

PROPOSED CONSTRUCTION INSPECTION ASSESSMENT PROCESS (CIAP)

A PURPOSE

The purpose of this white paper is to define the structure of a proposed construction inspection assessment process to be applied to the construction of new nuclear power plants.

B BACKGROUND

Operating U.S. nuclear power plants are assessed under the Reactor Oversight Process (ROP). There are three strategic performance areas: reactor safety, radiation safety and safeguards. Each strategic performance area has a number of cornerstones that are assessed through a combination of performance indicators and inspection activity. The performance indicators and inspection findings are assigned a color (green, white, yellow, or red) that corresponds to increasing levels of risk significance. Thresholds based on historical industry performance are used to determine the color of performance indicators. A Significance Determination Process (SDP) is used to determine the risk significance of inspection findings in terms of changes to baseline core damage frequency where appropriate in the reactor safety strategic area. The radiation safety and safeguards strategic areas use a deterministic process for assigning colors to inspection findings based on the frequency and/or severity of an adverse condition. The combination of performance indicators and

inspection finding results are fed into an action matrix to determine if more extensive NRC oversight is warranted beyond the baseline inspection program.

Clearly the ROP can not be used as is for a construction inspection assessment process. Until there is fuel on site, the radiation safety and safeguards strategic performance areas are not applicable and there is no potential for a core damage event. Additionally, there is no recent construction baseline of experience upon which to establish performance indicators and thresholds. While performance indicators could be developed, lessons learned in the ROP are that thresholds for performance indicators should be based on a minimum of three years of data and undergo a benchmarking process. Clearly this is not feasible for an anticipated four-year construction period.

However, a Construction Inspection Assessment Process (CIAP) can be established that embraces the fundamental principles of the ROP: objectivity, predictability, consistency, clarity and risk-informed. The CIAP described in the balance of this paper is designed to be consistent with the fundamental principles of the ROP.

C CONSTRUCTION INSPECTION ASSESSMENT PROCESS

1. Introduction

The fundamental purpose of the NRC construction inspection process is to verify that the as-built design is in accordance with the approved design and to verify the readiness of operational programs. This

verification is essential to ensuring that the plant can be operated without undue impact to public health and safety as defined by NRC regulations. There are four major aspects of a construction project: (1) design implementation, (2) procurement, (3) fabrication, and (4) inspection and testing. Similarly, there are two major aspects of operational readiness: (1) implementation of the operational programs and procedures and (2) the training and qualification of personnel that will implement the operational programs. Significant problems in any of these areas could challenge the confidence that the plant meets all of the applicable design requirements and can be operated safely upon startup.

2. Strategic Performance Areas

Figure 1 portrays the three recommended strategic performance areas:

- a. Plant Construction in Accordance With Approved Design
- b. Readiness of Operational Programs
- c. Construction Security

3. Cornerstones

Figure 1 also portrays the recommended cornerstone structure to meet the key strategic performance areas of ensuring the as-built plant conforms to the approved design and ensuring the readiness of operational programs. The cornerstones associated with each Strategic Performance Area are identified and described below.

The cornerstones and their associated objectives for the strategic performance area of “Plant Construction in Accordance With Approved Design” are as follows:

Design Implementation The objective is to ensure that the NRC-approved design has been properly translated into drawings, specifications, and other design information used to procure materials and equipment and to construct the plant. It includes the elements of NRC Engineering Design Verification of Design Acceptance Criteria and the licensee’s design change process.

Procurement The objective is to ensure that the licensee’s procurement program results in the procurement of materials that meet the approved design specifications. It includes the elements of source evaluation and selection, evaluation of objective evidence of quality furnished by the supplier, source inspection, audit, and examination of items or services.

Fabrication and Installation The objective is to ensure that the fabrication, erection, and installation of structures, systems and components is in accordance with the approved design and associated specifications. It includes the elements of special processes such as welding, heat treating, and NDE, material controls and required ASME code design reports.

Inspection and Testing The objective is to ensure that required inspections, tests and analyses are performed that validate that the plant has been built in accordance with the approved design and that it meets the acceptance criteria. It

includes the elements of verifying quality: (1) at the source of supplied items or services, (2) in-process during fabrication at a supplier's facility or at a company facility, (3) for final acceptance of fabricated and/or installed items during construction, (4) upon receipt of items for a facility and (5) during functional testing, maintenance, and modifications.

The cornerstones and their associated objectives for the strategic performance area of "Readiness of Operational Programs" are as follows:

Operational Programs The objective is to ensure that the operational programs required by the regulations are in place as appropriate prior to operation. It includes the elements of verifying that (1) the programs contain the features required by the regulations, (2) implementing procedures for the required operational programs have been prepared and (3) the programs and implementing procedures have been properly reviewed and approved by the appropriate levels of management.

Training and Qualification The objective is to ensure that trained and qualified personnel are in place to implement the operational programs and implementing procedures. It includes the elements of verifying that (1) training and qualification requirements have been established that meet applicable regulatory requirements, (2) personnel have completed all of the required training before being assigned responsibility for carrying out operational programs and (3) refresher training and

requalification is carried out in accordance with the requirements of the operational programs and implementing procedures.

