INSPECTION PROCEDURE 93809

# SAFETY SYSTEM ENGINEERING INSPECTION (SSEI)

PROGRAM APPLICABILITY: 2515

SALP FUNCTIONAL AREA: ENGINEERING (ENG)

## 93809-01 INSPECTION OBJECTIVES

01.01 The primary objective of this Safety System Engineering Inspection (SSEI) is to assess the licensee's engineering effectiveness through an in-depth review of calculations, analysis, and other engineering documents used to support system performance during normal and accident or abnormal conditions.

01.02 The secondary objective of the SSEI is to determine the quality of safety evaluations performed by the licensee in support of engineering modifications performed on the selected system.

## 93809-02 INSPECTION REQUIREMENTS

02.01 Inspection Planning. Before to the inspection, a designated member of the inspection group shall take the lead in developing an inspection plan to address, as a minimum, the following points:

a. Background information relative to significant issues between the responsible regional office and the licensee, particularly as it may relate to engineering and plant design.

b. System selection and key components to be addressed by the inspectors based upon the results of the plant-specific individual plant examination (IPE).

c. Assignments of individual team members to specific engineering areas of the system, for example, electrical, instrumentation and control, or mechanical, and expectations regarding the type and timing of information to be provided to the inspectors by the licensee.

d. A timetable of events involving inspection activities, such as site access training, entrance and exit meetings, coordination meetings, conference calls, and due dates.

02.02 System Selection. The SSEI should be performed on one principal safety system. During the planning process, the inspection group leader should review a number of electrical and mechanical systems from which a principal system can

be selected. System selection should be based on the plant IPE, past safety system functional inspections (SSFIs) that may have already been performed on a system by the licensee or by other NRC teams, and through review of plant licensee event reports (LERs) and other data that may indicate a system design problem. Also, the group leader may consider selection of a less prominent safety system that may have received less review from the NRC staff and the licensee.

02.03 Inspection Preparation. After selecting the safety system to be evaluated, the group leader should conduct a pre-inspection trip to the site and engineering offices to assemble the plant procedures, drawings, modification packages, calculations, analysis, and other background information. In addition, the group leader shall identify all other key administrative procedures. This information will be copied, collated, and distributed to the inspection team members for their in-office preparation.

02.04 Conduct of the Inspection. After initial arrival onsite, the inspection team should establish contact with the applicable system engineers and conduct a general system walkdown inspection either as a group or individually. The objective of this walkdown inspection is to familiarize the group with the general plant and the specific system hardware and layout.

The inspectors shall develop individual inspection plans to meet the inspection objectives listed in Section 01.01. The inspection plans shall incorporate the following inspection requirements:

a. Review the design, licensing basis, and other design documents, such as calculations and analyses for the selected system, and determine the functional requirements for the system and each active component during accident or abnormal conditions.

b. Select significant test procedures and verify that the acceptance criteria specified in the test procedures for system components are adequately supported by design calculations or other engineering documents.

c. Determine whether the normal and emergency operation of the system is consistent with the design-basis and licensing documents. Determine the need for further review and operational evaluation of discrepancies.

d. Evaluate the licensee's control and use of design and licensing input information, and the adequacy of design calculations from the perspective of modifications made to the selected safety system.

e. Review selected modifications made to the original system that could have changed the design or licensing basis. Determine whether the system meets the design basis and the licensing basis in the as-modified configuration.

f. Determine whether selected system modifications implemented since initial licensing have introduced any unreviewed safety questions as defined in 10 CFR 50.59.

g. Identify inconsistencies between the updated final safety analysis report and the design documents.

93809-03 INSPECTION GUIDANCE

General Guidance

The SSEI is intended to be conducted using three inspectors. Because of this resource limitation, the deep vertical slice approach used in the SSFI inspection, as described in inspection procedure (IP) 93801, cannot be fully implemented using this procedure. This inspection procedure is intended to assess the adequacy of calculations, analysis, and other engineering documents that are used to support system performance during normal and accident or abnormal conditions.

Review of other functional areas, such as operations, maintenance, surveillance and testing, and quality assurance and self-assessment, is addressed in other parts of the inspection program. However, when a weakness in any of the functional areas is identified, the region shall perform additional reviews to determine whether significant design weaknesses or other weaknesses exist.

The licensee is required by 10 CFR Part 50, Appendix B, and 10 CFR 50.59 to fully understand the design and licensing bases for all safety systems and the modifications to those systems since initial licensing. The licensee should be able to validate the design of the system and determine whether the facility is in compliance with the Commission's rules and regulations. As a minimum, the licensee should have documentation available to support any system design changes.

For older plants, some design documents, such as calculations and analyses, may not be available. Inspectors have a regulatory basis for actions that result in the provision of records by the licensee (including generation of new calculations to support the system design basis) that address demonstrated inspector concerns regarding particular aspects of system design. However, an inspector's request for a broad range of specific design documents, such as calculations and analysis that support system design, without any demonstrated concerns, may be perceived as a backfit.

