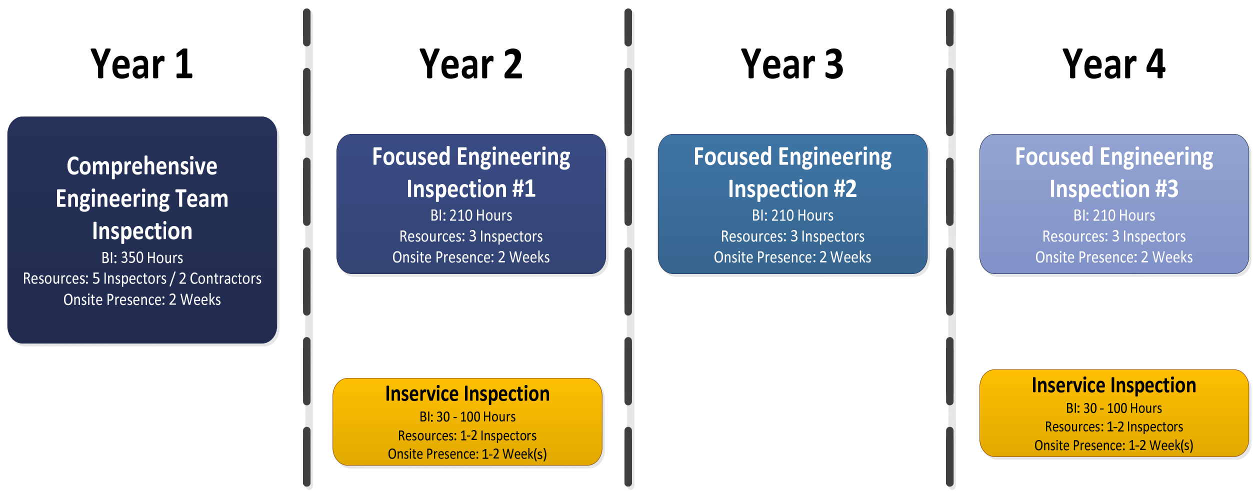

Figure 2 Schedule for the new ROP engineering inspection program

The EIWG presented a final recommendation at the Division Directors Counterpart meeting in January 2018 and the Office Directors meeting in February 2018. The overwhelming consensus of both groups was acceptance of the EIWG's recommendation. The following summarizes the EIWG's final recommendation:

- Change the frequency of the engineering inspections to a quadrennial cycle, with an engineering inspection "touch point" every year at each site.

- Begin the new engineering inspection program in CY 2020 to allow for completion of the current engineering inspection program, development of the new engineering IPs, and training of NRC inspectors to the new engineering IPs.

- Eliminate IP 71111.07 and include it as an inspection sample for the new CETI. Retain the resident inspector portion of IP 7111.07.

- Retain IP 71111.08 with some revisions.

- Develop a new CETI with the following characteristics:

  – Require five inspectors with two contractors onsite for 2 weeks.

  – Incorporate elements of modifications, 10 CFR 50.59, and DBAIs.

  – Include a new IP that emphasizes changes, operating experience, and aging to identify latent conditions.

- Develop FEIs that incorporate risk insights and operating experience and address the implementation of key engineering areas. During the first quadrennial cycle, fire protection, power-operated valves, and external hazards will be one of the three FEIs.

- In addition, the EIWG recommends that both the NRC and industry continue to develop guidance for the use of licensee SAs in place of one of the three FEIs. The EIWG concluded that SAs could help improve both effectiveness and efficiency of the NRC's oversight process with no loss of safety assurance when using well-defined industry SA guidance and implementing NRC review and oversight.

- Finally, the EIWG recommends that the NRC implement a similar effort to improve the effectiveness and efficiency of the remaining baseline inspections in the ROP.

V. ATTACHMENTS

Attachment 1: Consolidated External Comments on Improving the Effectiveness and Efficiency in the NRC's Engineering Inspections

Attachment 2: Evaluation of Program Changes Made in 2017

Attachment 3: Engineering Inspection Working Group Charter

Attachment 4: Minutes from Internal/External Meetings

CONSOLIDATED EXTERNAL COMMENTS ON IMPROVING THE EFFECTIVENESS AND EFFICIENCY IN THE U.S. NUCLEAR REGULATORY COMMISSION'S ENGINEERING INSPECTIONS

Table 1 provides the commenter/organization, date, and subject of comments received on improving the effectiveness and efficiency of the U.S. Nuclear Regulatory Commission's (NRC's) engineering inspections.

