November 8, 2000

EA-00-225

Mr. Mark Reddemann
Site Vice President
Kewaunee and Point Beach Nuclear Plants
Nuclear Management Company, LLC
6610 Nuclear Road
Two Rivers, WI 54241

SUBJECT: KEWAUNEE NRC - INSPECTION REPORT 50-305-00-12(DRS)

Dear Mr. Reddemann:

On August 9, 2000, the NRC completed the first baseline safety system design and performance capability inspection at the Kewaunee Nuclear Power Station. On August 9, 2000, the results were discussed with Mr Hoops, and other members of your staff. In addition, additional inspection information was provided to you and other members of your staff by conference calls on September 22 and October 2, 2000. The enclosed report presents the inspection results.

The inspection was a detailed examination of design activities and records as they relate to ensuring that the service water system was capable of performing the required post-accident functions, and to verify compliance with the Commission's rules and regulations and the conditions of your license. Within these areas the inspection consisted of observations of activities, discussions with cognizant personnel and a selective examination of procedures, design documents, and representative records.

This report discusses an issue that appears to have low to moderate safety significance. As described in Section 1R21.3 of the report, inadequate design control resulted in the installation of improperly sized auxiliary feedwater pump suction strainers. This issue was assessed, using the applicable Significance Determination Process, as a potentially safety significant finding that was preliminarily determined to be white, an issue with some increased importance to safety, which may require additional NRC inspection. The issue has a low to moderate safety significance because the service water suction source for the auxiliary feedwater system may not have been available for injection during or after high winds or seismic events when auxiliary feedwater would be necessary to perform its safety function.

The feedwater pump suction strainer issue appears to be an apparent violation of NRC requirements and is being considered for escalated enforcement action in accordance with the "General Statement of Policy and Procedure for NRC Enforcement Actions," (Enforcement Policy) NUREG-1600. The current Enforcement Policy is included on the NRC's website at www.nrc.gov/OE.

Before the NRC makes a final decision on this matter, we are providing you an opportunity to request a Regulatory Conference where you would be able to provide your perspectives on the significance of the finding, the bases for your position, and whether you agree with the apparent violation. If you choose to request a Regulatory Conference, we encourage you to submit your evaluation and any differences with the NRC evaluation at least one week prior to the conference in an effort to make the conference more efficient and effective. If a conference is held, it will be open for public observation. The NRC will also issue a press release to announce the conference.

Please contact Ron Gardner at (630) 829-9751 within seven days of the date of this letter to notify the NRC of your intentions. If we have not heard from you within 10 days, we will continue with our significance determination and enforcement decision, and you will be advised by separate correspondence of the results of our deliberations on this matter.

Since the NRC has not made a final determination in this matter, no Notice of Violation is being issued for this inspection finding at this time. In addition, please be advised that the number and characterization of the apparent violation described in the enclosed inspection report may change as a result of further NRC review.

In addition, the NRC inspection identified three other issues, which were considered to be of very low safety significance. These issues are listed in the summary of findings and are discussed in the report details. These issues were entered into your corrective action program and are being treated as non-cited violations (NCVs) consistent with Section VI.A.1 of the NRC Enforcement Policy.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosures will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/NRC/ADAMS/index.html (the Public Electronic Reading Room).

Sincerely,

/RA/

John A. Grobe, Director
Division of Reactor Safety

Docket No. 50-305
License No. DPR-43

Enclosure: Inspection Report 50-305-00-12(DRS)

cc w/encl: K. Weinhauer, Assistant Site Vice President, Kewaunee Plant
B. Burks, P.E., Director, Bureau of Field Operations
Chairman, Wisconsin Public Service Commission
State Liaison Officer

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U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket No:	50-305
License No:	DPR-43
Report No:	50-305-00-12(DRS)
Licensee:	Wisconsin Public Service Corporation
Facility:	Kewaunee Nuclear Power Plant
Location:	N 490 Highway 42 Kewaunee, WI 54216
Dates:	July 10 - August 9, 2000
Inspectors:	H. Walker, Team Leader D. Chyu, Electrical Inspector M. Herlihy, Mechanical Inspector (contractor) M. Holmberg, Mechanical Inspector G. O'Dwyer, Mechanical Inspector L. Scholl, Electrical Inspector
Approved by:	Ronald N. Gardner, Chief Electrical Engineering Branch Division of Reactor Safety

NRC's REVISED REACTOR OVERSIGHT PROCESS

The federal Nuclear Regulatory Commission (NRC) recently revamped its inspection, assessment, and enforcement programs for commercial nuclear power plants. The new process takes into account improvements in the performance of the nuclear industry over the past 25 years and improved approaches of inspecting and assessing safety performance at NRC licensed plants.

The new process monitors licensee performance in three broad areas (called strategic performance areas) reactor safety (avoiding accidents and reducing the consequences of accidents if they occur), radiation safety (protecting plant employees and the public during routine operations), and safeguards (protecting the plant against sabotage or other security threats). The process focuses on licensee performance within each of seven cornerstones of safety in the three areas:

Reactor Safety	Radiation Safety	Safeguards
● Initiating Events	● Occupational	● Physical Protection
● Mitigating Systems	● Public	
● Barrier Integrity		
● Emergency Preparedness		

To monitor these seven cornerstones of safety, the NRC uses two processes that generate information about the safety significance of plant operations: inspections and performance indicators. Inspection findings will be evaluated according to their potential significance for safety, using the Significance Determination Process, and assigned colors of GREEN, WHITE, YELLOW or RED. GREEN findings are indicative of issues that, while they may not be desirable, represent very low safety significance. WHITE findings indicate issues that are of low to moderate safety significance. YELLOW findings are issues that are of substantial safety significance. RED findings represent issues that are of high safety significance with a significant reduction in safety margin.

Performance indicator data will be compared to established criteria for measuring licensee performance in terms of potential safety. Based on prescribed thresholds, the indicators will be classified by color representing varying levels of performance and incremental degradation in safety: GREEN, WHITE, YELLOW, and RED. GREEN indicators represent performance at a level requiring no additional NRC oversight beyond the baseline inspections. WHITE corresponds to performance that may result in increased NRC oversight. YELLOW represents performance that minimally reduces safety margin and requires even more NRC oversight. And RED indicates performance that represents a significant reduction in safety margin but still provides adequate protection to public health and safety.

