Reactor Oversight Process Enhancement Project
Baseline Inspection Program
Inspection Area – Engineering

Background

The purpose of this review was to take a fresh look at the engineering inspection procedures (IPs): to identify current strengths and challenges and to make recommendations to ensure the program focuses on performance in evolving areas with the best use of resources and optimizing internal coordination. The IPs specifically targeted in this review included:

- 71111.05, Fire Protection
- 71111.06, Flood Protection
- 71111.07, Heat Sink
- 71111.17, Evaluation of Changes, Tests or Experiments and Permanent Plant Modifications
- 71111.18, Plant Modifications
- 71111.21, Component Design Bases Inspection

Because of the recent significant revision to the fire protection inspection procedures and the newly implement National Fire Protection Association (NFPA) Standard 805, the 71111.05 procedure was not assessed. Therefore, no specific recommendations will be made at this time for this procedure.

The goal of this overall effort was to ensure an effective and efficient inspection program with an appropriate focus on risk, safety, and performance which incorporates operating experience and/or lessons learned in a timely manner. No additional inspection resources were assumed in this evaluation. With this in mind, through the review and assessment of several internal and external inputs, proposed recommendations were generated and are discussed below.

Analysis

The process consisted of gathering information from a variety of sources to define issues or problem sets for each procedure as well as "engineering issues" at large and determine paths forward to address the perceived problems and/or issues. The sources of information included:

- Interviews with regional staff, branch chiefs, and IP owners
- Analysis of inspection findings (greater than green and self-revealed)
- Analysis of the circumstances surrounding Management Directive 8.3, "NRC Incident Investigation Program" reviews
- Information from IP owner's assessments of their assigned procedures
- Insights from external sources, public meetings, and responses to a *Federal Register Notice*
- Review of recent Office of Inspector General audits

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- Input from internal groups reviewing topics such as aging management, operating experience, Independent Spent Fuel Storage Installation, and Japan lessons learned
- Insights from senior management on the Reactor Oversight Process (ROP)

Each insight or proposed concept for change developed from the above sources was analyzed to define the impact of the proposed concept and determine an appropriate manner to disposition the concept. Possible dispositions included (1) training, (2) revising the IP, (3) creating a new inspection procedure, (4) revising an Inspection Manual Chapter (IMC), or (5) other. In addition, each insight or proposed concept was analyzed to determine the impact on the currently assigned resources for that inspection procedure. A checklist was developed to aid in the analysis process.

About 70 unique insights were generated and processed as a result of the effort above. Several themes are evident, including:

- Flexibility in scheduling and in determining the scope of inspection. This included the capability to perform inspection outside of a team and have this effort credited when the actual team inspection is conducted. This also included the use of licensee self assessments and resident inputs to better inform the depth and scope of an inspection.

- Emphasis or sensitizing inspection toward assessing the licensee's ability to monitor and address aging of components. This included replacement of obsolete equipment, justifying use of equipment beyond vendor specifications, monitoring the implementation and changes to the licensees' Aging Management Programs associated with license renewal commitments, and more direct inspections of the preventive maintenance program.

- Broadening inspection sample topics/areas. This included inspection of plant changes not typically covered during the 71111.17 inspection such as environmental qualifications, commercial grade dedication, Title 10 of the *Code of Federal Regulations* Part 21, "Reporting of Defects and Noncompliance," reconstitution efforts, etc. This also included inspecting engineering interface in other cornerstones such as emergency preparedness and security. In addition, topical areas and scopes should incorporate operating experience in real time.

- Broadening attributes to inspect. This includes broadening the selection potential of equipment, function, and environmental conditions which may not be a focus of the current inspections. This also included providing additional inspection guidance on technical issues. Most of these recommendations were derived from self-revealed findings and violations.

- Reduce sample sizes to achieve a deeper vertical slice inspection and allow a horizontal expansion when issues are identified. The current ROP does not prohibit a vertical slice (for example, a Component Design Basis Inspection (CDBI) can select a system), however, by reducing the number of samples while maintaining the inspection hours would allow a deeper (more attributes during a CDBI) inspection. This concept acknowledged the net zero increase in resources and the desire to broaden inspection attributes and areas.

- Develop refresher training focused on engineering. This review resulted in recommendations for several different topics to be covered in a training environment. Topics range from understanding programs/requirements such as environmental qualification to knowledge of current technical issues/violations/findings. Under the current program, engineering inspectors are required to take emergency response-operations training every three years. There is no requirement to take on-going engineering-focused training. There are several external training courses available; however, continuation of this training will be limited due to shrinking budgets. Implementation of this recommendation would entail evaluating the minimum training needed to maintain emergency response-operations capability to maximize the training time dedicated to engineering topics. Though there will be a startup cost, no additional travel or overall training hours would result.