Table 1 Commenter/Organization, Date, and Subject of Comments on the NRC's Engineering Inspections

Commenter/Organization	Date	Subject
Nuclear Energy Institute (NEI)	December 18, 2017 November 30, 2017 October 11, 2017 July 3, 2017 June 6, 2017	Inspection Cycle Length, Fire Protection Inspections, Comprehensive Inspections, Effectiveness Measures, and Self-Assessments
David Lockbaum, Union of Concerned Scientists (UCS)	October 23, 2017 October 17, 2017 October 10, 2017 June 15, 2017	Inspection Cycle Length, Engineering and Design Inspections, Effectiveness Measures, and Self-Assessments
Dr. Jim Garb, Pilgrim Legislative Advisory Coalition	December 7, 2017 November 22, 2017	Self-Assessments
C-10 Research and Education Foundation (C-10)	November 30, 2017	Self-Assessments
Pilgrim Watch/Town of Duxbury Nuclear Advisory Committee	November 27, 2017	Self-Assessments
Henrietta Cosentino	October 17, 2017	Self-Assessments
Nuclear Utility Group on Equipment Qualification	October 8, 2017	Environmental Qualification Inspections
NuEnergy	September 1, 2017	Design Inspections and Self-Assessments

<u>Ending the Fire Protection Triennial Inspections</u>

In Support:

NEI submitted a white paper outlining the accomplishments of the fire protection triennial program under the first 18 years of the Reactor Oversight Process (ROP), addressing key safety issues such as inadequate Thermo-Lag fire barriers and a range of other fire protection features, and ensuring compliance with post fire shutdown requirements and commitments. As these elements have essentially been completed over time, NEI recommended terminating the triennial fire protection team inspections. NEI also recommended moving nonfire protection topics comingled with the triennial teams (e.g., NRC inspection requirements associated with section B.5.b of the NRC Order EA-02-026, "Order for Interim Safeguards and Security Compensatory Measures") to other inspection procedures and relying more explicitly on the resident quarterly inspections to cover routine fire protection issues. For the unique inspections that remain (e.g., implementation of National Fire Protection Association 805, "Performance-Based Standard for Fire Protection for Light-Water Reactor Electric Generating Plants," at a small number of sites) or for new industrywide fire protection issues that arise in the future, temporary instructions can be developed to address those issues. Finally, to improve inspection consistency in the future, additional guidance and training should be provided on the minor/more-than-minor threshold for documenting fire protection findings.

In Opposition:

No specific remarks focused solely on the elimination of the triennial fire protection teams. However, UCS endorsed the continuation of all the engineering team inspections, provided its perspectives as to why the NRC's sampling inspections were less biased than any industry-run effort, and stated that the NRC's independent evaluations are more likely to flag latent equipment conditions than those of industry.

Staff Assessment:

The Engineering Inspection Working Group (EIWG) agrees that improvements in fire protection measures have occurred at reactor licensees during the 18 years of ROP implementation. The basis for conducting periodic fire protection inspections remains, because internal fires continue to be high contributors to risk at plants due to the potential for damage to redundant systems and multiple control circuits and the adverse effect on operator mitigation strategies. Fires continue to occur at nuclear power plants at a relatively constant rate; therefore, fire protection remains an important safety feature that plants need to maintain and that the NRC needs to review on some periodicity.

Based on industry's progress with addressing past fire protection concerns, such as the adequacy and qualification of fire barriers, the EIWG agrees that changes to the triennial fire protection procedure are now in order. For instance, the procedure going forward can focus more on the implementation of the fire protection programs, changes to fire protection features (e.g., replacing obsolete detection systems and replacing suppression systems from the phase out of Halon production), and aging management of fire protection features. The EIWG also agrees that the B.5.b provisions of the post-September 2011 security orders could be relocated to another procedure.

The EIWG disagrees that resident inspectors should cover some of the more in-depth aspects of fire protection because their job should remain more operationally focused instead of committing too much effort to the detailed assessment of fire protection features.

The staff does recommend changes to the fire inspection triennial as discussed above and recommends that it be included as one of the focused engineering inspections going forward. The EIWG recommends the selection of fire protection for a focused engineering inspection in the first cycle beginning in 2020. In addition, the EIWG recommends the retention of fire protection on the list to be considered for a focused engineering inspection in the future.

Altering All the Engineering-Related Inspections Under the ROP

In Support:

NEI submitted the following comments to alter all the engineering-related inspections:

- Move to a cycle of inspections that occur nominally every 5 years versus every 3 years as is currently the case. These inspections may be augmented by focused problem identification and resolution samples and more reactive/special inspections.

- Terminate the triennial fire protection teams as previously noted.

- Continue the performance of a comprehensive inspection focused on maintenance of the plant licensing and design bases, as well as consideration of latent issues during the engineering process. The current engineering team continues to focus heavily on validating the original design bases, and the sample selections have now become repetitive because of the limited number of risk-significant samples available. This revised inspection should be similar in scope to the current design-basis assurance inspection (DBAI) but it should be conducted on a 5-year cycle.

- Consider allowing a licensee performance verification (LPV) effort in lieu of some inspections at qualifying sites, including a pilot program to demonstrate the concept (discussed separately).

- Measure the effectiveness of changes to the engineering inspection program on a periodic basis following its implementation. Those changes include (in addition to those previously mentioned) altering the heat sink, inservice, and boric acid inspections from standalone inspections to samples in a reconstituted engineering inspection program.

- Consolidate the existing inspection and modification review under Title 10 of the *Code of Federal Regulations* (10 CFR) 50.59, “Changes, Tests and Experiments,” and conduct this review annually for a 1-week duration. This revised inspection would be expanded to include the review of licensing-basis changes so that it could also be used to eliminate the need for the annual 10 CFR 50.59 report submitted to the NRC.