The assessment process integrates performance indicators and inspection so the agency can reach objective conclusions regarding overall plant performance. The agency will use an Action Matrix to determine in a systematic, predictable manner which regulatory actions should be taken based on a licensee's performance. The NRC's actions in response to the significance (as represented by the color) of issues will be the same for performance indicators as for inspection findings. As a licensee's safety performance degrades, the NRC will take more and increasingly significant action, which can include shutting down a plant, as described in the Action Matrix.

More information can be found at: http://www.nrc.gov/NRR/OVERSIGHT/index.html.

SUMMARY OF FINDINGS

IR 05000305-00-12(DRS), on 08/09/2000, Wisconsin Public Service Corporation, Kewaunee Nuclear Power Plant. Design activities and records related to the service water system and the ability of the system to perform it's design function.

The inspection was conducted by region based inspectors. The inspection identified one White finding, three Green findings (which were non-cited violations), and a No Color finding. The significance of most findings is indicated by their color (Green, White, Yellow, Red) using IMC 0609, "Significance Determination Process" (SDP). Findings for which the SDP does not apply are indicated by "no color" or by the severity level of the applicable violation.

Inspector Identified Findings

Cornerstone: Mitigating Systems

- White. The inspectors questioned the mesh size of the strainers which were installed in the suction of the three auxiliary feedwater (AFW) pumps. As a result of the inspectors' questions, licensee personnel inspected the strainers on August 21, 2000, and found the strainers to have 1/16 inch openings. A note was later found on Figure 10.2-3 of the UFSAR that indicated that the AFW suction strainer size was 1/8 inch. The smaller openings would not support the use of service water as a safety related source for AFW and all three trains of AFW were declared inoperable. This condition had existed for approximately 25 years and was identified as an apparent violation of Criterion III of 10 CFR 50, Appendix B (Section 1R21.3).

- No color. In many cases, design basis information for the service water (SW) system was difficult if not impossible to locate. Licensee personnel wrote KAP WO 00-002566 to enter the problem in the corrective action program (Section 1R21.5).

- Green. An example of a Non-Cited Violation was identified in the handling of SW system flow test data, which was subsequently used in calculations. Gauge readings corrected for post test calibration checks, gauge reading corrections for elevation considerations, and flow values corrected for pump degradation were contained in spreadsheets in the possession of an individual staff member, but not currently packaged with raw test data, and not bearing evidence of a formal review and control process. The connection between the test data, which had been vaulted, and the values used in the calculation, could not be made without use of the uncontrolled spreadsheet (Section 1R21.5).

- Green. An example of a Non-Cited Violation was identified because of inadequate control of design calculations. The control failures included improper identification of calculations, non-conservative assumptions, calculation errors, and duplicate or superceded calculations not properly identified or canceled. The failure to follow the established design control process increased the potential for errors in the design and operation of the service water system. Because the system was subsequently demonstrated to be capable of removing

the design heat load, the actual significance was low and this finding screened out as having very low risk significance (Section 1R21.5).

Cross-Cutting Issue: Human Performance

Green. An example of a Non-Cited Violation was identified because of inadequate corrective action to correct an incorrect coupling adjust nut set screw and a low strength “soft” key material, which had contributed to a pump shaft failure. Licensee personnel had known of the “soft” key material since July 21, 1999. The “soft” key material was found in other SW pumps but not been removed from all pumps. As of July 25, 2000, licensee personnel had not documented the existence of the “soft” key material in the corrective action program (Section 1R21.4).

Report Details

Summary of Plant Status: The plant operated at 94 percent power throughout the inspection period.

1. REACTOR SAFETY

Cornerstone: Initiating Events, Mitigating Systems, Barrier Integrity

1R21 Safety System Design and Performance Capability (71111.21)

.1 System Requirements

a. Inspection Scope

The inspectors reviewed the Final Safety Analysis Report (FSAR), Technical Specifications (TS), and available design basis information to determine the performance requirements of the service water (SW) system. The following attributes of the system: process medium (water, air, electrical signal, or the atmosphere being processed), energy sources (electrical and air), control systems, and equipment protection, were reviewed. The inspectors also evaluated operator actions by review of normal, abnormal, and emergency operating procedures and by verification that instrumentation and alarms were available to operators for making necessary decisions. The review included a consideration of requirements and commitments identified in the FSAR, TS, design basis documents, and plant design documents.

b. Findings

No findings of significance were identified.

.2 System Condition and Capability

a. Inspection Scope

The inspectors reviewed the SW system operations by conducting system walkdowns, review of normal, abnormal, and emergency operating procedures and review of system records. Records for two Service Water System critical components were selected for in-depth inspection and records review. Components selected were the Containment Fan Coil Units and the Shroud Cooling Bypass Valves in the discharge lines from the Containment Fan Coil Units. In addition, selected over-all system records of periodic testing and calibration procedures and results were reviewed to verify that the design requirements of calculations, drawings, and procedures were incorporated in the SW system and were demonstrated by test results. Test results were also reviewed to ensure automatic initiations occurred within required times and that testing performed to validate the procedures were consistent with design basis information.

b. Findings

No findings of significance were identified.

.3 System Walk-downs

a. Inspection Scope

The inspectors performed walk-downs of the SW system and portions of the SW support systems. The walk-downs focused on the installation and configuration of piping, components, and instruments; the placement of protective barriers and systems; the susceptibility to flooding, fire, or other environmental concerns; physical separation; provisions for seismic concerns; accessibility for operator action; and the conformance of the currently installed configuration of the systems with the design and licensing bases.

b. Findings

Service Water Supply for the Auxiliary Feedwater System

During the walk-down of the SW system, the inspectors noted that strainers were installed in the suction lines of the three auxiliary feedwater (AFW) pumps. During a review of appropriate drawings, the inspectors verified that strainers should be installed, however, the drawings did not specify the size of the strainer openings or the strainer material. In response to questions from the inspectors, licensee personnel could not provide records or other documentation that provided this information.