- Develop and maintain better inspection tools. Adding detailed inspection guidance to each procedure will result in unmanageable procedures – especially if a procedure change results in a cascade of changes. In addition, there is a need to incorporate operating experience in a more timely and consistent manner (discussed in detail in Enclosure 15) and identify those topics that should be considered for generic communication.

Recommendations
(Note: Recommendations in this subject area will require additional development before they can be implemented.)

- Individual Procedure Changes:

  Several recommendations focused on specific guidance and/or enhancements for the individual procedures. These recommendations are not presented below and will be captured on feedback forms or another mechanism for consideration in the final products. The items below represent the more significant changes in the planning, scheduling, and execution of the engineering procedures.

  - 71111.05, Fire Protection

    No significant changes are recommended at this time.

  - 71111.06, Flood Protection

    Provide more flexibility in the procedure by requiring three samples at the discretion of the inspectors. Current procedure requires two samples for internal flooding and one annual review of cables in underground bunkers. By specifying three samples, the inspectors could select three samples for internal flooding, thus eliminating the requirement to inspect bunkers at sites where water intrusion is not a problem. For sites where water intrusion is a problem, the inspectors could select two reviews of cables resulting in a more thorough assessment, including verifying the implementation of the applicable Aging Management Program(s). As with the current ROP, if the inspector notes a problem or negative trend in performance in an area not inspected, the inspector can inspect the issue using IP 71152, “Problem Identification and Resolution.”

- 71111.07, Heat Sink

  Emphasize the potential to select all types of heat exchangers. The current procedure focuses on water to water and impact on the tube side of the heat exchanger. Guidance needs to include selection of select air to water heat exchangers and review the effects on the shell side of the exchanger.

  Add flexibility to allow the inspectors to split the triennial inspection requirements into two rotating inspections, essentially inspecting each requirement every six years. One inspection would be focused on heat exchangers and will incorporate the aging management review recommended by the special topic group. The second inspection would focus on the service water and ultimate heat sink. No reduction or addition of resources is anticipated. This focused look (with no reduction of resources) will allow a more thorough inspection of each topical area.

  A recommendation was tabled to remove the service water (SW) and ultimate heat sink (UHS) portion from this inspection completely anticipating it would be picked up by the CDBI; however, there is no guarantee the CDBI would select the UHS or SW resulting in a vulnerability of no inspection of the UHS/SW which was not an acceptable outcome.

- 71111.17, Evaluation of Changes, Tests or Experiments and Permanent Plant Modifications

  One recommendation included combining the .17 and .18 procedures into one procedure. The resident portion (quarterly, semi-annual, annual) would focus on the need for the modification (i.e. the corrective action it is addressing), the installation of the modification, and the post modification testing. Residents or regional inspectors could review the design and licensing impact at the time of installation or this review could wait for the team inspection. It is unclear if this recommendation would enhance the efficiency or effectiveness of the ROP.

  Move the technical guidance from the .18 procedure into the .17 procedure. Currently the .18 procedure contains the technical guidance for the design portion of the inspection. The focus of the .18 procedure will be to focus on the need for the modification (i.e. the corrective action it is addressing), the installation of the modification, and the post modification testing. Move the applicable hours (design) to the .17 procedure.

  Change the name of the procedure (and broaden the objectives) to include inspection of other mechanisms used to modify the plant. This could include the following topics: (1) Final Safety Analysis Report updates, (2) commercial grade dedication, (3) quality assurance program changes, (4) license amendments, (5) equipment qualification, (6) inservice testing program plan, (7) inservice inspection program plan, and (8) programs controlled by technical specification Chapter 5, “Administrative Controls.” The intent is to verify no unintentional safety consequences, compliance to regulations, and identification of vulnerabilities as a result of changes to the plant. In addition, potential samples

would be expanded to include equipment and facilities related to emergency preparedness (and their ability to meet their licensing/design bases) and security, if applicable. The intent is not to make these areas "required" samples – it is to allow the flexibility to inspect these areas under this procedure.

Close the triennial portion of the inspection at the end of the triennial cycle. For example, if a team inspection occurs in year one, the team portion (design/licensing) remains open until year three. This will allow timely inspection of modifications/changes which occur in year two and three. In addition, the team should be focused on performing the minimum number of samples within the given range to allow inspection throughout the triennial year. This also leads to more accurate accounting of inspection time since the regional inspectors will continue to have the ability to charge to the inspection procedure when performing inspection at the request of the resident inspector. Feedback obtained from the February 2014 public meeting cautioned this level of flexibility and the potential impact on the licensee due to unpredictability of a team inspection.

- 71111.18, Plant Modifications

  See above. If a combined effort is not approved, there are several line item changes recommended for this procedure.