- Expand the use of performance indicators (PIs) that industry and the Institute of Nuclear Power Operations have already collected and measured to monitor real-time equipment performance. Identify trends after the revised engineering inspection program has been implemented.

The Nuclear Utility Group on Equipment Qualification submitted comments that were focused solely on the conduct of DBAIs involving the environmental qualification of electrical equipment. NuEnergy submitted comments recommending the conduct of a comprehensive engineering inspection similar to previously conducted safety system functional inspections.

In Opposition:

UCS endorsed the continuation of all the engineering team inspections, provided its perspectives as to why the NRC’s sampling inspections were less biased than any industry-run effort, and stated that the NRC’s independent evaluations are more likely to flag latent equipment conditions than those of industry. Several comments from other entities focused on the proposed self-assessment or LPV effort. The EIWG will discuss those later as a group.

Staff Assessment:

Inspection Cycle

The EIWG agrees that, based on the experience gained over the 18 years of the ROP, the cycle for performing specific inspection procedures can be adjusted. Regardless of the cycle length chosen, the EIWG considers that the conduct of an in-depth inspection of engineering at least once a year is important to ensure that the NRC is providing adequate oversight of the implementation of essential attributes of engineering at a time when the engineering staff's level of experience is declining and the reactor facilities are aging. These annual inspection insights provide the agency with feedback that licensees are properly implementing their engineering activities and addressing engineering issues in a timely manner at the same frequency as the agency's annual assessments.

The inspection cycle has to be short enough to remain agile to changes in overall engineering performance and new industry challenges. It must also use the latest operating experience to ensure that the most risk significant and potentially deficient areas are reviewed. For example, the focused engineering inspections would need to be evaluated for each inspection cycle. In addition, to ensure that these focused engineering inspections remain efficient and effective, inspectors would require specialized training and would need to conduct inspections at an appropriate frequency to maintain their proficiency. Inspection cycles that are too long would hamper the effectiveness and efficiency of these inspections.

In summary, the EIWG is considered modifications of the inspection frequency of engineering inspections based on industry performance, the NRC's ability to assess licensee engineering activity performance through sufficient "touch points," and confidence that these inspections would detect the decline of performance in key engineering areas. These changes in inspection frequency must be balanced to maintain the effectiveness and efficiency of the program overall. The EIWG recommends a change to the engineering inspections to a quadrennial cycle as discussed in Section II.B.3.b of the recommendations).

Comprehensive Engineering Inspection

The EIWG conducted extensive reviews of each of the engineering inspection procedures as outlined in Section II.A of the recommendations. This review identified and addressed overlaps between inspection procedures such as the 10 CFR 50.59 and the DBAIs. In addition, the inspections would focus on current safety concerns and review aging management, plant changes, and operating experience while using risk insights. The EIWG disagreed with the recommended change to safety system functional inspections because these inspections focus on the original design instead of current issues as previously described.

Effectiveness Reviews and Performance Indicators

During the original development of the ROP, the NRC developed PIs to address areas of the seven safety cornerstones and developed inspections of areas that were not covered by PIs. The EIWG conducted a further review of potential PIs to replace NRC inspections. This issue was also discussed in several public meetings. The EIWG concluded that PIs could not replace inspections in the engineering areas. The inherent purpose of finding latent conditions makes PIs impractical. Section II.B.3.a of the recommendations further discusses the evaluation.

With regard to effectiveness reviews, the EIWG considers continual improvement as vital to any program or process. Effectiveness reviews of the new engineering inspection programs will be conducted as part of the routine self-assessments of the ROP.

Environmental Qualification

The comments on environmental qualification inspections focused on implementation and are being addressed separately from this overall engineering assessment.

Self-Assessments

The comments on self-assessments will be addressed collectively later.

Allowing for Self-Assessments To Supplement Independent NRC Engineering Inspections

In Support:

NEI described how an NRC-endorsed LPV process could be used to allow licensees to identify and correct their own performance issues through a rigorous self-assessment process subject to NRC oversight. The successful completion of an LPV would result in a commensurate reduction in NRC inspection hours. NEI made the case for this change based on sustained, improved industry safety performance over the 18 years of the ROP. The LPV process would be conducted as follows:

- Licensees would perform engineering self-assessments using an NRC-endorsed process and template on a triennial basis.

- The NRC would choose the sample size and scope based on previous inspection results and resident inspector insights, and the licensee would provide the NRC with results of its self-assessment.

- An NRC inspector would observe the self-assessment and document the effort in an inspection report,

- The LPV effort would only be available to plants that are in Column 1 or 2 of the ROP Action Matrix.

- The triennial self-assessment would replace the following engineering inspections: (1) DBAIs, (2) the triennial fire protection teams (assuming that the self-assessment continues), and (3) the ultimate heat sink inspections.

- The NRC would have the ability to perform more event-follow-up/area-of-emphasis inspections to focus on specific events that are lower in significance to reactive/special inspections and supplemental inspections.