Based on uncontrolled vendor information, licensee personnel believed that the existing filters had 1/8-inch diameter holes and were likely fabricated from stainless steel. To justify operability of the system, licensee personnel completed an operability evaluation assuming a six inch long strainer with 1/8-inch diameter holes. Licensee personnel wrote KAPs WO 00-002570 and WO 00-002571 to enter the issue in the plant corrective action program.

Because of inspector concerns, licensee personnel opened and inspected the “A” AFW pump suction strainer on August 21, 2000. The installed strainer was approximately 10 inches long and had 1/16 diameter holes. There was no test data or analysis information to confirm that sufficient service water would pass thru the smaller strainer openings to the auxiliary feedwater system. Based on this lack of information, licensee personnel decided that the installed strainers might not support the use of service water as a safety related source of water for AFW. Licensee personnel did an outside visual inspection of the suction strainers for the “B” and the turbine driven AFW pumps and determined that these suction strainers were probably identical to the “A” pump strainer. All three AFW pumps were then declared inoperable.

Licensee personnel planned to remove the strainers from all three AFW pumps. The “A” AFW loop was reassembled with the strainer removed and the “A” pump was declared operable. This resulted in a four hour shut-down LCO with the two other AFW pumps inoperable. On August 22, 2000, removal of the strainers for the three AFW

pumps had been completed and the systems reassembled without the strainers. All three pumps were then declared operable.

Based on the FSAR, the use of SW as a source of water for the AFW pumps was required only in the event the condensate supply to the pumps had been lost following a seismic event or tornado. However, the TS prohibits the operation of the reactor coolant system (RCS) above 350 degrees with the AFW systems inoperable. Since there was no objective evidence that the AFW suction strainers had been opened since 1975, the strainer problem had apparently existed for approximately 25 years. At the time of the inspection and at many other times during this period the plant had operated with RCS temperatures above 350 degrees.

Design control requirements were not met since the size of the strainer openings and the strainer material were not specified in the appropriate drawings and the adequacy of design was not verified or tested. Subsequently, after the removal of the strainers, Figure 10.2-3 of the UFSAR was found to contain a note which stated that the AFW suction strainer size was 1/8 inch. The size of the suction strainer actually installed was 1/16 inch.

Inadequate design control measures for the auxiliary feedwater system, which resulted in the installation of undersized AFW pump suction strainers, is an apparent violation of 10 CFR 50, Appendix B, Criterion III (50-305-00-12-01 (DRS)). This non-compliance existed for approximately 25 years. This violation is characterized by the significance determination process as having a low to medium risk significance (WHITE).

Analysis of Significance:

The significance determination process (SDP) was used to evaluate the risk significance of the improperly sized strainers associated with the service water supply for the auxiliary feedwater system at the Kewaunee plant. The staff evaluated the risk significance of the inspection finding in terms of the contribution from both internal and external initiating events. Consistent with the guidance for the SDP in the Revised Oversight Process, the change in core damage frequency (CDF) was evaluated stemming from the identified plant design deficiency. External initiating events including earthquake, fire, and tornado/high wind were individually evaluated. A brief description of the SDP evaluation process follows:

(1) Internal Initiating Events

The dominant sequence in this category is a transient followed by a complete loss of secondary cooling due to unavailability of the main steam and feedwater systems, failure of all condensate storage tanks (CSTs), failure to switch over from the CSTs to the SW system, and failure to establish bleed and feed. Given an internal initiating event, the failure probability of the CSTs is very small. The licensee's risk calculation indicated that the increase in CDF due to internal events was much less than $1x10^{-6}$ per year. In some cases, recovery of secondary cooling would also be available. The NRC finds the risk impact of the inspection finding due to internal initiating events to be negligible.

(2) External Initiating Events

a. **Earthquake** - The NRC finds this category to be the dominant contributor to the overall risk significance of the inspection finding. The postulated scenario is associated with an earthquake followed by loss of secondary cooling and failure to establish bleed and feed. The NRC's assumptions and justifications are provided below:

- An earthquake occurs with a frequency of $1x10^{-4}$ per year based on the Los Alamos National Laboratory (LLNL) Seismic Hazard Curve for Kewaunee.

  The licensee used the LLNL Seismic Hazard Curve for the site to calculate the seismic initiating event frequency. Depending on the Peak Ground Acceleration (PGA) values, the annual frequency of seismic events ranges from low-10^{-6} per year (for a PGA of 1.0) to mid-10^{-4} per year (for a PGA of less than 0.1). In this evaluation, the NRC assumes the initiating event of an earthquake to be $1x10^{-4}$ per year. This value corresponds to a PGA of about 0.1 on the LLNL Seismic Hazard Curve.

- Offsite power is lost with probability of one. This is consistent with the licensee's assumption in the Kewaunee IPEEE.

- The CSTs are damaged and lost with probability of one. This is consistent with the licensee's assumption in the Kewaunee IPEEE.

- Instrument air is lost with probability of one. This is consistent with the licensee's assumption in the Kewaunee IPEEE.

- Operator fails to establish bleed and feed with probability 0.1. Given the plant conditions associated with the event, the NRC considers the operator action to establish bleed and feed to be a high-stress operator action. Originally, the licensee's IPEEE did not take credit for bleed and feed stating that the licensee was uncertain whether the alternate air supply would have a sufficient capacity for the duration of the bleed and feed operation. The licensee now credits bleed and feed citing that the alternate air supply has sufficient capacity and is being tested to verify this assumption.

Based on these assumptions, the change in CDF is approximated to be $1x10^{-5}$ per year (WHITE).

b. **Fire** - The licensee's fire risk analysis does not credit the alternate AFW water source from the SW system given the loss of the CSTs. Therefore, the inspection finding would not have any risk implications due to fire. The NRC finds that even if modeled, the risk impact would be negligible due to the reasons similar to those for internal initiating events.

c. **Tornado and High Winds** - The licensee's IPEEE stated that the probability of a tornado striking a point in close vicinity of the site was calculated to be about $5x10^{-4}$ per year. The analysis then attempted to evaluate the frequency of tornados with the potential to cause damage and concluded that the initiating event frequency was below $1x10^{-6}$ per year; therefore, this scenario was not considered to be risk significant based on IE frequency at 10^{-6} per year.

