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SUBJECT: Responds to NRC 921214 ltr re violations & deviations noted in insp rept 50-397/92-37.Corrective actions:supply sys design reviews will be expanded to provide addl oversight of vendor reload & analysis.

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January 11, 1993
G02-93-008

Docket No. 50-397

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
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Washington, D. C. 20555

Gentlemen:

Subject: **WNP-2, OPERATING LICENSE NO. NPF-21**
NRC INSPECTION REPORT 92-37
RESPONSE TO NOTICE OF VIOLATIONS AND NOTICE OF DEVIATION-POWER OSCILLATION EVENT

Reference: Letter dated October 30, 1992, AL Oxsen, (SS) to JB Martin, (NRC) "Response to NRC Augmented Inspection Team Report"

The Washington Public Power Supply System hereby replies to the Notice of Violations and Notice of Deviation contained in your letter dated December 14, 1992. Our reply, pursuant to the provisions of Section 2.201, Title 10, Code of Federal Regulations, consists of this letter and Appendices A and B (attached).

In Appendix A, the violations are addressed with an explanation of our position regarding validity, corrective action and date of full compliance. In Appendix B, the deviation is addressed with an explanation of our position regarding validity and corrective action.

The Appendix A and B responses focus on the technical issues associated with this event. Your cover letter dicusses weakness in management oversight that underlies the issues associated with this event. Management oversight corrective actions that emphasize responsibility and accountability at all management levels are discussed in the reference.

Sincerely,

J. V. Parrish (Mail Drop 1023)
Assistant Managing Director, Operations

Attachments

190066

cc: JB Martin - NRC RV
NS Reynolds - Winston & Strawn
JW Clifford - NRR
DL Williams - BPA/399
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Appendix A

During an NRC inspection conducted on October 5 through 21, 1992, violations of NRC requirements were identified. In accordance with the "General Statement of Policy and Procedure for NRC Enforcement Actions," 10 CFR Part 2, Appendix C, the Nuclear Regulatory Commission proposes to impose a civil penalty pursuant to Section 234 of the Atomic Energy Act of 1954, as amended (Act), 42 U.S.C. 2282, and 10 CFR 2.205. The particular violations and associated civil penalty are set forth below:

I. Violations Assessed a Civil Penalty

A. 10 CFR Part 50, Appendix B, Criterion V, as implemented by the WPPSS Operational Quality Assurance Program Description, Section 5, states that activities affecting quality shall be prescribed by documented instructions, procedures, or drawings of a type appropriate to the circumstances, and shall be accomplished in accordance with these instructions, procedures, or drawings; and that these instructions, procedures, or drawings shall include appropriate quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished.

Contrary to the above, as of August 15, 1992, plant procedures for establishing reactor control rod patterns did not provide appropriate quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished, in that:

1. Plant Procedures Manual (PPM) Procedure 9.3.12, Revision 6, "Plant Power Maneuvering", paragraph 7.1.3, allowed deviations from the approved control rod withdrawal sequences after the rod sequence control system (RSCS) and the rod worth minimizer (RWM) were above the Low Power Setpoint (LPSP, at 204), but did not provide appropriate qualitative or quantitative acceptance criteria for the review and approval of the rod sequence deviations.

2. PPM procedure 9.3.12, Revision 6, paragraph 7.1.4, "Performing a Rod Set", subparagraph b, "Principles and Objectives", required that radial peaking be flattened in selecting control rod positions for the final rod pattern, but did not provide appropriate acceptance criteria for the peaking factors.

3. PPM 9.3.12, Revision 6, paragraph 7.1.5.c, "Power Distribution Constraints", required that care be taken to prevent excessive peaking, but did not provide appropriate acceptance criteria for "excessive" peaking.

4. PPM 9.3.12, Revision 6, paragraph 7.1.5.d, "Power Distribution Constraints", stated that due to preconditioning limits, establishing too large a bottom peak would prevent opening of the flow control valves for recirculation pumps A and B to 20,000 and 24,000 GPM, respectively, following recirculation pump speed shift to 60 Hertz, but did not provide appropriate acceptance criteria for the peaking factors.

5. PPM 9.3.12, Revision 6, paragraph 7.1.5.d, "Power Distribution Constraints", prohibited "overly aggressive" operator actions when pulling shaper rods, but did not provide appropriate acceptance criteria for the positioning of shaper rods.

6. PPM 9.3.12, Revision 6, paragraph 7.1.5.e, "Power Distribution Constraints", stated that the more time spent at low power, the more "fierce" the xenon burn would be following power increase, and required minimization of the time spent using slow speed recirculation pumps when performing a rod set following a reduction in power or prior to the second ramp in a startup. However, it did not provide appropriate acceptance criteria for the time spent at low power using slow speed recirculation pumps for the noted conditions or for defining the "fierce xenon burn."

