INSPECTION PROCEDURE 93810

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION (SWSOPI)

PROGRAM APPLICABILITY: 2515

SALP FUNCTIONAL AREA: PLANT OPERATIONS (OPS)

93810-01 OBJECTIVES

01.01 Verify that the service water system (SWS) is capable of fulfilling its thermal and hydraulic performance requirements and is operated consistent with its design bases.

01.02 Assess the SWS operational controls, maintenance, surveillance, and other testing, and personnel training to ensure the SWS is operated and maintained so as to perform its safety-related functions.

93810-02 INSPECTION REQUIREMENTS

The scope of the inspection at a specific plant may be reduced after taking into consideration the previous SWS inspections, such as safety system functional inspections (SSFIs), routine inspections by resident or regional inspectors, and licensee self-assessments. If SWS inspections are performed at plants where SWSOPIs had previously been conducted, the inspection scope in the engineering design area should be limited to inspecting design changes to the system. Inspection resources should also be adjusted to be commensurate with the scope of the inspection.

02.01 Mechanical Systems Engineering Design Review and Configuration Control

a. Review the design-basis and other design documents such as calculations and analyses for the SWS, and determine the functional requirements for the SWS and each active component during accident or abnormal conditions. This review may include the appropriateness of assumptions, boundary conditions, and models, and independent calculations by the engineering design inspector(s). The team should determine if (1) the system design is in accordance with the facility's licensing commitments and regulatory requirements, and (2)

whether the system will meet its thermal and hydraulic performance requirements.

b. Review the individual plant examination (IPE) data or plant-specific PRA data and identify equipment or conditions that have been dominant contributors to the SWS operational risk at the plant or at similar plants. Provide the operations and maintenance team members information obtained from the IPE data.

c. Through discussions with the operations inspectors, confirm that operation of the SWS is in accordance with its design requirements.

d. Evaluate single active failure vulnerabilities of the system and the resulting impact on interfacing system components such as emergency diesel generators. Evaluate the effect on SWS operability of failures in interfacing systems, such as instrument air. Examine potential common mode failures associated with intakes or traveling screens.

e. Review the effectiveness of any design features installed to minimize silting and biofouling of the piping and components. Verify if features are provided for the timely detection of flow degradation.

f. Verify that system flow balance data is consistent with key design assumptions, where available, for flow coefficients, rated pressure drops across components and piping, rated heat removal, heat exchanger fouling, and total system flow for operating modes. Flow balance verification should be done for worst case combinations of pump operation. Verify that pump runout conditions are not present with minimum number of pumps operating with worst-case alignment of non-safety related loads. Evaluate minimum and maximum limits for valve positions required to achieve flow balance and verify that these limits are properly incorp-orated into operational controls.

g. Assess whether design features are needed to mitigate the effects of flooding caused by SWS leaks. Review NUREG 1275, Volume 3, Section 3.3 for information on SWS events involving actual or potential flooding.

h. Review the safety-related portion of the system for seismic qualification and verify that non-safety-related portions can be isolated in accordance with the provisions specified in the system design bases.

i. Select at least three significant SWS modification packages for a detailed review. This review should include assessment of 10 CFR 50.59 evaluations and should ensure that the changes have not compromised the system design bases and have included revised maintenance requirements and procedures, operating instructions, training, and periodic testing, as necessary.

j. Review the instrumentation setpoints for alarms and actuations to ensure they are consistent with the design basis and assumptions.

k. Review test procedure and test results for one air-to-water heat exchanger served by the SWS. Verify that the test results have been evaluated including consideration of test instrument inaccuracies.

02.02 Operations

a. Perform a system walkdown. Review the SWS configuration for consistency with design drawings. Coordinate with engineering and maintenance inspectors as necessary.

b. Review the SWS alarm response procedures and operating procedures for normal, abnormal, and emergency system operations to assure the system is operated within the design envelope. This review should be coordinated with the mechanical systems design inspector. Review the implementation of operating and alarm response procedures. Assess adequacy of flow instrumentation relied upon during accident conditions. Review available operating logs to determine adequacy of temperature and flow monitoring.

c. Review operator training for the SWS, focusing on the technical completeness and accuracy of the training manual and lesson plans. Verify that the lesson plans reflect the system modifications and that the licensed operators have been trained on these modifications.