Conclusion

The NRC's risk evaluation finds the increase in CDF due to an earthquake to be about $1x10^{-5}$ per year. The NRC concludes the risk significance of the inspection finding based on the change in CDF to be WHITE.

.4 Identification and Resolution of Problems

a. Inspection Scope

The inspectors reviewed a sample of SW system problems, which had been previously identified and documented by licensee personnel, and had been placed in the corrective action program. The corrective action system used Kewaunee assessment process (KAP) documents for problem identification and tracking. Where possible, the inspectors verified that SW problems were appropriately documented. The purpose of the review was to evaluate the adequacy and effectiveness of the identification and correction of SW system problems. In addition, test documents related to the system wide flow testing, performed during the spring 2000 outage, were reviewed because of the importance of the tests to assuring the SW system design basis. Calculations related to the testing were also reviewed to determine if test results were properly integrated into design basis information. Inspection Procedure 71152, "Identification and Resolution of Problems," was used as guidance in this area.

b. Findings

Service Water System Flow Issues: In order to address previously identified questions on the flow capability of the SW system, SW system flow tests were performed on both trains of the SW system during the 2000 Plant Refueling Outage. Different flow situations and system performance degradations were simulated. Test documents (SOP-SW-02-16, Revision A, "SW Flow Test – Train A" and SOP-SW-02-17, Revision B, "SW Flow Test – Train B") included test configurations to evaluate:

- Failure of shroud cooling bypass valves to open, affecting Containment Fan Coil Unit performance,
- High Strainer differential pressure,
- Failure (open) of the component cooling water (CCW) heat exchanger (HX) outlet valve, robbing the rest of the system flows,
- High backpressure caused by having opposite train area fan coil units in service.

The tests covered previously identified questions on system flow capability. The review of test results by licensee personnel and compensatory actions to correct inadequate flow situations were summarized in two Safety Evaluation Reports (00-032 and 00-033). These test results also answered some questions on design basis information.

No findings of significance were identified.

KAP WO 99-3066 Service Water Pump Shaft Failure: On June 1, 1999, licensee personnel initiated KAP WO 99-3066 to document an increase in vibration and a shift in the position of the pump coupling shaft key for the A2 SW pump. Through discussions with the cognizant engineer, the inspectors learned that the pump shaft had failed due to cyclic fatigue. Potential contributing causes, documented by the cognizant engineer in a memorandum dated November 3, 1999, included the use of an incorrect coupling adjust nut set screw and a low strength “soft” key material 1018 steel in the hot rolled condition. The licensee had known of the “soft” key material since receiving the metallurgical evaluation of the shaft failure documented in report No. 101800 “Failure Analysis of An SW Pump Shaft PER PO No. 24983" dated July 21, 1999. This “soft” key material was reportedly found in other SW pumps at the pump head shaft location (failure point for the A2 pump shaft).

As of July 25, 2000, licensee personnel had not documented the existence of the “soft” key material, found in the SW pumps, in the corrective action program. The failure to promptly identify this problem and enter it into the corrective action system delayed the evaluation of operability for the affected SW pumps and was possibly risk significant. After identification of the problem by the inspectors, licensee personnel initiated KAP WR-00-002702 to enter the issue into the corrective action program. This failure is considered a violation of 10 CFR 50, Appendix B, Criterion XVI Corrective Actions." This violation is associated with an inspection finding that is characterized by the SDP as having very low risk significance (GREEN) and is being treated as a non-cited violation, consistent with Section VI.A.1 of the NRC Enforcement Policy (NCV 50-305-00-12-02).

Licensee personnel had refurbished three of the four SW pumps to correct the “soft” key material and replace the incorrect coupling adjust nut set screw. Corrective actions had not been taken for the B1 SW pump. The licensee performed an operability evaluation on the B1 SW pump as documented in KAP WR 00-002702. The licensee’s basis for operability included comparison of material strength and reliance on the operators’ ability to “feel” a change in pump operation prior to a shaft failure. The inspectors noted that none of the potential causes of the A2 pump shaft failure could be ruled out for the B1 pump and that no basis existed for the licensee’s position that the operators could “feel” a change in pump operation prior to shaft failure. Further, the licensee’s next scheduled maintenance on the B1 SW pump was scheduled for October of 2002. The inspectors were concerned that the licensee had not established an adequate technical basis to operate the B1 SW pump for two years. Licensee personnel stated that the B1 SW pump would be inspected in October of 2000, and that the incorrect set screw and pump head shaft key material would be corrected at that time. Licensee personnel subsequently revised the operability determination and considered the B1 SW pump fully operable without reliance on operators to detect impending shaft failure.

.5 Design Review

a. Inspection Scope

The inspectors reviewed selected areas of SW design to verify that the system and components would function as required under accident conditions. The review included a review of the design basis, design changes, design assumptions, calculations, boundary conditions, and models as well as a review of eleven modification packages (DCRs). Instrumentation was reviewed to verify appropriateness of applications and set-points based on the required equipment function. Additionally, the inspectors performed analyses in several areas to verify that design values were correct and appropriate. Documentation reviewed included drawings, procedures, calculations, plant modifications, and maintenance work orders, as well as the TS and the FSAR. The purpose of the reviews was to determine if the design bases of the systems were met by the installed and tested configurations.

b. Findings

Design Basis Information

Based on the inability or difficulties in retrieving design information requested by the inspectors, licensee personnel documented that, in many cases, design basis information for the SW system was difficult if not impossible to locate. Licensee personnel wrote KAP WO 00-002566 to enter the problem in the corrective action program.

Control of Flow Testing Data

The inspector identified deficiencies in the methods used to control the handling of data derived from the System Flow testing (SOP-SW-02-16 Rev A "SW Flow Test – Train A" and SOP-SW-02-17 Rev B "SW Flow Test – Train B") and used in follow on calculations. Gauge readings corrected for post test calibration checks, gauge reading corrections for elevation considerations, and flow values corrected for pump degradation, were contained in spreadsheets in the possession of an individual staff member, but not currently packaged with raw test data. There was no evidence of the use of a formal review and control process. Some corrected values had been used in a later calculation (C11165 "Proto-HX Analyses in Support of the 2000 Service Water Flow Test"); however, the connection between the raw data, which had been vaulted, and the values used in that calculation, could not be made without use of the uncontrolled and apparently unreviewed or approved spreadsheet.