B. WNP-2 Technical Specifications Section 6.2.3.1 states that the Nuclear Safety Assurance Group (NSAG) shall function to examine unit operating characteristics, NRC issuances, industry advisories, Licensee Event Reports, and other sources of unit design and operating experience information, including units of similar design, which may indicate areas for improving unit safety; and that the NSAG shall make detailed recommendations for revised procedures, equipment and modifications, maintenance activities, operations activities, or other means of improving unit safety to the Director of Licensing and Assurance.

Contrary to the above, as of August 15, 1992, NSAG had not reviewed the industry advisory contained in a March 18, 1992, BWR Owners' Group (BWROG) letter, and had not made any recommendations for revising procedures, training, operating activities, or otherwise improving unit safety associated with core stability and the BWROG advisory.

C. 10 CFR Part 50, Appendix B, Criterion III, as implemented by the WPPSS Operational Quality Assurance Program Description, Section 3, states that measures shall be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the safety-related functions of structures, systems and components.

As stated in the bases for Technical Specification 3/4.2.6, the licensee has established as a design criterion, for core stability essential to the safety-related function of the core, that operation is forbidden in regions having calculated decay ratios of 0.9 or greater.

> Contrary to the above, design evaluations, which were measures to review the suitability of application of fuel in the reactor core, performed by the licensee for both the Cycle 7 and Cycle 8 core reloads, were not adequate. In particular, the licensee's evaluations for Cycles 7 and 8, as described in the Core Operating Limits Report and the Reload Analysis Report (RAR) for both cycles, did not adequately consider possible core power oscillations. The RARs evaluated core hydrodynamic stability, and in both cases incorrectly determined that decay ratios for both reloads were within acceptable limits. However, subsequent calculations indicated a core-wide decay ratio of 1.05 and an out-of-phase decay ratio of 1.0 for the operating conditions at the time of the August 15 power oscillation.

This is a Severity Level III problem (Supplement I).
Civil Penalty - $75,000.

<u>Validity of the Violations</u>

The Supply System acknowledges the validity of these violations. At 0301 hours on August 15, 1992 the reactor was manually scrammed due to indications of core instability. Plant control room operators noted Average Power Range Monitors (APRMs) swinging between 25 and 45 percent power with numerous Local Power Range Monitor (LPRM) downscale indications. The plant was scrammed within 80 seconds after the oscillations were detected.

The Supply System response to these violations is given below in one integrated presentation since many of the root cause statements and the corresponding corrective actions cover more than one violation. Each item is annotated with a parenthetical indication of the violation that is being addressed (A, B, or C).

This event was analyzed by Plant staff with representatives from General Electric, Institute for Nuclear Power Operation (INPO) and Siemens Power Corporation (Fuel Vendor). The primary root cause for this oscillation event has been determined to be unanticipated interaction of operating conditions and components (A, C). The Supply System staff and vendor personnel failed to identify the extent of the tendency for this core design to become unstable under certain operating practices. In addition to the primary root cause, there were several contributing root causes.

1. The first root cause involves Plant/System Operation (A, C) since the effects of changing operating parameters were not fully evaluated in that:

    a. The Station Nuclear Engineer (SNE) selected a startup rod pattern with characteristics of aggressive critical power ratios and high radial peaking. This was standard operating practice to minimize stress on the Reactor Recirculation pumps and the fuel. Maximizing the amount of control rod movement during low speed recirculation pump operation minimizes the amount of rod movement required after the shift to high speed. With the control rods set to support power increases principally by increasing flow, the number of high power changes

associated with rod movement is significantly reduced. This results in less local fuel stress at higher power levels. In addition, recirculation flow and power could then be increased quickly minimizing the time spent at high speed with the flow control valves at the minimum position when the pumps are subject to increased vibration.

b. Past startups and operating regimes during Cycles 7 and 8 had not disclosed problems with similar patterns.

c. The plant stability monitor (ANNA) was not employed to provide early warning of the potential changes in core instability. This was, in part, due to past experience and a confirmation that the existing core exclusion region versus actual and planned plant conditions for this startup were acceptable.

Thus, the SNE failed to consider the need to be conservative in rod pattern selection and use of monitoring tools for conditions that could promote and predict core stability.

2. The second root cause was design related (C). Specifically, there was inadequate independent review of design changes in that:

a. The Supply System design review process for the mixed core consisting of 9x9 and 8x8 fuel assemblies failed to discern the impact that differences in hydraulic resistance of the fuel assemblies would have on the core's susceptibility to instabilities outside existing instability regions defined by Technical Specification 3.2.7 and current BWROG guidance.

b. Design review included assurances of conformance to license requirements, but did not discern that core stability licensing analyses did not consider the effects of high peaking on core stability at operating conditions which existed at conditions other than the licensing basis.