If the selected system has not been modified since initial licensing, the fact that original documents are not available to demonstrate safety system functionality does not in itself raise an operability question. It may be possible to determine operability by licensee surveillance testing, review of pre-operational test data, or other means. For plants at which original design documents are difficult to retrieve, the team should focus on reviewing system modifications and responses to NRC bulletins and generic letters that would require licensees to assess the adequacy

of their facility, at least on a topical basis, and that would have required the regeneration of a limited set of design documents.

However, for systems modified since issuance of the operating license, the licensee should have a set of design documents that are sufficient to demonstrate that design margins have not been unacceptably reduced. For those systems that have been modified, the licensee's difficulty in retrieving design information may be an indicator of the lack of rigorous control of design calculations at the facility. This lack of control, in turn, may result in discrepancies between the plant licensing and design bases.

The inspectors should verify that the current configuration of the system conforms to the design and licensing bases. Additionally, the inspectors should ensure that design-basis documents are controlled documents, are being maintained accurately and are up to date.

The facility's current licensing basis is the set of regulatory requirements and licensing commitments that forms the basis for issuance of the operating license and for the continued safe operation of the facility. The licensing basis is contained in NRC regulations, plant Technical Specifications, the final safety analysis report (FSAR), NRC safety evaluation reports, and licensee commitments, such as those made in response to NRC generic notifications or to NRC violations. The licensing basis changes with time. For example, as Technical Specification amendments are issued, the licensing basis is updated.

Specific Guidance

03.01 Inspection Planning. The ideal system for an SSEI is one that is relied upon for accident mitigation and has been significantly modified over the life of the plant. If available, the plant-specific probabilistic risk assessment or the IPE should be reviewed as part of the system selection methodology. The recommended system is to have been originally designed by the architect-engineer (A/E). Modifications to nuclear steam supply system (NSSS) vendor-designed systems are typically performed by the NSSS vendor, and modifications to A/E-designed systems are often solely performed by the licensee's engineering staff. Therefore, the potential for compromising the design basis and reducing safety may be greater for an A/E-designed system than for an NSSS vendor-designed system, although an NSSS vendor-designed system is acceptable for evaluations. In addition, the previous NRC inspection history and licensee self-assessments, including SSFIs, should be considered in selecting a system for review. Operability evaluations and Technical Specification interpretations performed on systems may also indicate inconsistencies between licensing requirements (i.e. the Technical Specification) and design of the system.

03.02 System Selection. The engineering design inspection begins with the pre-inspection visit (sometimes referred to as the "bagman" trip) to allow in-office review 2 weeks earlier than the onsite portion of the inspection. The need for a "bagman trip" must be evaluated on a case-by-case basis. This additional time is

required because the team must review a considerable amount of design documentation to determine whether the system design basis has been maintained throughout the modification process.

During the in-office preparation phase, the following items should be reviewed by each inspector to obtain a detailed working understanding of the system operation and design bases:

a. FSAR and Updated Safety Analysis Report.

b. Site-specific administrative procedures related to design-basis document control and to engineering change control.

c. System descriptions and design-basis documents.

d. Technical Specification requirements and surveillance test procedures.

e. System piping and instrumentation drawings; one-line diagrams; electrical schematics; wiring and logic diagrams; cross section drawings for pumps and heat exchangers; and procurement specifications for major components.

f. Engineering calculations (e.g., equipment sizing and short circuit analysis).

g. Temporary and permanent modifications, including safety evaluations.

h. Relevant regulatory information such as information notices, generic letters, and special studies that apply to the system.

i. Industry standards applicable to the assigned functional areas.

j. LERs for the past 12 months.

k. Inspection reports for the past 12 months and the Plant Issues Matrix.

l. Licensee engineering design guides.

m. Significant nonconformance reports.

n. Operator work arounds.

Each team member should study the documentation to achieve an in-depth understanding of the selected system (e.g., the safety function in all modes of operation, major system flow paths, essential safety features actuation signals, system alignment during accident mitigation, safety interlocks, etc.). The inspectors should become familiar with system hardware, design basis, operation requirements, and equipment history. They should also become familiar with the accident sequences that the system is designed to mitigate, as well as the accident analysis assumptions for the system.

The team should initially focus on in-depth inspection of one system. A detailed and in-depth review of one system is preferable to a review of numerous systems that are reviewed in less depth. However, the team may have to expand its review of engineering calculations to other systems on the basis of observations obtained from the review of calculations associated with the system that was initially selected for inspection. As a result, the inspection may result in review of selected calculations from other systems.

03.03 Inspection Preparation.

a. In reviewing the functional adequacy of the selected system, the inspector should determine whether the design basis is met by the installed and tested configuration. The inspector should understand not only the original purpose of the design but the manner and conditions under which the system will actually be required to function. For example

1. For valves. What permissive interlocks are involved? What differential pressures will exist when the valve strokes? Will the valve be repositioned during the course of an event? What is the source of control and indication power? What control logic is involved? What manual actions are required to back up and restore a degraded function?