The inadequate control of design and design support information was considered a violation of 10CFR50, Appendix B, Criterion III, "Design Control." The finding was considered to be of low safety significance since the SW system remained operable. The violation is associated with an inspection finding that is characterized by the SDP as having very low risk significance (GREEN) since the SW system remained operable. The issue is a non-cited violation, consistent with Section VI.A.1 of the NRC Enforcement Policy (NCV 50-305-00-12-03).

Calculation Control

The inspectors noted that procedure GNP 4.3.4, "Calculation/Evaluation Control, Revision B," was not always followed to control the preparation, review, approval, issuance and revision of design calculations. As a result, problems were noted in many calculation activities performed for the SW system. This lack of control resulted in incomplete, inaccurate and in some cases duplicate calculations that contained required design information and were necessary to verify and ensure proper functional design. These calculation problems included the following:

1. Inadequate Calculation Identification -- Calculations were sometimes completed as actions under KAPs and were not always designated as calculations and assigned a unique calculation identification number as required by procedure GNP 4.3.4. This sometimes resulted in problems locating specific calculations and tracking system design information. In addition, the calculations completed as actions for KAPs would not be entered into the Kewaunee quality assurance record system and were not required to be retained. For example:

- KAP 97-0783 -- Actions for KAP 97-0783, initiated May 1, 1997, required the evaluation of low flow-rates in the SW supply lines to the "B" safety injection pump heat exchanger and included a special test and calculations to establish lower SW system design flow-rates, higher SW system design operating temperatures and higher safety injection (SI) pump lube oil operating temperatures. The test and calculations established the above parameters and were documented in KAP 97-0783. However, the evaluation did not have a unique calculation number assigned as required by Step 4.1.7 of procedure GNP 4.3.4 and was not identified as a document to be retained.

- KAP 97-1136 -- Actions for KAP 97-1136, initiated November 4, 1998, required an evaluation of low SW flow-rates to the component CCW HX. Corrective actions included a special test and calculations to establish lower SW system design flow-rates, higher SW system design operating temperatures and margin for tube plugging. The test and calculations established the above parameters and were documented in KAP 97-0783. The evaluation did not have a unique calculation number assigned as required by Step 4.1.7 of procedure GNP 4.3.4 and was not identified as a documents to be retained.

2. Non-conservative Information or Assumptions -- The inspectors noted that non-conservative assumptions and information were sometimes used in design calculations. Specific examples of the use of non-conservative information, which were noted in calculations, are discussed below.

a. Instrument Uncertainties -- Calculations were sometimes completed without evaluating quantified margins for flow measurement instrument uncertainties or margin for system flow degradation. The calculations for KAP 97-0783 and KAP 97-1136, see item # 1 above, established several SW parameters but did not address instrument uncertainties or margin for system flow degradation.

On July 10, 2000, licensee personnel completed calculation C11165 "Proto-HX Analysis in Support of the 2000 Service Water Flow Test." This calculation demonstrated that the previous evaluation of the SW flow-rate in KAP WO 97-1136 did not have sufficient SW flow margins to account for pump degradation and instrument uncertainty.

b. In reviewing records on the CCW HX, the inspectors questioned the failure to consider the plugged tubes in pressure drop evaluations. The licensee's engineering staff's evaluation nonconservatively used the HX flow-rate of 2520 gallons per minute (gpm) rather than the maximum flow-rate of 3316 gpm measured during recent testing. Licensee personnel re-performed this evaluation at the maximum measured flow-rate and concluded that the design differential pressure would not be exceeded.

Calculation C10984 -- The inspectors noted that in Calculation C10984 no allowance was made for liquid mass from the SI accumulators or the RCS for the liquid volume in the sump. With this assumption, the post accident level in the containment could be higher than calculated because the inventories from the SI accumulators and RCS were not accounted for and that leakage would be expected to travel to the sump.

3. Duplicate/superceded calculations -- In a number of cases two calculations were prepared for the same purpose with different results and in other cases calculations were replaced without the cancellation or superceded calculation being identified or removed. No identification was provided as to which calculation was the valid applicable calculation. For example:

Calculations C10680 and C10807 -- Calculation C10680, "Evaluation of Annunciator 47002-12 Being Removed From Service Without Proper Safety Evaluations, Revision 1." and Calculation C10807, "Dilution of Containment Sump Water Boron Concentration Due to Service Water Leak" both included the determination of the time required for containment sump water to reach one percent cold shutdown boron concentration. In Calculation C10680 this time was determined to be 21 hours and in Calculation C10807 the time was determined to be11 hours 26 minutes. Licensee personnel reviewed the issue and determined that calculation C10807 should be the applicable calculation and that calculation C10680 should have been revised or superceded to reflect the correct information and avoid inadvertent use of the invalid calculation.

4. Errors in Calculations -- The inspectors noted that, in some cases, existing calculations contained errors which had existed for years. When identified, the calculations were revised and the errors were corrected.

- Calculation C11163 -- The inspectors had questions that resulted in licensee personnel revising the calculation for clarification. During the revision of the calculation, licensee personnel noted that incorrect airflow values had been used in Revision 1 of the calculation. The errors arose in the selection and input of values to a computer program to determine containment fan coil unit performance at a SW flow of 800 gpm. The selection of values and run of that

program would seem to be part of the calculation process itself, but appeared to have been handled as an "input" to the calculation, and lacked evidence of an independent check, required if it had been treated as part of the calculation itself. It was also noted that a second calculation (C11159) was impacted by the same errors.

- Calculation C10984 -- On July 10, 2000, licensee personnel completed calculation C11165 "Proto-HX Analysis in Support of the 2000 Service Water Flow Test." This calculation demonstrated that the previous evaluation of SW flow-rate in KAP WO 97-1136 did not have sufficient SW flow margins to account for pump degradation and instrument uncertainty.