Thus, the design review program responsible for setting limits on the plant failed to adjust the rod pattern and peaking conditions to assure core stability.

3. The third root cause was analysis deficiencies (C) in that:

a. The fuel designer did not perform sensitivity analyses for core instability at reactor conditions other than those required to perform reload licensing analyses.

b. Current licensing methodologies do not require these sensitivity analyses on startup power distributions.

c. Computer models to analyze cores to this level of sophistication are in development and not licensed for use.

d. The designer believed the hydraulic differences between 8x8 and advanced 9x9 would be offset by the void coefficient and would not contribute to the likelihood of instability under nominal startup conditions.

Thus, the fuel designers failed to identify that this core was less stable and did not provide recommendations for compensating through conservative operating conditions.

4. A contributing causal factor was management methods (A, B, C). A Management Oversight and Risk Tree (MORT) analysis has been completed for this event. This analysis found significant weaknesses in the barriers management has established to prevent the event and in the management controls in place for the design and operation of the core. Management acknowledges it should have responded to prior industry information and critically questioned the design oversight and operating philosophy to minimize the potential for core power oscillations. Specific findings resulted from this review included the following:

   a. Management's response to the Implementation Guidance for Stability Interim Corrective Actions issued on March 18, 1992 was weak. Training was provided to Shift Technical Advisors (STAs), SNEs and Plant Operators but procedures were not updated.

   b. Management Policy allowed too much flexibility for the SNE/STA to determine the core flux profile.

   c. Management methods used to review the reload design did not ask penetrating questions in the area of core stability.

   d. Management decisions and reasoning for reanalysis and acceptance of a lower feedwater interlock value were not well communicated. Consequently, procedures were inconsistently amended and SNE operating strategies were not appropriately influenced to take advantage of the lower feedwater value.

<u>Corrective Steps Taken/Results Achieved</u>

1. In order to maintain assembly power to flow ratio as low as possible, as well as maintaining radial peaking as low as possible, procedures (including Plant Procedure PPM 9.3.12, Plant Power Maneuvering) were revised to require Critical Power Ratio (CPR) greater than 2.2 between 25 percent power and 50 percent core flow. PPM 9.3.12 was also changed to require the core total peaking factor will be maintained less than 3.4 prior to pump shift.

Fifteen case studies were run by the Fuel Vendor to validate the stability of the Cycle 8 core. This was accomplished utilizing one dimensional and three dimensional modeling codes. The calculations were performed under a variety of conditions including but not limited to: August 15, 1992 restart conditions, August 2, 1992 restart conditions before and after FCV closure, restart conditions with worst case under corrective action restraints both now (500 MWD/MTU), at 1000 MWD/MTU, and at 1500 MWD/MTU.

The results of these stability analysis show decay ratios for this core to be less than 1.00. All cases showed decay ratios to be between 0.2 and 0.6 thus indicating all situations to be self dampening (A, C).

2. In an effort to minimize the inlet sub-cooling, which can contribute to power oscillations, a change was made to the Minimum Feedwater Temperature Curve in Plant Procedure, PPM 3.1.2, "Reactor Plant Cold Startup" (A)

3. Procedures for monitoring power oscillations were modified to require that the ANNA system be operable and in service from greater than 25% reactor power and less than 50% core flow (A).

4. In addition to general precautions recommended by the BWROG on stability, specific requirements were put in place to minimize plant testing and time spent below 50% core rated flow and above 25% core rated power. This will require shifting recirculation pumps from 15 to 60Hz speed at power less than 33% (A).

5. An approved startup plan was written and approved that controlled and specified rod patterns for the Cycle 8 startup. This plan utilized a rod pattern that was analyzed for stability prior to closing the first flow control valve for recirculation pump shift to fast speed. Revisions, except for minor rod position deviations due to instrument or equipment malfunctions, will require a new stability evaluation of the alternate rod pattern and Plant Operating Committee approval prior to recirculation pump upshift (A, C).

6. The above actions were implemented by procedural changes and training of personnel on these changes. The Power to Flow Map was revised to reflect these changes by designating an "INCREASED AWARENESS" region. BWROG Implementation Guidance for Stability Interim Corrective Actions have been implemented in Plant procedures and reinforced by training sessions and exam testing (A).

7. Plant Shutdown and Abnormal Condition Procedures were modified to provide increased monitoring, precautions, and direction regarding potential core instabilities (A).