In Opposition:

Most of the public comments on proposed changes to the ROP baseline engineering inspection focused on the use of licensee self-assessments in lieu of NRC inspections.

The C-10 Research and Education Foundation, located near Seabrook Station, expressed grave concern at the proposal to "surrender" important regulatory oversight activities to the nuclear industry through such self-assessments. C-10 endorsed the comments made by UCS, which delineated instances in which the NRC had detected problems that had not been flagged or were minimized by corporate owners of nuclear plants. C-10 stated that minimizing any problems that might be detected would generally be in the plant owner's interest instead of self-reporting and calling forth regulatory and public scrutiny. C-10 was also concerned with the possible lack of transparency of the self-assessment process, which it viewed as an essential part of the NRC's work and a key to the ability of this organization to function as watchdogs of nuclear plants such as Seabrook Station.

Mary Lampert of Pilgrim Watch, Rebecca Chin of the Town of Duxbury Nuclear Advisory Committee, and Henrietta Cosentino of Plymouth, MA, expressed concerns similar to those of C-10 about the possible reliance on industry self-assessments versus NRC inspections but focused on their experiences with Pilgrim Nuclear Power Station (Pilgrim). They indicated that Pilgrim provides the "perfect" example of why NRC safety inspections are necessary and why the licensee cannot be counted on to conduct complete or accurate self-assessments. They noted that Entergy Nuclear Operations, Inc., has decided to shut down Pilgrim by June 2019 because it is losing money; therefore, they do not believe that any licensee self-assessment would look for or report anything that would require the licensee to spend a significant amount of money. The NRC placed Pilgrim in Column 4 of its Action Matrix after multiple NRC inspections identified and documented performance deficiencies at Pilgrim. The commenters do not want Pilgrim's owner in charge of its own engineering inspections, and they do not understand how the NRC could rationally expect the operator of a failing plant to do so in a way that would meet the agency's statutory obligations.

In addition, Dr. James Garb of the Pilgrim Legislative Advisory Coalition expressed his concern about the concept of allowing nuclear power plants to conduct self-assessments. He did not believe that this strategy was wise for ensuring the highest safety standards. However, if the NRC is determined to pursue this option, Dr. Garb recommended that the agency establish the following eight protections:

(1) All licensees should not automatically be eligible to conduct a self-assessment. Self-assessments should be a privilege that licensees earn by virtue of an excellent safety record on prior NRC inspections.

(2) Only those reactors that have been in Column 1 of the Action Matrix for the last 3 years of NRC inspections should be eligible to conduct self-assessments. New reactors would be eligible after a period of 10 years if they have remained in Column 1 of the Action Matrix for the last 3 years.

(3) The NRC should continue to conduct inspections at one-half the normal frequency for eligible reactors identified in item 2, and these should alternate with the self-assessments conducted by the facility.

(4) If a reactor slips to Column 2 of the Action Matrix on any NRC inspection, the right to conduct self-assessments should be rescinded until the reactor returns to Column 1 for 3 years.

(5) If a reactor slips to Column 2 of the Action Matrix a second time, the right to conduct self-assessments should be rescinded for 10 years and only reinstated when the reactor returns to Column 1 for 3 years.

(6) If a reactor slips to Column 3 or 4 of the Action Matrix, the right to conduct self-assessments should be terminated for that facility.

(7) Licensees should be required to file a detailed report of their self-assessments with the NRC. Any deficiencies found by the NRC in these written reports should trigger an inspection by the NRC. These reports should be made available to the public.

(8) In addition to the NRC conducting routine inspections at reactors in the self-assessment program at one-half the prior frequency, these facilities should be subject to random, unannounced NRC inspections.

Finally, UCS made several comments on the proposed LPV initiative. First, UCS noted that, contrary to NEI's assertion that the safety record of the nuclear industry has steadily improved, the latest annual report on the accident sequence precursor program shows that the number of precursors involving degraded conditions has been essentially constant over the past two decades and that the mean occurrence of precursors at boiling-water reactors exhibits a statistically significant increasing trend during that period.

Secondly, UCS stated that the NRC must conduct the design engineering inspections and other team inspections within the ROP's baseline inspection program because the agency provides independent assessments of licensee performance. These independent assessments guard against misconceptions (of licensee performance relative to the industry) caused by the licensee's isolation from industry performance trends, organizational dysfunctionality, and any number of other impairments. UCS referenced experiences at the Maine Yankee Nuclear Power Plant and Millstone Power Station before the implementation of the ROP and noted the large number of plant outages greater than 1 year in duration to correct safety/performance issues or major equipment problems before the ROP. UCS believed it would be unwise and imprudent to tamper with the apparent success achieved under the ROP by replacing NRC engineering inspections with self-assessments. UCS was also concerned that the replacement of NRC inspections by self-assessments would only be confined to those sites perceived to be top performers. This might lead to a potential gap between the perception of safety levels and actual safety levels that was noted before the ROP for licensees that received less inspection attention because of their perceived "good" performance.