The cornerstone and its associated objectives for the strategic performance area of "Construction Security" are as follows:

Construction Security The objective is to ensure that proper measures are in place to prevent sabotage or other malevolent acts that could degrade the performance of systems important to protecting public health and safety during operations. It includes the elements of verifying that (1) personnel are trustworthy, (2) personnel are fit for duty, and (3) that access to sensitive areas is restricted to individuals having a need to perform work in those areas.

4. Significance of Inspection Findings

The NRC identifies within the combined license the inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that, if met, are necessary and sufficient to provide reasonable assurance that the facility has been constructed and will be operated in conformity with the license, the provisions of the Atomic Energy Act, and the Commission's rules and regulations.

The NRC Construction Inspection Program (CIP) focuses in large part on verification that these inspections, tests, analyses and acceptance criteria (ITAAC) have been met. The ITAAC have been pre-determined

to capture the risk important aspects of the plant and, as such, risk inform the CIAP.

Similar to the ROP, construction inspection findings result from performance deficiencies that can be identified by either the licensee or the NRC. As with the operating plants, most performance deficiencies are expected to be identified and corrected by the licensee without additional NRC inspection. IMC 0613 defines the appropriate treatment of deficiencies identified by the licensee or NRC. While performance deficiencies can have significant impact on cost and schedule, they can only have low safety significance due to the lack of potential, prior to initial criticality, for impacting public health and safety. As discussed below, findings have greater significance if they are repetitive in nature or if they are identified after ITAAC Closure Letters are submitted to NRC.

There are four categories of potential performance deficiencies:

- a. Minor Non-compliances
- b. Construction Findings
- c. ITAAC Related or Operational Program Construction Findings
- d. ITAAC Findings

Minor Non-compliances do not materially affect the acceptance criteria of an ITAAC or are not material to construction. The threshold and criteria for minor non-compliances are consistent with the designation of minor violation under the ROP and are defined in IMC 0613. As such, no formal violation is issued in the inspection report, and the licensee places the item in its problem identification and

resolution program for resolution and closure.

Construction Finding is a finding that is considered a greater-than-minor non-compliance with regulatory requirements or licensee commitments and is not associated with a specific ITAAC or required operational program. Prior to the Commission finding that all ITAAC acceptance criteria are met, findings in this category are "GREEN" (very low safety significance). As such, they are treated as non-cited violations in the inspection report if the NRC has verified the effectiveness of the licensee's CAP. The licensee places the item in its CAP for resolution and closure. If the NRC has not verified the effectiveness of the CAP, a Level IV violation is issued that requires a licensee response.

The significance of Construction Findings identified after the Commission makes its final ITAAC finding will be evaluated using the operating reactor SDPs.

ITAAC Related or Operational Program Construction Finding

An ITAAC Related Construction Finding is a regulatory violation that is greater than minor, is associated with a specific ITAAC for which the licensee has not yet issued the ITAAC closure letter, and is material to an ITAAC acceptance criterion.

An Operational Program Construction Finding is greater than minor and related to required operational program. Findings in this category are "GREEN" (very low safety significance) and the licensee places these items in its CAP. These findings would result in a non-cited violation provided the NRC has verified the

effectiveness of the CAP. If the NRC has not verified the effectiveness of the CAP, a Level IV violation is issued that requires a licensee response.

Either of these types of findings may be increased to "WHITE" if they are repetitive within the construction process cornerstone depicted in Figure 1, indicating a breakdown in the effectiveness of the CAP.

ITAAC Finding is a regulatory violation that is greater than minor, is associated with a specific ITAAC for which the licensee has issued the ITAAC closure letter, and is material to an ITAAC acceptance criterion. This type of finding could invalidate a prior ITAAC conclusion and could require that previously closed ITAAC be re-opened. An ITAAC finding may be related to a single ITAAC or a family of ITAAC. ITAAC Findings are categorized as "WHITE."

As discussed later in the section on "Construction Response Table," increasing occurrences of white or greater ITAAC Findings within or across cornerstones can lead to increased regulatory oversight.

In addition to these four categories, NRC would continue traditional enforcement similar to the ROP (i.e., deliberate misconduct, employee protection, actual consequences (such as overexposure), and accuracy of information.)

5. Elements of Construction Safety Culture

Certain aspects of licensee performance are common to all the cornerstones and are important to ensuring the plant is constructed as approved. These aspects are referred to as elements of construction safety culture and provide insights into the overall safety culture climate at a facility. The elements of construction safety culture include the establishment of a safety-conscious work environment, quality assurance and problem identification and resolution (PI&R). Licensee deficiencies in these areas manifest themselves as performance issues in the cornerstones and are often the root cause of the issues. Each aspect is described below:

Safety Conscious Work Environment This program looks at the site's safety conscious work environment and provides opportunities to raise issues outside the normal chain of command. The objective is to ensure that employees do not feel inhibited from raising safety concerns.

Quality Assurance This program provides for independent assessment of the effectiveness of programs and processes related to construction activities as well as the effectiveness of personnel in implementing program and process requirements. The objective is to ensure that the programs and processes needed to construct a high quality project are working effectively and that employees understand their role in assuring quality.