- 71111.21, Component Design Bases Inspection

  Significantly reorganize this inspection to include (1) deep design review, (2) program reviews when needed (discretionary hours), and (3) operating experience topic (discretionary hours). It is envisioned this inspection would remain at a triennial frequency; however, regions can decide on implementation – that is, one large team or several smaller teams – the entire procedure would be complete within three years. The deep design review would be similar to that conducted now; however, the sample size would be smaller and the attributes reviewed would be greater. Inspectors would have more time to delve into other attributes such as aging, equipment replacement, and preventive maintenance/vendor recommendations. Inspectors should also focus attention on operability evaluations. Program reviews (meaning evaluating how the licensee addressed the greater cause of an identified trend) would be conducted based on trends identified by the resident inspectors or if a finding from the team inspection indicates a broader misunderstanding/misinterpretation of a rule/regulation or incorrect implementation of actions taken (and/or committed to) in response to previously issued generic communication. The resources for this portion of the inspection result from the reduction of deep design inspection samples. For the operating experience topic, it is envisioned that an Operating Experience Update for the IP would be provided as discussed Enclosure 15. The program review and operating experience will be incorporated into the Problem Identification and Resolution portion of the current inspection procedure.

  Current component samples are risk informed and predominantly fall in the mitigating system cornerstone. Potential samples would be expanded to include

(1) emergency response facilities (and their ability to meet their licensing/design bases), (2) security, if applicable, and (3) components not modeled directly in the probabilistic risk assessment. Emphasis should be placed on selecting containment and containment systems, as well as, equipment whose failure would result in an initiating event. In addition, components with a small likelihood of failure, but high consequence if failed, should be available for selection.

Close the triennial portion of the inspection at the end of the triennial cycle. For example, if a team inspection occurs in year 1, the team portion (design/licensing) remains open until year 3. This will allow timely inspection of modifications/changes which occur in year 2 and 3. In addition, the team should be focused on performing the minimum number of samples within the given range to allow inspection throughout the triennial year. This also leads to more accurate accounting of inspection time since the regional inspectors will continue to have the ability to charge to the inspection procedure when performing inspection at the request of the resident inspector.

- Create One Large Engineering Inspection Procedure.

  The proposal below is not recommended. It is presented here to acknowledge the concept was analyzed.

  It is envisioned that this procedure would have quarterly, annual, bi-annual, triennial inspection requirements. Inspection samples would be focused on "every day" engineering to maintenance of the licensing and design bases. Inspection samples would be broad so that inspectors could form the inspections around plant performance. For example, if there is a negative trend in valve performance, the inspectors could perform a vertical slice of the Motor Operated Valve program to identify other issues or assess the licensee's actions to address the issue. Plants with no such trend would not receive this inspection. In addition, hours charged to an inspection activity will be more accurate and reflect the work performed. For example, under the current program, an inspector could review most of the attributes described in the CDBI procedure but not charge the CDBI procedure if that inspection effort was initiated by a question from a resident inspector. With this single IP, a "design" sample could be accomplished at any time, outside the large team resulting in a smaller effort by the team at a later date.

  This proposal is the most radical and resembles how inspections were performed pre-ROP (with the exception that samples would be risk-informed in this new procedure).

- Training

  Develop a continuing/refresher training course for engineers. Currently, the engineering inspectors attend a simulator course once every three years to maintain their qualification. Based on the insights from this project, it is recommended a course be developed which focuses on engineering topics and be changed every three years to ensure fresh material for each refresher cycle. This concept is similar to an internal course (H-401) provided in the nuclear materials arena. A list of potential topics will be forwarded to the IMC 1245, "Qualification Program for Operating Reactor Programs," working group once this recommendation is approved.

- Inspection Aids/Tools

  Develop a standard request for information letter for the team inspections. Encourage counterpart groups and develop charters to focus on (1) consistently handling latent vulnerabilities, (2) identifying issues to present for training and/or generic communication, (3) developing a consistent approach in notifying the licensee senior management of planned inspections, and (4) sharing real time inspection findings and issues.

  Revise or strengthen guidance in the IMC 0307, "Reactor Oversight Process Self-Assessment Program," procedure and Technical Review Group review processes to (1) encourage the identification of smart samples, (2) capture knowledge from temporary instructions into the appropriate inspection procedure, (3) identify potential candidates for Information Notices, and (4) incorporate lessons learned from augmented and special inspections.

  Develop an inspection aid as a central location for technical inspection guidance. For example, the aid would include a statement to assess the interface between the remote shutdown panel and the equipment/component when determining operability and a link to the plant finding instead of placing this information in the CDBI procedure itself.

  Support initiatives developed by the Operating Experience Branch to provide timely input for IP Operating Experience Updates as discussed in Enclosure 15.