Finally, UCS considers effective, independent regulatory oversight to be the public's best and most reliable protection against the decline in safety caused by aging reactors, shrinking operations and maintenance budgets, ineffective plant management, and other factors. UCS noted a recurring theme among the many examples in its submittal that workers thought a plant configuration was acceptable, whereas the NRC disagreed. UCS suggested that plant workers have inherent biases that can influence the selection of engineering samples chosen for self-assessments; therefore, industry self-assessments simply cannot replace the NRC's engineering inspections. UCS provided its perspectives from the review of inspection reports indicating that the NRC's independent evaluations are more likely to flag latent plant conditions and 10 CFR 50.59 violations. Moreover, UCS expressed concerns with the lessening of transparency because the public would not likely have the same access to licensees' self-assessments that they have to NRC inspection reports. Finally, UCS expressed concerns with extending the cycle for the baseline engineering inspections from 3 years to either 4 or 5 years, noting that plants with the same number of greater-than-Green findings would be placed in different columns on the NRC's Action Matrix based solely on when the findings occurred over the cycle length.

Staff Assessment:

The proposal for the potential inclusion of self-assessments to supplement independent NRC engineering inspections is a conceptual idea at this point and has not yet been developed in sufficient detail for acceptance by the EIWG. However, self-assessments would only be conducted as a small portion of the ROP inspections. The vast majority of the ROP inspections would continue to rely on the independent NRC inspection of reactor licensees and on the NRC's PI data. The currently considered initiative is that self-assessments would be conducted instead of only one of the four engineering team inspections. Qualified inspectors would review and evaluate self-assessments as part of the ROP to ensure that their quality meets the NRC's standards for review of the selected focused engineering areas. A determination by NRC inspectors that the standard has not been met would require an additional NRC review and inspection.

If any self-assessment activity is relied upon as part of the ROP, it must still maintain the NRC Principles of Good Regulation (i.e., independence, openness, efficiency, clarity, and reliability). For example, the EIWG agrees that the conclusions to the self-assessments must be made available to the public to achieve the principle of openness. Given the challenges and potential pitfalls in implementing this effort, the EIWG concludes that a project demonstration of this concept would be prudent to evaluate the potential effectiveness of such an effort.

Finally, the EIWG has determined that this option should only be available to those licensees that have displayed consistent strong performance over an extended period of time. In development of the overriding NRC guidance, strict criteria for allowing licensees to conduct self-assessments would be based on Action Matrix inputs. The recommendations by Dr. Garb should be considered during the development of NRC guidance. At this point, a final conclusion is premature because several actions still need to be completed. The industry would need to develop guidance documents for the self-assessment, the NRC would need to develop overall governing guidance, and a project demonstration would need to be conducted. Section II.B.3.e of the recommendations further discusses self-assessments.

EVALUATION OF PROGRAM CHANGES MADE IN CALENDAR YEAR 2017

The questions below and the responses received by the U.S. Nuclear Regulatory Commission (NRC) from regional inspectors were based on the changes made to Inspection Procedure (IP) 71111.21M, "Design Bases Assurance Inspection (Team)," and the new IP 71111.21N, "Design Bases Assurance Inspection (Program)."

Survey Question No. 1:

Describe any area(s) of the inspection procedure which should be considered for change and why change(s) are needed.

Summary of Responses to Survey Question No. 1:

The responses to how the current design-basis assurance inspections should be revised were mixed. One responder recommended reducing the number of operating experience samples, whereas another responder recommended increasing the number of operating experience samples. A reduction in the number of minimum samples may be warranted based on the time it takes to understand the design basis. Some respondents recommended conducting the inspections for modifications and Title 10 of the *Code of Federal Regulations* (10 CFR) 50.59, "Changes, Tests and Experiments," together through one inspection activity.

Survey Question No. 2:

Was DIE [direct inspection effort] hours allocated for IP 71111.21M and 71111.21N inspections sufficient?

Summary of Responses to Survey Question No. 2:

Most responders believed that the NRC had allotted sufficient inspection resources to perform both the IP 71111.21M and 71111.21N inspections. One comment suggested that the NRC should allow additional inspection resources for the preparation of IP 71111.21M inspections.

Survey Question No. 3:

Did we sample sufficient number of components to allow adequate determination of licensee's program performance in the areas reviewed?

Summary of Responses to Survey Question No. 3:

The responses were mixed; some believed that the number of samples were acceptable, whereas other responses believed that the number of samples were either too high or too low.

Survey Question No. 4:

Were inspection requirements and guidance in the inspection procedures clear and easily understandable?

Summary of Responses to Survey Question No. 4:

All responses indicated that the inspection requirements and guidance were clear and understandable.

Survey Question No. 5:

Are additional training recommended for either IP 71111.21M and IP 711111.21N?

Summary of Responses to Survey Question No. 5:

Although most responses indicated that no additional training is needed, some responses indicated that additional lessons learned training may be warranted and that inspectors may be receptive to such training.

Survey Question No. 6:

Are there any changes recommended for implementation of future new design or focused engineering inspections such as EQ [environmental qualification]?

Summary of Responses to Survey Question No. 6:

The responses encompassed a wide range of topics and areas. A consensus was not reached on whether to recommend the implementation of future new design or focused engineering inspections such as environmental qualification.