- Calculation C11165 –The inspectors noted that in Calculation C11165 licensee personnel used an incorrect non-conservatively high flow-rate for the emergency diesel generators (EDG) HX shell side flow rate. One purpose of this calculation was to confirm adequate heat removal from the EDG HXs based on minimum SW flows and assumed 80 ^{o}F SW temperature. The non-conservative shell side flow-rate established a larger heat removal margin, which could have allowed the diesel to be operated without adequate cooling.

  Licensee personnel subsequently re-performed the EDG HX analysis which demonstrated that the design heat load would be removed using the design shell side flow-rate. When these margins were considered, the maximum SW operating temperature was restricted to 77.9 ^{o}F. At this maximum temperature the inspectors agreed that the CCW HX could remove design heat loads.

Licensee personnel wrote KAPs for each of the items noted above to enter the issues in the corrective action program. Based on discussions with licensee personnel, equipment operability and the safety related function of the respective equipment were not affected by these calculation errors and problems. The failure to maintain required control of design calculations and verify the adequacy of design is considered an example of a violation of Criterion III, "Design Control." This violation is associated with an inspection finding that is characterized by the significance determine process as having very low risk significance (GREEN) and is being treated as a non-cited violation, consistent with Section VI.A.1 of the NRC Enforcement Policy (NCV 50-305-00-12-04).

4. OTHER ACTIVITIES

4OA3 Event Follow-up

(Closed) Unresolved Item 305/99009-01: Absence of SW system design basis information. This URI was opened during a previous inspection as a result of questions on the adequacy of design basis information for the SW system. The adequacy of current design basis information appeared to be adequate based on the results of SW testing and additional calculations completed in the recent past. These activities included the SW flow testing performed during the spring 2000 outage and additional calculations in the area of Containment Flow Cooling Units (C11163 and C11159), as well as other system loads (C11165). This item is closed.

4OA6 Management Meetings

Exit Meeting Summary

The inspection results were presented to members of licensee management at the conclusion of the inspection on August 9, 2000. The inspectors noted that one document, previously provided during the inspection, was identified as proprietary. The proprietary document was returned. Licensee personnel acknowledged the results presented during the exit and agreed that no additional proprietary information was discussed or provided. Additional inspection information was provided to members of licensee management during conference calls on September 22 and October 2, 2000.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

C. Schrock, Senior Vice President Energy Supply
M. Reddemann, Site Vice President
D. Cole, Plant Assessments Manager
G. Harrington, Plant Licensing Leader
K. Hoops, Plant Manager
J. Mortonson, Assistant Plant Manager Maintenance
J. Palmer, Superintendent of Mechanical Maintenance
J. Schweitzer, Manager of Engineering & Technical Support
M. Marchi, Vice President Nuclear
T. Webb, Nuclear Licensing Director
K. Weinhauer, Plant General Manager

NRC

S. Burgess, Senior Reactor Analyst
Z. Dunham, Resident Inspector
R. Gardner, Chief, Electrical Engineering Branch
J. Grobe, Division Director, DRS
J. Lara, Senior Resident Inspector
C. Lipa, Acting Chief, Projects Branch 2

ITEMS OPENED, CLOSED AND DISCUSSED

Opened

50-305-00-12-01	Apparent Violation	Inadequate design control measures, which resulted in undersized AFW pump suction strainers.

Opened and Closed During This Inspection

50-305-00-12-02	NCV	Failure to take prompt corrective action to replace an incorrectly designed coupling set screw and a low strength shaft key material for the service water pumps.
50-305-00-12-03	NCV	Test data information, which was used in calculations, was transmitted into the calculation process by the use of uncontrolled spreadsheets.
50-305-00-12-04	NCV	Inadequate control of design calculations in several areas.

Previous Items Closed

50-305/99009-01	URI	Absence of service water system design basis information.

Previous Items Discussed

No items from previous inspections were discussed and not closed.

LIST OF LICENSEE DOCUMENTS REVIEWED

The following is a list of licensee documents reviewed during the inspection, including documents prepared by others for the licensee. Inclusion on this list does not imply that NRC inspectors reviewed the documents in their entirety but rather that selected sections or portions of the documents were evaluated as part of the overall inspection effort. Inclusion of a document on this list does not imply NRC acceptance of the document or any part of it, unless this is stated in the body of the inspection report.

I. Procedures

- ARP 47051-P SW Header Pressure Low
- ARP 47052-P Turbine BLDG SW Header Abnormal
- ARP 47091-C Diesel Gen A Abnormal
- DC/PM 2974-01 FCU 1A Discharge Line SI Signal Modification
- DC/PM 3163-01 SW1306A and SW1300A SI Signal Change
- ICP 02-03 SW - Pressure Indicators Calibration, Revision N.
- ICP 02-07 SW - Strainer Differential Pressure Switches and Indicators Calibration, Revision J.
- ICP 02-15 SW - Header A Pressure Loop Calibration, Revision J.
- ICP 02-19 SW - Header Pressure Indicators and Switches Calibration, Revision J.
- GNP 4.3.4 Calculation/Evaluation Control, Revision B
- GMP-239-A1 Limitorque MOV Maintenance Table of Information, Revision A.
- N-SW-02 Service Water System, Revision S
- N-SW-02-CL Service Water System Prestartup Checklist, Revision AO
- PMP-02-04 Service Water System Strainer Inspection, Lubrication and Packing Replacement, Revision M.
- PMP-02-05 Service Water Pump Motor Maintenance, Revision M.
- PMP-02-14 Service Water System Functional Check Panel Meters Service Water Pump Motors.
- PMP-10-06 DGM - Cooling System, Revision L.
- PMP-10-09 DGM - Diesel Generator Service Water Isolation Valve Inspection & Maintenance SW301A & SW301B, Revision F.
- RT-SW-028 SW-30A-1 and SW-30A-2 Accumulator Leak rate Test, Revision D.
- SOP-SW-02-16 Service Water Flow Test – Train A, Revision A
- SOP-SW-02-17 Service Water Flow Test – Train B, Revision B
- SP-02-138 Service Water Pump and Valve Test - IST, Revision AQ.
- SP-04-134 Forebay Area Water Level Logic Test, Revision J.
- SP-31-168 Component Cooling Pump and Valve Test - IST.
- SP-33-110 Diesel Generator Automatic Test, Revision AA.
- SP-42-047A Diesel Generator A Operational Test, Revision M.
- SP-42-047B Diesel Generator B Operational Test, Revision N.
- SP 45-49.16 RMS Channel R-16 Containment FCU SW Return Radiation Monitor Quarterly Functional Test, Revision O.
- SP 45-49.20 RMS Channel R-20 Aux Bldg Service Water Return Radiation Monitor Quarterly Functional Test, Revision L.
- SP 45-50.16 RMS Channel R-16 Containment Fan Coil Unit SW Return Radiation Monitor Calibration, Revision K.