Problem Identification and Resolution This program

provides the vehicle for capturing departures from expected performance and adverse conditions, for identifying and implementing corrective actions, performing cause analyses, and assessing the extent that the adverse condition could exist in related activities. The objective is to identify and correct adverse conditions in a timely manner and to prevent their reoccurrence and to ensure that employees understand their role in the PI&R Program.

The licensee is responsible for the construction site safety culture and will implement a program to assess and address safety culture issues. The NRC will oversee the licensee's activities in the safety culture area. The NRC may tag inspection findings with one of the three elements if the root cause of the violation is determined to be a safety culture element. These insights are entered into the licensee's CAP and provide an input to the licensee's self assessment of safety culture.

6. Construction Response Table

NRC is guided in its responses to licensee performance by a construction response table. The construction response table is intended to provide consistent, predictable, understandable agency responses to licensee performance so that stakeholder confidence in NRC's oversight process is enhanced. The actions in the table are graded such that the NRC becomes more engaged as licensee performance declines, as reflected in the columns describing licensee performance. Those licensees whose performance is in the "licensee response column" receive only the baseline inspection effort. At this performance level, identified deficiencies are of very low safety

significance, and deficiencies are consistently addressed as part of the licensee's problem identification and resolution program.

Licensees move out of the licensee response column on the basis of the number of inspection findings that exceed the thresholds in each of the cornerstones. For example, a single inspection finding crossing its threshold from green to white would require the NRC to take the actions listed in the "regulatory response column" of the construction response table, which includes additional inspection to assess the licensee's efforts to determine the cause of the assessment input degradation. More significant degradation in performance would cause a licensee to be placed in the other columns, which require increasingly more significant NRC actions.

The proposed Construction Response Table is depicted in Figure 2. Under the ROP, a finding remains active for consideration in an action matrix for one year or until closed out, whichever occurs later. This is because the baseline inspection program for operating reactors is a defined, annual program and not all aspects of the program are inspected each quarter. It takes one full year to cover all of the operating baseline inspection elements. A different model is needed for a dynamic construction project where specific inspection elements phase in and out as construction progresses. It is proposed that inspection findings remain for consideration in the construction response table for six months or until closed out through the NRC supplemental inspection process for white or greater findings, whichever is later. Also, consistent with the current ROP, findings are not double counted in the construction response table. Rather, the finding is assigned to the cornerstone that best fits the deficiency.

D. TRANSITION TO ROP

Licensee performance would continue to be assessed under the above proposed CIAP until the following criteria are met:

- All significant construction and testing activities are complete.
- Licensee corrective actions for significant deficiencies for construction, testing, and startup activities have been implemented and have been effective.
- All other construction, testing, and startup open items have been placed in the licensee's corrective action program.
- The licensee has established a program to benchmark and to collect performance indicator (PI) data.
- The plant has completed a minimum of 100 hours of commercial operation.

When the above conditions are met, licensee performance would then transition to the ROP. It is recognized that insufficient data may exist to have valid performance indicators when first transitioning to the ROP. Areas normally covered by performance indicators would be covered by inspection until sufficient data exists. This approach is similar to operating plants that may have experienced an extended shutdown period.

CIAP REGULATORY FRAMEWORK

**NRC's Overall
Safety Mission**

**Public Health and Safety as a
Result of Civilian Nuclear Reactor
Operation**

**Strategic
Performance
Area**

**Plant Construction In
Accordance With
Approved Design**

**Readiness of
Operational Programs**

Construction Security

Cornerstones

Design

Procurement

**Fabrication &
Installation**

**Inspection
& Testing**

**Operational
Programs**

**Training &
Qualification**

**Construction
Security**

-----Quality ---
Assurance

---- Safety Conscious-----
Work Environment

---- Problem-----
Identification
& Resolution

**Elements of Construction Safety
Culture**

Figure 1

Construction Response Table

	Licensee Response Column	Regulatory Response Column	Degraded Cornerstone Column	Multiple/Repetitive Degraded Cornerstone Column	Unacceptable Performance Column
Results	All assessment inputs green	Up to two white inputs in a cornerstone	Three or more white inputs in a cornerstone, or one yellow input	Repetitive Degraded Cornerstone or Multiple Degraded Cornerstones, or 2 yellow inputs or one red input	Overall unacceptable performance. Construction activities suspended.
Response	None	Branch chief (BC) or division director (DD) meet with licensee	DD or RA meet with licensee management	RA or EDO meet with senior licensee management	Commission meeting with senior licensee management
	Licensee Corrective Action	Licensee root cause evaluation and corrective action with NRC oversight.	Licensee cumulative root cause evaluation with NRC oversight.	Licensee performance improvement plan with NRC oversight	
	Baseline Inspection Program	Baseline and supplemental inspection per 90001	Baseline and supplemental inspection per 90002	Baseline and supplemental inspection per 90003	.
Regulatory Actions	None	Supplemental inspection only	Supplemental inspection only	10CFR2.204 DFI 10CFR50.54(f) Confirmatory Action Letter	Order to modify, suspend or revoke license