d. Review the proper implementation of procedures for verifying periodic and post-maintenance alignments of valves in the SWS especially those valves that isolate flow to safety-related components. Verify that required accident condition flow is not degraded during normal system operation valve alignments. Review the method used to verify proper SWS throttle valve position. Review control of SWS heat exchanger flow variations due to changing climate (temperature) conditions.

e. Walk through the system operating procedures and the system piping and instrument diagrams with engineering and operations staff, as appropriate. Consider using the plant simulator for this walk through, if available. Verify that the procedures can be performed and that components and equipment are accessible for normal and emergency operation. If any special equipment is required to perform these procedures, determine if the equipment is available and in good working order. Verify that the operators' knowledge of equipment location and operation.

f. Interview the operators to determine the adequacy of their technical knowledge of such items as the operation of the system, its role in accident mitigation, technical specification surveillance requirements, and determination of operability.

g. Review the local operation of equipment. Determine if the indication available to operate the equipment is in accordance with applicable operating procedures and instructions. Verify that the environmental conditions, such as expected room temperature, emergency lighting, and steam, assumed under accident conditions are adequate for remote operation of equipment.

h. Assess operational controls (including indication, annunciation, and operator response requirements) for traveling screens and circulating water pumps to preclude excessive drawdown of the intake bay, with associated loss of SWS pump suction head, as a result of clogging the traveling screens.

i. Confirm that licensee commitments to Generic Letter 96-06, "Assurance of Equipment Operability and Containment Integrity During Design Basis Accident Conditions," have been implemented.

02.03 Maintenance

a. Conduct a system walkdown to review the as-configured system for material condition. (This task may be shared with or performed entirely by the operations inspector).

b. If possible, witness maintenance performed on the selected system. Review maintenance package preparation and observe quality control involvement.

c. Review maintenance procedures for technical adequacy. Determine if the procedures are sufficient to perform the maintenance task and provide for identification and evaluation of equipment deficiencies. Compare the procedures to the vendor manuals to identify any vendor recommendations not incorporated into procedures. Verify that important vendor manuals are complete and up-to-date.

d. Review the periodic inspection program used to detect corrosion, erosion, protective coating failure, silting, and biofouling. Review previous inspection results, as-found conditions, inspection frequency, cleaning and flushing procedures and frequency, and trending of inspection results.

e. Review the maintenance program for trending degradation of and removal and repair of SWS piping and interface system components due to silting, biofouling, corrosion, erosion, and failure of protective coating.

f. Determine if the SWS components are being maintained to ensure their operability under all accident conditions. Review information regarding unavailability due to planned maintenance as an indicator of maintenance adequacy.

g. Review the maintenance history for the selected components of the SWS for the past two operating cycles (minimum of 2 years) or longer if necessary. Look for recurring equipment

problems and determine if any trends exist. Evaluate the adequacy of the root cause analysis and corrective actions implemented in response to adverse trends. Review several completed maintenance activities for technical adequacy, performance of post-maintenance testing and satisfactory demonstration of equipment operability.

h. Conduct detailed interviews with the maintenance personnel to determine their technical knowledge of how components are maintained, such as the setting of limit switches, the alignment of pump couplings, cleaning and replacing filters, and the maintenance of circuit breakers.

i. Determine if maintenance personnel receive training pertaining to the SWS and if the degree of training provided is consistent with the amount of technical detail in the procedures.

02.04 Surveillance and Testing

a. Review the technical specification surveillance procedures and inservice test procedures performed in the past two operating cycles (minimum of 2 years) for the SWS.

Coordinate the review with the mechanical systems design inspector to ensure design assumptions on system performance are satisfactorily demonstrated by the test methodology.

b. Verify that test acceptance criteria are consistent with the design basis to ensure the SWS testing demonstrates that the SWS will operate as designed. Review indicators of SWS system performance (such as overall system unavailability or recurring problems) to identify if any testing inadequacies exist or if testing frequency is appropriate. Determine if surveillance test procedures comprehensively address required SWS responses.

c. Review results from preoperational testing to determine whether the SWS capabilities and limitations were demonstrated. Determine whether controls were established to avoid unacceptable system or component operating regimes, such as limiting valve travel to avoid pump runout conditions.

d. Evaluate the risk-significant equipment and support systems and plant modifications selected for review by the engineering team to ensure that surveillance and testing has been performed.

e. Review the inservice test records for pumps and valves in the SWS, with an emphasis on the technical adequacy of procedures, trending of test results and recurrent failures. Review the IST program for completeness.

