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

NRC INSPECTION MANUAL

INSPECTION PROCEDURE 93807

SYSTEMS BASED INSTRUMENTATION AND CONTROL INSPECTION

PROGRAM APPLICABILITY: 2515

SALP FUNCTIONAL AREA: ENGINEERING/TECHNICAL SUPPORT (SOETS-0)

93807 INSPECTION OBJECTIVES

The objective of the System Based Instrumentation and Control Inspection (SBICI) is to verify the functionality of safety systems by inspecting performance related attributes of the safety system with a focus on its associated instrumentation and control.

93807-02 INSPECTION REQUIREMENTS

02.01 Inspection Planning. The team leader shall develop an inspection plan to address the background information on the plant relative to this inspection, the basis for selecting the system(s) for inspection, the selected instrumentation, the assignment of individual team members to specific areas, and the schedule.

02.02 Selection of Instrumentation. The team leader, assisted by the mechanical system design engineer, and one I&C design engineer, should review a current plant specific probabilistic risk assessment (PRA) and plant experience to identify the dominant accident sequences that contribute significantly to core damage. Two or three systems whose failure could affect these accident sequences should be selected, and about 10 to 12 instrument loops in these systems that initiate and control protective actions for accident mitigation should then be identified for inspection. A review of applicable experience reports may be helpful in identifying specific instrument loops within the selected systems.

02.03 Conduct of the Inspection. This inspection has two components, a design inspection typically conducted in the engineering offices of the licensee and a concurrently conducted site inspection.

a. Design Inspection

1. Verify that the thermal/hydraulic performance of the mechanical system is consistent with the limits specified in technical specifications (TS), accident analyses, emergency operating procedures, and design bases documents (DBD).

2. Verify that the process parameters used as controlling variables and their specified control values have been selected with adequate

margins to assure system functionality.

3. Verify that the device range for each selected parameter is adequate, taking into consideration the device accuracy, calibration tolerances, drift, etc. Also verify that the licensee's loop calibration methodology ensures that the device is calibrated over its entire range.

4. Verify that the calculated system process response times are consistent with required system performance.

5. Verify that setpoints are calculated consistent with the methodologies defined in NRC approved topical reports, Regulatory Guides, or equivalent guidelines in industry standards as applicable, and utilize correct inputs from technical specifications, accident analyses or DBD. Also verify that effects of physical elevations, density ranges and temperatures ranges are appropriately considered.

6. Verify that devices have been qualified for the anticipated normal and accident environmental conditions applicable to their physical location (e.g., temperature, humidity, radiation, seismic loading) and that inaccuracies associated with environmental conditions have been appropriately factored into loop accuracy calculations and considered in appropriate abnormal and emergency operating procedures. Also verify that all inaccuracies due to environmental effects of the loop elements (i.e., cables, transmitters, terminal blocks, penetrations, etc.) have been appropriately considered.

7. Verify that proper logic has been incorporated for system actuation, annunciation and control.

8. Verify that system modifications, including revisions to setpoints, have been appropriately evaluated per 10 CFR 50.59, and that in-kind replacements were truly in-kind.

9. Verify that all pertinent functions of the equipment are checked during surveillance testing.

10. Verify that equipment responses to a loss of power are adequate. Also, verify that procedures for handling loss of power incidents are adequate for the instruments selected.

11. Verify that the required isolation devices are qualified and that the system maximum credible fault/surge withstand capability is bounded by the installed isolation devices.

12. Verify that protection system/control system failure will not adversely challenge plant safety systems (control system interaction).

13. Verify grounding of equipment and cabling have been evaluated for the effects of noise interference, lightning induced surges, or ground loops.

14. Review maintenance, calibration, and surveillance procedures, and verify conformance to TS, FSAR and calculation requirements. Confirm that calibration, annunciator, abnormal response and

maintenance procedures have been updated to reflect any revised equipment requirements due to system modifications.

15. Verify that the installed equipment configuration and rack arrangement allow adequate equipment cooling.

16. Verify that equipment susceptibility to Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) sources has been evaluated.

17. Verify that appropriate electrostatic discharge procedural precautions are in place.

b. Site Inspection

1. Verify that physical locations of instrument taps and device elevations are consistent with calculations.

2. Verify that sensing lines are arranged with appropriate consideration of slope, venting, draining, equalizing, process isolation and hydraulic requirements.