- SP 45-50.20 RMS Channel R-20 Service Water Radiation Monitoring Calibration, Revision I.

II. Modification Packages (DCRs)

- DCR 1271 Removal of leak detection for containment fan coil unit
- DCR 2475 Modify service water piping to auxiliary feedwater pumps, Revision 1
- DCR 2479 Clean and coat the service water side of the component cooling water heat exchangers, Revision 1
- DCR 2486 Replace diesel jacket water heat exchangers, Revision 1
- DCR 2825 Open Containment Sump C to Post LOCA Flooding in accordance with the Severe Accident Management Guidelines Recommendations, Revision 1
- DCR 2959 Balance ring for service water pump motor.
- DCR 2974 Fan coil unit (FCU) discharge line safety injection (SI) signal modification.
- DCR 3129 Add support to SW pump A2 chlorine injection quill assembly.
- DCR 3139 Diesel generator jacket water heat exchanger replacement, Revision 1
- DCR 3163 Modify Control for Valves SW 1300 A(B) and SW 1306A(B) on an SI Signal, Revision 1
- DCR 3907 Replace the SW strainers backwash control switches.

III. Temporary Design Changes

- TC 00-01 Raise Circ Water Pump Forebay Level Trip from 42% to 47.85%, 1/28/00
- TC 00-13 Modify Actuators on SW30A1 and SW30A2 to Assure Continuous Backwash of the SW Strainers, Revision 1
- TC 00-14 Fail Open the Service Water Control Valves (SW-1016A and B) to the Aux Bldg Fan Floor Fan Coil Units, Revision 1

IV. Design Drawings

- A-213, “General Arrangement, Screenhouse and Circulating Water Discharge”, Revision V
- 237127A-S605T, “Screenhouse Sections and Details,” Revision T
- 237127A-S610R, “Screenhouse Miscellaneous Steel Details,” Revision R
- Iowa Institute of Hydraulic Research, “Plan at EL. 586'-0" and Screenhouse Section, 7/10/00

V. Calculations

- C-038-003 125 vdc safeguard cable voltage drop.
- C-042-001 Safeguards EDG loading.
- C10046 DG 1A/1B cooling water heat exchanger service water requirements.
- C10088 Safeguards bus voltage analysis.
- C10680 Evaluation of the Annunciator 47002-12 Being Removed From Service Without Proper Safety Evaluations, Revision 1.
- C10739 4kv bus and fault current calculation.

- C10807 Dilution of Containment Sump Water Boron Concentration Due to Service Water Leak.
- C10809 Containment Presssure and Temperature Transients following a Design Basis LOCA (For Resolving IR#93-001 Action Items)," Revision 0
- C10830 Service water strainer backwash control and high d/p alarm setpoint.
- C10900 Post LOCA Containment Submergence Level.
- C10984 EOP Setpoint Calculation Wide Range Containment Sump Level Versus Available RWST Volume.
- C11099 Screen Roof Evaluation for Grove Truck Mounted Crane Loads, Revision 0
- C11124 Diesel Generator Jacket Water Cooler Performance Curves (90-10 Copper Nickel Coolers)
- C11140 Replacement Diesel Generator Heat Exchanger Flow Resistence Effect on Service Water System Flow," Revision 0
- C11150 Diesel Generator Heat Exchanger Design Heat Removal Capacity
- C11159 Determination of Minimum Pressure Required Downstream of Containment FCUs, Revision 0
- C11159 Determination of Minimum Pressure Required Downstream of Containment FCUs, Revision A
- C11163 Containment Fan Coil Unit Performance Degradation Due to Service Water System Flow Reduction Special Study, Revision 1
- C11163 Containment Fan Coil Unit Performance Degradation Due to Service Water System Flow Reduction Special Study, Revision 2
- C11165 Proto-HX Analyses in Support of the 2000 Service Water Flow Test, Revision 0

- 8632-12-EPED-1 Voltage drops for medium and low voltage buses.
- P834779.E4 Fault duty & breaker coordination.
- P912301.3 Safeguards motor load evaluation.
- Aerofin Corporation Calculation CA-483, "Kewaunee Coils - New Performance," Revision 1

VI. Kewaunee Assessment Process (KAPs)
(CORRECTIVE ACTION DOCUMENTS)

- 96-000098-000 Pump A2 motor heater off.
- 96-000259-000 Re-power space heaters to 20 amp circuit.
- 96-001150-000 4160 volt circuit breaker failures - a(1) MR.
- 97-000661-000 Valve SW3B failed to remain open.
- 97-001334-000 Pump B1 motor vibration.
- 98-001793-000 Dim indicating light - Appendix R design.
- 98-001882-000 Pump 1A1 bearing temperature alarm.
- 98-002046-000 Evaluate replacing ASCO solenoid valves with AVCO valves.
- 98-002118-000 Emergency diesel generator (EDG) bypass valve.
- 99-002908-000 Differential pressure switches.
- 99-002923-000 Valve indicating lights remained on after operation.
- 99-003044-000 Strainer differential pressure (d/p) switches.
- 99-003057-000 Strainer differential pressure switches.
- 99-003069-000 Strainer circuit breaker trip.