f. Review how specific SWS instruments are calibrated and tested, how valve stroke time testing is performed, and how and where temporary test equipment is installed to verify

compliance with technical specification operability requirements. Verify the tolerance used for instrument accuracy is acceptable.

g. If possible, witness post-maintenance, surveillance, and inservice tests performed on the SWS.

h. Review procedures for periodic testing of safety-related heat exchanger heat transfer capability and the trending of test results. Verify that the test results have been evaluated including consideration of test instrument inaccuracies. Inform the mechanical systems inspector of unusual data trends or apparent procedural inadequacies.

i. For the two previous operating cycles (2 years minimum) preceding the inspection, ascertain the system train, pumps, or significant component unavailability during power and shutdown conditions. This review shall be coordinated with the maintenance inspector. Compare the actual unavailability data to that assumed by the analysis used by the licensee to comply with 10 CFR 50.65 (Maintenance Rule). Assess the degree to which the licensee has input accurate unavailability data into this analysis. Any gross disparities identified should be addressed in the inspection report using IP 62707.

j. Verify that the installed SWS components are tested to ensure the components will perform in accordance with their design bases. This review should be coordinated with the mechanical design inspector.

02.05 Quality Assurance and Corrective Actions

a. Review the meeting minutes of the plant onsite safety review committee and the offsite safety review committee for the past six months for items pertaining to the SWS. Inform the operations and design inspectors of any discrepancies and unusual operability determinations.

b. Review the operational history of the SWS, including licensee event reports, nuclear plant reliability data system reports (NPRDS), 10 CFR 50.72 reports, enforcement actions, nonconformance reports, technical specifications operability determinations, maintenance work requests, and adverse test results or recurrent test failures. Emphasize the adequacy of root-cause evaluations.

c. Compare the results of the team's assessment of the areas inspected for the SWS with the results of applicable licensee quality verification activities in the same areas (i.e., operations, maintenance, surveillance and testing, engineering design, and design control). Determine why the licensee's quality verification activities did not uncover significant issues identified by the team.

d. Review the timeliness and technical adequacy of licensee resolution of findings from its self-assessments. Review the

open item tracking system items pertaining to the SWS for tracking and closure of identified deficiencies.

e. Evaluate the interface between engineering and technical support (E&TS) and plant operations, regarding corrective actions to resolve operational problems.

93810-03 INSPECTION GUIDANCE

General Guidance

Inspection Planning. The team leader shall develop an inspection plan to address the background information related to the selected plant, such as the licensee's actions in response to Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment," and plant specific problems identified in licensee event reports (LERs) and inspection reports, assignment of individual team members to specific areas, and inspection schedule.

Plant Selection

Plants should be selected for inspection where the operating experience indicates that the SWS performance is risk-significant. This could include:

- Plants for which the percentage of core damage frequency (CDF) attributable to SWS failures is a significant contributor to risk,

- Plants that had experienced SWS related accident sequence precursor (ASP) events whose conditional core damage probabilities (CCDPs) was high, for example, greater than 1.0 E-4.

- Plants experiencing safety significant SWS events, such as actual total failure of one or more SWS trains.

- Plants whose design and operating characteristics are similar to those identified above, and thus could potentially be at a higher risk of occurrence of safety significant SWS events.

System and Component Selection. The selection of SWS components and systems that support successful operation of the SWS should consider those that have been dominant contributors to the SWS operational risk at the plant or similar plants. Previous inspection reports, LERs, and operational history should be reviewed to assist in this selection. The emphasis of the review of support systems should be their interfaces with the SWS. The selected components should include the SWS pumps and several representative heat exchangers.

Inspection Preparation. Acquisition of contractors will require close coordination with headquarters staff.

Inspectors should read the inspection requirements, Section 93810-02, in their areas of review to identify the documents and

information needed for the inspection. The team leader and inspector(s), as appropriate, should make a pre-inspection visit to the site and engineering offices to assemble applicable procedures, drawings, modification packages, calculations, analyses, documents demonstrating GL 89-13 implementation, and other necessary information concerning the SWS inspection sample. Some of this material can be obtained by letter request.

Conduct of Inspection

The inspection should determine whether the licensee has taken corrective actions to resolve self-identified problems. The inspection should also verify capability of equipment to perform its risk-significant functions and the effectiveness of inservice and surveillance testing with respect to significant operational requirements and past operating history. Investigation of conditions or operations that operating experience has indicated would adversely affect the reliability of the SWS equipment to perform its risk-significant function should be conducted.