3. Verify that device make and model number and actual setpoint are consistent with the calculation and instrument list.

4. Verify that the physical location of the instrumentation loop is such that there are no unresolved concerns due to high-energy or moderate-energy line breaks, jet impingement, seismic II/I, flooding, missiles, or vibration.

5. Verify that plant specific historical data on instrument drift between calibrations is consistent with the calculation assumptions.

6. Verify that calibration procedures are consistent with the calculation requirements.

7. Verify that preventive maintenance, including vendor recommended periodic replacements of aging parts, is satisfactory.

8. Verify that test equipment accuracies are consistent with those assumed in setpoint calculations.

9. Verify that instrumentation that is bypassed is properly indicated or annunciated.

10. Verify that adequate corrective action has been taken to identify and correct I&C related maintenance concerns identified in information notices, IE Bulletins, generic letters and vendor recommendations.

11. Verify that appropriate documented operability/reportability evaluations have been performed for dispositioning identified problems and maloperation or failure of instrumentation.

12. Verify that adequate physical separation/independence is maintained between channels/divisions.

93807-03 INSPECTION GUIDANCE

General Guidance

The inspection will review the licensee's evaluation of the thermal/hydraulic performance of the safety system and the process parameters used to control the operation of the safety system to assure that it will perform as described in the FSAR and as assumed in the accident analysis. The inspection will also review the design and field aspects of the associated instrumentation and control systems, including setpoint calculations, mechanical systems interfaces, testability, calibration procedures, isolation and bypass status indication, maintenance, and equipment installation.

Specific Guidance

03.01 No specific guidance.

03.02 Selection of Instrumentation. The selection of instruments for inspection should be done during the pre-inspection visit to the licensee's facilities. The inspection sample should include those instruments that are typically engineered by the NSSS vendor, e.g., ECCS and other accident mitigating systems, and those engineered by the architect-engineer, e.g., balance of plant systems. Technical specifications and FSAR system descriptions should be used in the selection process. The size and scope of the inspection sample may be adjusted for each facility as determined necessary.

03.03a Design Inspection. The inspectors assigned to perform system based I&C design inspections should have experience in designing the systems being inspected or, as a minimum, with the NSSS design to be inspected. Preferably this experience should have been gained while working at the design offices of an NSSS supplier or an architect-engineer.

The inspectors should evaluate the I&C systems relative to their design bases, technical specifications and accident analyses (as appropriate), process limits calculations, setpoint calculations, and control loop logic for actuation/alarm functions. For verifying instrument setpoints the guidance in Regulatory Guide 1.105, "Instrument Setpoints for Safety Related Systems" should be used. Specific design attributes to be considered are listed in Section 02.03a of this procedure.

03.03b Site Inspection. Field engineers performing the site inspection should be experienced in I&C component installation, maintenance, surveillance, calibration, testing and operations. Site inspectors should closely coordinate their activities with the design inspectors to ensure that the physical installation, procedure requirements, test results, drift data, etc., are consistent with the design documents and calculations. Specific site attributes to be considered are listed in Section 02.03b of this procedure.

93807-04 INSPECTION RESOURCES

04.01 Team Composition. The SBICI team includes 5 or 6 inspectors with the following assignments:

Team leader

Assistant team leader (optional depending on the need to split the team for

concurrent inspections at the site and the engineering office remote from the site)

Two I&C design engineers

One mechanical system design engineer.

One I&C field engineer

04.02 Inspection Duration. The following guidance is provided for planning the inspection:

Week 1 - Three days of pre-inspection visit by the team leader, the mechanical system design engineer and one I&C design engineer, for selection of instruments for inspection and acquisition of inspection documents.

Week 2 - In office inspection preparation and review of documents.

Week 3 - Inspection at the site and licensee engineering offices.

Week 4 - In office review of information collected during week 3 and continuation of review of documentation.

Week 5 - Completion of site and engineering office inspection. Pre-exit meeting with the NRC management and exit meeting with the licensee.

Week 6 - Preparation of report inputs by the team members and transmittal to the team leader.

Weeks 7 through 11 - Team leader compile and finalize team member inputs and issue inspection report.

93807-05 REPORTING REQUIREMENTS

The team leader shall develop input for the facility Systematic Assessment of Licensee Performance (SALP) report, based upon the inspection observations. This input should generally address functional areas such as Engineering and Technical Support, Maintenance/Surveillance, and Safety Assessment/Quality Verification.

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