Survey Question No. 7:

Other comments

Summary of Responses to Survey Question No. 7:

The comments received included considering the elimination of the use of contractors for design-basis assurance inspections and a need to ensure that the Agencywide Documents Access and Management System (ADAMS) contains a more comprehensive set of licensing documents than that currently included in the system. Many older licensing documents are missing from ADAMS, and the unavailability of these older licensing documents hinders the inspectors' ability to determine the plant's licensing basis in a timely and efficient manner.

Engineering Inspection
Working Group Charter

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

August 07, 2017

MEMORANDUM TO: Anthony T. Gody, Jr., Director
Division of Reactor Safety, Region II

FROM: Brian E. Holian, Acting Director **/RA/**
Office of Nuclear Reactor Regulation

SUBJECT: APPROVAL OF CHARTER FOR IMPROVING THE EFFECTIVENESS AND EFFICIENCY OF ENGINEERING INSPECTIONS

This memorandum approves the charter that describes the review of selected engineering inspections for the purpose of improving the effectiveness and efficiency of these inspections in the Reactor Oversight Process (ROP). All four Regional Administrators have also reviewed and concurred on this charter.

In February 2017, a working group consisting of experienced supervisors and inspectors was formed by the Director of the Office of Nuclear Reactor Regulation to conduct an assessment of the U.S. Nuclear Regulatory Commission (NRC) engineering inspections that verify the adequacy of facility design, operations, and testing and make recommendations on improving both the effectiveness and efficiency of the suite of engineering inspections within the ROP. The working group was tasked with the review of NRC engineering inspection procedures (IPs) to determine if gaps and/or overlaps of inspection areas exist. The working group will conduct a regional survey in CY 2017 to assess the efficiency and effectiveness of the recent changes made to engineering inspection procedures, IP 71111.21M, “Design Bases Assurance Inspection (Team);” IP 71111.21N, “Design Bases Assurance Inspection (Program);” and IP 71111.17T, “Evaluations of Changes, Tests, and Experiments.” The working group will also solicit and assess feedback from external stakeholders (public, industry, etc.) on any proposed changes to the engineering inspections.

You are requested to make periodic updates from the results of this effort to NRC management.

Finally, you are requested to document any planned recommendations for significant changes to the ROP engineering inspections.

Enclosure:
Charter

cc: D. Dorman, RI
C. Haney, RII
C. Pederson, RIII
K. Kennedy, RIV

SUBJECT: APPROVAL OF CHARTER FOR IMPROVING THE EFFECTIVENESS AND EFFICIENCY OF ENGINEERING INSPECTIONS

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Accession Number: ML17172A620 ** Concurrence on the charter obtained by e-mail

OFFICE	Region II**	Region IV**	Region I **	Region III**
NAME	CHaney	KKennedy	DDorman	DRoberts
DATE	06/22/17	06/27/17	06/28/17	06/30/17
OFFICE	NRR/DIRS/IRIB:	NRR/DIRS/IRIB	NRR/DIRS	NRR
NAME	JIsom	SAnderson	CMiller	BHolian
DATE	07/25 /17	07/26 /17	07/27/17	08/07/17

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I. BACKGROUND:

The objectives of the staff in developing the various components of the Reactor Oversight Process were to provide tools for inspecting and assessing licensee performance in a manner that was more risk-informed, objective, predictable, and understandable than the previous oversight process. The Reactor Oversight Process (ROP) was developed to meet the four agency performance goals to: 1) maintain safety: 2) increase openness, 3) make NRC activities and decisions more effective, efficient, and realistic, and 4) reduce unnecessary regulatory burden. Where possible, the staff sought to identify performance indicators (PIs) as a means of measuring the performance of key attributes in each of the cornerstone areas. Where a PI could not be identified, or where a PI was identified but was not sufficiently comprehensive, or when a PI provided no insight on potential latent conditions, the staff identified a baseline inspection activity. The areas inspected were derived based on risk insights, operating experience, deterministic analyses, and regulatory requirements. Specifically, the baseline inspections requiring engineering expertise focused on attributes such as design, protection against external events, configuration control, and equipment performance. These inspections are important from the perspective that they are the only inspections that: 1) independently verify the capability of systems to operate consistent with deterministic and PRA models; 2) independently verify that the licensee adequately considered defense in depth for potential common mode failure and external events; and 3) independently verify that barriers remain sufficiently robust. The basis for the inspection program is Inspection Manual Chapter (IMC) 0308 and each specific engineering inspection is discussed in IMC 0308 Attachment 2.