- 99-003425-000 Strainer backwash circuit non-1E.
- 99-003675-000 SW flow to EDG.
- 99-003723-000 SW System Pressure Went to 150 psig Upstream SW-903C – 96-06 Issue
- 99-003733-000 96-06 Overpressure Protection Check Valves Associated With CFC Units
- 99-300030-000 Flow indicator did not have bistable.
- 00-000119-000 Circulating water pump trip on low water level.
- 00-000166 Inadequate Technical Basis for Circulating WAter Pump trip setpoint, 1/28/00
- 00-001201-000 Identify and Document Design Basis for the Safety Related Area Fan Coil Units
- 00-001203-000 Power lost to safeguards Bus 5, 51 and 52.
- 00-001824-000 Document the Current Operability of the SW System Following System Testing Performed During the 2000 Outage
- 00-001825-000 Document the Past Operability of the SW System Based on System Testing Performed During the 2000 Outage
- 00-001836 Error in KAP 1136
- 00-012203-000 Power lost to safeguards buses.
- 0163 NRC Generic Letter 96-06 Concerns Addressed, 8/9/96
- 1114 Develop Long Term Solution for GL 96-06 Water Hammer Issue, 8/7/97
- 1136 Low Service Water Flow to Component Cooling Water Heat Exchanger"
- 1136 Determine Acceptable SW Flow to Component Cooling Water Ht Exchanger
- 1712-000 Auxiliary Building Fan Floor Fan Coil Units A and B will not remove the Required Area Heat Load
- 1858-000 TCR 00-13 failed open both Strainer Backwash Control Valves for 1A1 and 1A2 SW Pumps
- 3240 SW Hdr Shroud Cooling Coil Bypass Vlvs Fail Timing Test
- 3349 Determine Operability of CFCU With Shroud Cooling Bypass Valves (SW-901A-1, B-1, C-1, D-1) closed (throttled)
- Incident Report 95-239 Service water pump A2 failed to start.

VII. Test and Maintenance Records

- SOP-SW-02-17 "SW Flow Test - Train A" dated May 14, 2000
- SOP-SW-02-17 "SW Flow Test - Train B" dated May 20, 2000
- SP-05B-105 "Turbine Driven AFW Pump and Valve Test - IST" Revision BA, Dated 4/20/2000.
- SP-02-138 "Service Water Pump and Valve Test - IST," Revision AQ, Dated 5/30/2000.
- SP-55-167-9 "Refueling Shutdown Valve Tests - IST," Revision AC, Dated 5/1/2000.
- SP-02-249 "Service Water System Pressure Test" Revision G, Dated 4/22/2000.
- PMP-02-03 "Service Water Pump Replacement QA-1" Revision M, Dated 11/30/1999.

VIII. WORK ORDERS /WORK REQUESTS

- WO 98-214352-000 Remove shroud cooling service water valves from step 5.
- WO 99-217246-000 8 In Valve-Control-Header 1C Shroud Cooling Coil C/D Bypass (SW-901C-1)
- WO 99-217801-000 0.5 In Valve – Check-Containment FCU SW Bypass Line (SW-905A-1)
- WO 99-217802-000 0.5 In. Valve-Check-Containment FCU SW Bypass Line (SW-905B-1)
- WO 00-000337-000 8 In Valve-Control-Header 1D Shroud Cooling Coil C/D Bypass (SW-901D-1)
- WR 210503 Valve-Control-Header 1A Shroud Cooling Coil A/B Bypass (SW901A-1)
- WR 213739 Replace valve SW28B1.
- WR 214438 Check indication for valve SW3A.
- WR 214693 Valve-Control-Header 121B Shroud Cooling Coil A/B Bypass (SW901B-1)
- WR 217757 Valve-Check-Containment FCU SW Bypass Line (SW905D-1)
- WR 217684 Valve-Check-Containment FCU SW Bypass Line (SW905C-1)
- WR 217244 Valve-Control-Header 1B Shroud Cooling Coil A/B Bypass (SW901B-1)
- WR PM02-931 – Preventive Maintenance for SW-905A-1-Insp Valve Internals
- WR PM02-932 – Preventive Maintenance for SW-905B-1- Insp Valve Internals
- WR PM02-933 – Preventive Maintenance for SW-905C-1- Insp Valve Internals
- WR PM02-934 – Preventive Maintenance for SW-905D-1- Insp Valve Internals

IX. Miscellaneous

- System description, “Service Water,” May 8, 1991.
- System Description Number 2, “Service Water (SW),” Revision 1
- Kewaunee Nuclear Power Plant Updated Safety Analysis Report, Revision 15, dated 5/1/99
- Safety Evaluation 00-032 dated 5/26/00, (Untitled)
- Safety Evaluation 00-033 dated 5/30/00, (Untitled)
- Worthington Vertical Double Suction Pump Vendor Manual, Revision 0
- Vendor Manual #162-13-1 for Kinney Automatic Self-Cleaning Strainer
- Risk-Informed Inspection Notebook for Kewaunee Nuclear Power Plant, Revision 1, 4/7/00
- KNPP Services Request, “Flow Modeling of KNPP Forebay, CW Pumps, SW Pumps and Fire Pumps,” 5/6/00
- PTE 92-0176, Procurement Technical Evaluation for bronze ball valves.
- Schematic Diagram MCC 1-52E Motor 1-193, Revision M.
- Report SW-02-011 Revision 3
- 611.1134.m4 “Auxiliary Feedwater pump Operation” Revision 0
- EQ File KAH17.1 Containment Fan Coil’s Service Water Return Valves, March 7, 1986
- EQ H1 and H2 Equipment Located in Containment Below 600 Foot Elevation

LIST OF ACRONYMS USED

AFW	Auxiliary Feed Water
CCW	Component Cooling Water
CDF	Core Damage Frequency
CFR	Code of Federal Regulations
CST	Condensate Storage Tank
DCR	Design Change Request
DRS	Division of Reactor Safety
EDG	Emergency Diesel Generator
FSAR	Final Safety Analysis Report
gpm	gallons per minute
HX	Heat Exchanger
KAP	Kewaunee Assessment Process
LLNL	Los Alamos National Laboratory
NCR	Non-conformance Report
NCV	Non-Cited Violation
NRC	Nuclear Regulatory Commission
PARS	Publicly Available Records
PGA	Peak Ground Acceleration
RCS	Reactor Coolant System
SDP	Significance Determination Process
SI	Safety Injection
SW	Service Water
TS	Technical Specifications
UFSAR	Updated Final Safety Analysis Report
URI	Unresolved Item
WO	Work Order