Specific Guidance

No specific guidance is provided.

93810-04 INSPECTION RESOURCES

04.01 Team Composition. Every attempt should be made by the team leader to limit the size of the team to only those personnel essential to perform an effective inspection as determined by the scope of the effort planned for a particular site. Generally, the SWSOPI team should be comprised of the team leader and 3 inspectors. The inspectors should be assigned as follows:

Inspector	Assigned Area
Team leader	Quality assurance and corrective actions
Mechanical design engineer (with SWS design and heat exchanger testing & performance experience)	Engineering design and configuration control
Operations inspector	Operations/Surveillance/Testing
Operations inspector	Maintenance

An additional team member may be appropriate for multi-unit sites where service water systems differ substantially from one another. In addition, consideration can be given to including a part-time electrical engineer on the team. This can be extremely beneficial for plants with complex electrical distribution system supplies to SWS equipment. Attributes such as load sequencing, timing and electrical alignment of power supplies can be examined. A part-time instrumentation and controls engineer may be included in the

team for reviewing the instrument setpoints and setpoint calculations and system controls.

04.02 Inspection Duration. The length of the inspection cycle, including one week of preparation, should be approximately six weeks. The region should notify the licensee of the SWSOPI at least two months before the pre-inspection visit to ensure that the licensee has sufficient time to locate and assemble the design-basis documents.

04.03 Inspection Schedule. The following schedule is provided to allow the commitment of resources and planning for conducting an SWSOPI.

Week 1	Pre-inspection visit by the team to the site, and if necessary to corporate engineering offices, to collect necessary background information, to present expectations to the licensee concerning the remainder of the inspection, and to get badged.
Week 2	In-office review of material for on-site inspection.
Week 3	The entire team on site for the inspection.
Week 4	In-office review of inspection documentation and internal NRC management briefings on preliminary inspection findings and potential operational issues. This off-site period will give the licensee time to review the outstanding concerns and questions identified during the first week of the inspection on site.
Week 5	Final week of inspection during which the entire team is on site and follows up the outstanding concerns and questions from inspections during previous weeks. The pre-exit meeting at which NRC management representatives are present is to be conducted Thursday afternoon. The exit meeting with the licensee is to be conducted on Friday morning.
Week 6	Inspection report prepared by the team.
Weeks 7-11	Inspection report assembled by the team leader, reviewed, and issued.

93810-05 REFERENCES

NUREG 1275 Vol. 3	Operating Experience Feedback Report - Service Water System Failures and Degradations
NUREG/CR-5865	Generic Service Water System Risk-Based Inspection Guide
Generic letter 89-13	Service Water System Problems Affecting Safety-Related Equipment

Generic Letter 96-06	Assurance of Equipment Operability and Containment Integrity During Design Basis Accident Conditions.
IE Bulletin 80-24	Prevention of Damage Due to Water Leakage Inside Containment
IE Bulletin 81-03	Flow Blockage of Cooling Water to Safety System Components by Corbicula (Asiatic clams) and Mytilus (mussel)
IE Bulletin 83-03	Check Valve Failures in Raw Water Cooling Systems of Diesel Generators
Information Notice 81-21	Potential Loss of Direct Access to Ultimate Heat Sink
Information Notice 85-30	Microbiologically Induced Corrosion of Containment Service Water System
Information Notice 86-96	Heat Exchanger Fouling Can Cause Inadequate Operability of Service Water System
Information Notice 87-06	Loss of Suction to Low-Pressure Service Water System Pumps Resulting From Loss of Siphon
Information Notice 88-37	Flow Blockage of Cooling Water to Satisfy System Components
Information Notice 89-49	Failure to Close Service Water Cross-Connection Isolation Valves
Information Notice 90-39	Recent Problems With Service Water Systems
Information Notice 92-49	Recent Loss or Severe Degradation of Service Water Systems
Information Notice 94-03	Deficiencies Identified During Service Water System Operational Performance Inspections
Information Notice 94-79	Microbiologically Influenced Corrosion of Emergency Diesel Generator Service Water Piping
Information Notice 96-36	Degradation of Cooling Water Systems Due to Icing
Information Notice 96-45	Potential Common-Mode Post-Accident Failure of Containment Coolers
Information Notice 98-02	Nuclear Power Plant Cold Weather Problems and Protective Measures

END