The ROP was constructed with a number of baseline inspection procedures that provide independent verification that structures, systems, and components are operated, modified, and maintained in a condition that ensures their ability to perform their design functions during design basis and external events with reasonable assurance. Since the 90s, the NRC has conducted many different types of inspections focusing on this independent verification. Over time, these inspections have shifted from a verification of original plant design adequacy (a functional system inspection) to an inspection increasingly focused on the maintenance of design and licensing bases function. This shift in focus was due, in part to the fact that some of the same systems, structures, and components had been inspected previously. As nuclear power plants age, as more equipment become obsolete, as the environment in which SSCs are operated change (plant operation beyond 40-years, equipment replacement, electrical power reliability, etc.) the focus of NRC design verification inspections can shift to the latest design challenges and licensing bases functionality. In addition, with enhanced risk assessment tools, this focus can be more risk-informed. For example, NRC engineering inspections conducted during the period of extended operation following a license renewal (focusing on time limiting aging analyses, aging management programs, etc.) will be included in this effort. The inspections within the scope of this charter are split into two general groups. First, the baseline inspections implemented by region-based engineering inspectors which focus heavily on the adequacy of engineering analysis and compliance with Codes, Standards, and the facility licensing bases. Second, the remaining inspections that involve engineering aspects which are conducted by resident inspectors and focus on verifying that the facility design bases are adequately translated into plant operations and testing for which it is more suitable to directly inspect activities as they occur at the facility.

Six engineering inspections performed by regional specialists are:

- IP 71111.05T, “Fire Protection (Triennial)” or IP 71111.05XT, “Fire Protection-NFPA 805 (Triennial)”
- IP 71111.07, “Heat Sink Performance”
- IP 71111.08, “Inservice Inspection Activities”
- IP 71111.17T, “Evaluations of Changes, Tests, and Experiments”
- IP 71111.21M, “Design Bases Assurance Inspection (Team)”
- IP 71111.21N, “Design Bases Assurance Inspection (Program)”

In FY 2016, the NRC added Design Bases Assurance (DBA) Inspection (Program), IP 71111.21N, to its baseline inspection program. This change allowed periodic inspection of licensee’s implementation of key engineering programs important to safety. To maintain the overall level of inspection effort in the engineering inspection area, changes in scope were made to DBA inspection (Team), IP 71111.21M, and to IP 71111.17T, “Evaluation of Changes, Tests, and Experiments,” inspection. The NRC continues to receive early and mixed feedback on these inspection procedure changes from NRC inspectors and the industry. Part of the staff effort for this charter will be to conduct a survey to assess more thoroughly the recent changes to these inspections.

In addition to these six inspections, resident inspectors perform inspections in engineering areas associated with IP 71111.12, “Maintenance Effectiveness,” and IP 71111.18, “Plant Modifications.”

II. PURPOSE:

In February 2017, a working group consisting of experienced supervisors and inspectors was formed by the Director of the Office of Nuclear Reactor Regulation to conduct an assessment of the NRC inspections that verify the adequacy of facility design, operations, and testing and make recommendations on improving both the effectiveness and efficiency of the suite of engineering inspections within the ROP. Accordingly, the working group will review NRC IPs and determine if both gaps and overlap exist. Additionally, the working group will conduct a regional survey in CY 2017 based on a request to assess the efficiency and effectiveness of the recent changes made to engineering Inspection procedures, IP 71111.21M, -.21N and -.17T. Finally, the working group will solicit and assess feedback from external stakeholders (public, industry, etc.).

III. TASKING:

A. Validate and document the bases for performing all the baseline NRC Inspection Procedures (IPs) accomplished by both region based and resident inspectors that provide independent verification that structures, systems, and components can perform their design functions during design basis and external events with reasonable assurance. The following IPs are included in the scope of review:

   - IP 71111.05T, “Fire Protection (Triennial)” or IP 71111.05XT, “Fire Protection-NFPA 805 (Triennial)”
   - IP 71111.07, “Heat Sink Performance”
   - IP 71111.08, “Inservice Inspection Activities”

- IP 71111.12, “Maintenance Effectiveness,”
- IP 71111.17T, “Evaluations of Changes, Tests, and Experiments”
- IP 71111.18, “Plant Modifications,”
- IP 71111.21M, “Design Bases Assurance Inspection (Team)”
- IP 71111.21N, “Design Bases Assurance Inspection (Program)”

B. Assess the IPs identified in Step A for gaps, if any, in inspection coverage based on an assessment of all engineering activities potentially affecting an NRC licensed operating reactor and areas of overlap or redundancy taking into consideration current operating experience and risk insights.

C. Determine if more efficient and effective ways exist to accomplish agency goals. Consider, as a minimum, the following:

- overlap areas between the IPs
- gaps in the IPs,
- inspection structure:
  a. team composition and expertise
  b. team size,
  c. schedule and duration
  d. frequency

D. Develop recommendation for changes to current baseline NRC IPs including overall triennial framework. For each recommendation identify the pros and cons of implementation. Consider the following aspects as applicable:

1. Mission impact (degree to which the option would deliver confidence that cornerstone objectives are met in support of reasonable assurance of adequate protection)
2. Rigor and independence of NRC inspection conclusions
3. Assess proper NRC expertise and depth of specialists
4. Resident and regional inspector staffing
5. Impact on regional ability to respond to events and emergent issues
6. Evaluation of contracting options/flexibility
7. Whether engineering inspections can be conducted on a “graded approach”

E. Gather feedback from internal and external stakeholders and consider that feedback in the option paper. In addition, conduct a survey of NRC inspectors who have implemented the new 71111.21M, .21N, and 17T inspection procedures and consider their feedback. If any additional options are incorporated, fully document the pros and cons of those options using the criteria in Item D above.