2. For pumps. What flow paths will the pump experience during accident scenarios? Do the flow paths change? Is adequate net positive suction head available under all operating conditions? What permissive interlock and control logic applies? How is the pump controlled during accident conditions? What manual actions are required to back up and restore a degraded function? What suction and discharge pressures can the pump be expected to experience during accident conditions? What is the motive power for the pump during all conditions? Do vendor data and specifications support sustained operations at low flow rates?

3. For instrumentation and sensors. What plant parameters are used as inputs to the initiation and control system? Is operator intervention required in certain scenarios? Are the range, accuracy, and setpoint of instrumentation adequate? Are the specified surveillance and calibrations of such instrumentation acceptable?

Inspectors may also want to examine the results of the licensee's review of the design-bases documents that may have identified potential engineering deficiencies.

b. When comparing the as-built design with the design basis and the licensing basis for the selected system, the inspectors should consider the following questions:

1. Are the assumptions upon which the original design was based adequate? For example, are service water flow capacities sufficient with the minimum number of pumps available under accident conditions? Are the voltage studies accurate and will the required motor-operated valves and relays operate under end-of-life battery conditions and degraded grid voltages? Are fuses and thermal overloads properly sized? Are direct current loads within the capacity of the station batteries? Is the instrumentation adequate in range and accessibility for the Operations Department to control the system under normal and abnormal conditions?

2. Have modified structures surrounding safety equipment, components, or structures been evaluated for seismic
two-over-one considerations and have modified equipment components falling under the scope of 10 CFR 50.49 been thoroughly evaluated for environmental equipment qualifications considerations such as temperature, radiation, and humidity?

3. If the as-built documents have been marked for the design changes on an interim basis, have additional measures been taken, including document review, approval, and safeguarding the marked documents and related papers until the changes have been incorporated on the revised documents?

Inspectors should also perform a walkdown inspection of the selected system during their first week on site and review the system engineering reports on the system, if available, to obtain an appreciation of the current concerns associated with the system.

03.04 Conduct of the Inspection. Review of the design basis and the licensing basis should include verifying the appropriateness of the design assumptions, boundary conditions, and models. The review should determine whether (1) the design basis conforms to the facility's licensing commitments and regulatory requirements, (2) the design bases, analyses, and associated design output documents, such as facility drawings and procurement specifications, are correct, and (3) the installed system and components are tested to verify that the design bases have been met.

## 93809-04 INSPECTION RESOURCE ESTIMATE

04.01 Inspection Group Composition. The inspection group should consist of three inspectors. Two of the group members will be regional inspectors, with additional support supplied by the NRR staff or through contractors. An NRR staff member (e.g., a project manager) can provide assistance in the review of 10 CFR 50.59 documentation. The contractors will be individuals who can provide assistance in the review of design calculations. One member of the

inspection group shall be designated as a group leader to act as spokesman for the group so that issues can be consistently directed to the attention of the licensee's management during the inspection. The resident inspectors for the site being inspected should not normally be assigned as participating team members; however, their involvement in the inspection process should be encouraged to the extent their resident duties will allow.

04.02 Inspection Duration. The length of the inspection is about 4 weeks. The 4 weeks include 1 week for inspection preparation, a 2 week onsite inspection period, and 1 week in which inspectors may document their observations. The licensee should be notified of the safety system selected to be reviewed about 1 to 2 months in advance of the pre-inspection visit. This amount of time is necessary because of the difficulty many licensees have experienced in locating and reassembling the design-basis documents. Before the onsite inspection, the group leader shall visit the site or engineering offices to perform the pre-inspection visit. The purpose of this visit is to obtain the required plant procedures, drawings, calculations and other support information. The inspection report preparation will require, at a minimum, an additional 1 week effort by all team members immediately following the inspection exit.

04.03 Inspection Schedule. The following guidance is provided for resource commitments and planning in conducting the inspection from start to finish.

PRE-INSPECTION VISIT: The inspection group leader visits the licensee to collect design documents as required to conduct in-office preparation.

The group leader copies, collates, and distributes background information to all team members.

Week 1 Each inspector performs an in-office review of design documents and develops an inspection plan.

Week 2 The entrance meeting is held at the site. The team begins the inspection.

Week 3 The team continues the inspection. The pre-exit review is conducted on Thursday of week 3 with the NRC staff. The exit meeting is held on Friday of week 3.

Week 4 The team prepares the input for the inspection report.

Week 5-6 The group leader completes the report.

## 93809-05 ADDITIONAL INSPECTION GUIDANCE

The following inspection procedures are applicable for reference during the inspection:

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| 37700 | - | Design, Design Changes, and Modifications |
| 37701 | - | Facility Modifications |
| 37702 | - | Design Changes and Modifications Program |
| 72701 | - | Modification Testing |

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