F. Finalize the option paper and conduct stakeholder briefings. The goal of the position paper briefing is to ensure stakeholders are aware of comment resolution, recommendations and the bases.

G. Develop a recommendations paper and attend management meetings.

H. Working Group Guidance:

Process:

- Come to an agreement on the purpose for performing engineering inspections
- Identify IPs which directly support the purpose for performing engineering inspections
- For those IPs which directly support the purpose for performing engineering inspections
    - Identify areas of overlap between engineering IPs
    - Identify gaps in the engineering IPs
    - Recommend inspection structure which includes:

        1) Team composition and expertise
        2) Team size
        3) Inspection schedule and duration
        4) Inspection frequency

- The working group chairman will develop conclusion and recommendations from the review which includes specific recommendations which will improve the effectiveness or efficiency of the engineering inspections within the scope of this effort. The plan for collaboration with stakeholders and the timeline for implementation are shown in the schedule below.

IV. CHAIR FUNCTIONS

- Schedule and lead meetings
- Ensure minutes are prepared and action item tracking
- Circulate draft products to members for review
- Notify responsible managers of Charter modifications.
- Provide periodic status brief to the NRR Office Director and the Regional Administrators on the progress and status of this engineering review (e.g., at the Deputy EDO Direct Reports (DEDR) quarterly meetings.)

V. HOLISTIC REVIEW GROUP MEMBERSHIP

Tony Gody, Region II/Director, DRS. ....(404) 997-4600
Jim Isom, NRR/DIRS/IRIB (Chair) ....(301) 415-1109
Mel Gray (Region I/DRS, EB1 Chief)...(610) 337-5209
Glenn Dentel (Region I/DRS, EB2 Chief)...(610) 337-5233
Jonathan Bartley (Region II/DRS, EB1 Chief).......................................(404) 997-4607
Shakur Walker (Region II/DRS, EB3 Chief) ....(404) 997-4639
Mark Jeffers (Region III/DRS, EB2 Chief)...(630) 829-9798
Greg Werner (Region IV/DRS, EB2 Chief) ....(817) 200-1137
Tom Farnholtz (Region IV/DRS, EB1 Chief) ....(817) 200-1243
Heather Jones, NRR/DLR/RPGB..(301) 415-4054

VI. DURATION

The charter will remain in place until the SECY paper is completed.

VII. LEVEL OF EFFORT

Periodic meetings (or teleconferences) of the working group will be coordinated approximately monthly by the chair. These meetings may be slightly more frequent during project startup and wrap-up. In addition, one or two public meetings may be scheduled. These meetings may require travel to either Headquarters or to one of the regional offices. Active participation and meeting attendance is expected of members.

VIII. CHARTER MODIFICATIONS

The Holistic Engineering Review Group will obtain approval from Director, NRR and concurrences from all Regional Administrators prior to making substantive change to the charter tasking or desired outcome.

Activity (Within Scope of Charter)	Start Date	Target Date
Issue Charter	**4/3/2017**	**6/5/2017**
Conduct Public Meeting #1 to discuss the NRC Charter, communicate the plan for collaboration, and future meetings	**6/6/2017**	**Complete**
All stakeholder input regarding option recommendations with pros and cons due in writing to Jim Isom		9/29/2017
Conduct Public Meeting #2 to discuss use of industry self-assessments		10/10/2017
Develop draft NRC options paper (eliminate none) incorporating internal and external ideas. Develop public meeting slides to facilitate stepping through NRC options and stakeholder options. Brief Office Director / Regional Administrators on draft options.	8/21/2017	11/1/2017
Conduct Public Meeting #3 to discuss options or groups of options presented by stakeholders	9/26/2017	11/14-15/2017
Develop second draft NRC options paper (choose several options with pros and cons, justify the elimination of others). Develop public meeting slides. Brief Office Director / Regional Administrators on draft option paper and public meeting slides		11/28/2017
Conduct Public Meeting #4 to present the various options or grouping of options and their pros and cons, to facilitate discussion on NRC review of proposed options, to present NRC options that will be discussed in Commission Paper		12/12/2017
Develop draft recommendations paper	12/1/2017	2/15/2018
Brief Office Director / Regional Administrators on recommendations		3/1/2018
DIRS implements SECY approval process		4/1/2018

MINUTES FROM INTERNAL/EXTERNAL MEETINGS

1. Meeting Minutes from the June 6, 2017, Public Meeting on Design Verification Inspections (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17208A613)

2. Meeting Minutes from the October 11, 2017, Public Meeting on the Licensees' Use of Self-Assessments in the Reactor Oversight Process (ADAMS Accession No. ML17297B761)

3. Meeting Summary from the December 12, 2017, Public Meeting on the U.S. Nuclear Regulatory Commission's (NRC's) Engineering Inspections (ADAMS Accession No. ML18024A636)

4. Meeting Summary from the February 22, 2018, Public Meeting on the NRC's Engineering Inspections (ADAMS Accession No. ML18081A589)