8. A memo was issued by the Plant Manager to all Plant Personnel informing them of the significance of this event. The memo provided information on the seriousness of the event, a summary of the causes, and an outline of corrective actions (A).

9. A peer review by the BWR Owners Group was performed of the current WNP-2 operating practices related to prevention, detection, and suppression of power oscillations (A).

10. The Supply System has encouraged the fuel vendor to accelerate the validation of the present stability code used for assessing selected rod patterns for the startup plan (C).

11. An evaluation was performed of long-term shutdown strategies to ensure the correct procedures are in place for all conditions. Changes were made to plant procedures to provide guidance in this area. This included Plant Procedures PPM 3.2.1, Normal Shutdown to Cold Shutdown, PPM 3.2.2, Normal Shutdown to Hot Shutdown, and PPM 4.12.4.7, Unintentional Entry into Region of Potential Core Power Instabilities (A).

12. For Cycle 9 a revalidation of the startup plan was performed to assure this approach provides adequate margins for stability. This review involved an assessment of the pump up-shift corrective actions utilized for Cycle 8 with respect to their application to Cycle 9. This analysis was performed at several exposure increments through the cycle. While this evaluation is preliminary, it concluded that the corrective action limits of MCPR greater than 2.2 and core total peaking factor less than 3.4 prior to pump shift are adequate for Cycle 9 (A, C).

13. Action has been taken to strengthen programs and practices used to review and assimilate industry information. Specific changes to Plant Procedure 1.10.4, External Operating Experience, have been made to ensure BWROG and NUMARC information is screened for specific and general relevance to WNP-2. An examination was performed to identify the need to review other documents which may strengthen the influence of industry information on Supply System practices (B).

Corrective Action to be Taken

1. The scope of the Supply System design reviews will be expanded to provide additional oversight of vendor reload design and analysis. This expanded review process will be implemented for the Cycle 9 reload design and will include increased scope and technical depth of the design. A plan for the design review for Cycle 9 will be developed by March 15, 1993 and the enhanced reviews will include:

    a. Increased emphasis on the operating performance of the core in addition to meeting the licensing requirements;

    b. Increased awareness of the impact of core and fuel design changes on plant operations.

    c. Increased attention to core stability and thermal hydraulic characteristics.

    d. Fuel vendor will be required to perform additional stability analysis beyond the current licensing requirements (C).

2. The Miminum Critical Power Ratio and core total peaking factor prior to pump shift between 25 percent power and 50 percent core flow will be established for each cycle during the transition from a mixed 8X8/9X9 to a uniform 9X9 core. This evaluation will be completed prior to plant restart following the applicable refueling outages (A, C).

3. The Supply System will evaluate the feasibility of changing the fuel design to one that is more stable than the current 9x9-9X design. The long-term objective is the use of fuel designs which create known and manageable stability characteristics during plant operations and transients. The goal is that the next fuel fabrication contract, for fuel to be delivered in 1995, will meet the criteria necessary to satisfy this objective. The potential of earlier changes in fuel design will be evaluated, but to assure understanding of the impacts of a new fuel design on the existing mixed core, the Supply System does not expect to be able to implement fuel design changes prior to the 1995 fuel delivery. This evaluation will be completed by March 15, 1993 (C).

4. To support the enhanced reload design reviews and implementation of operating strategies, the Supply System will pursue obtaining core stability analysis codes. The Supply System will evaluate the existing codes and their availability in an attempt to implement their use in support of Cycle 10 core design review. This evaluation will be completed by January 1, 1994 (C).

5. The startup plan will be evaluated, as necessary, to ensure the stability of the existing core during plant startups that may occur for the remainder of Cycle 8 operation (A, C).

6. The Reactor Engineering Group within the Plant Technical Department provides on-shift direction to the operating crews during power operation and maneuvering. The Fuels Engineering Group, within Engineering, is the primary interface with the fuel vendor. The Supply System will evaluate this division of responsibilities and the working relationship between the two groups in establishing strategies during startup and full power operation. This evaluation will be completed by March 1, 1993 (C).

7. A plant modification is being implemented to replace the Flow Control Valves (FCVs) and two speed pump operation with Adjustable Speed Drive (ASD) pumps. This will eliminate the need to conduct operations under the restrictions on FCVs and 15 Hz speed pumps. The current two speed recirculation pumps will be powered from adjustable speed power supplies, allowing continuous flow adjustments from 15 to 60 Hz. With this modification, recirculation flow control valves will not be required. Due to implementation restraints and concerns, this modification is now scheduled to be complete by June 30, 1994. As an interim measure, to regain flow margin for Cycle 9, the Supply System is aggressively pursuing jet pump cleaning for the next refueling outage (A, C).

8. The Supply System will continue its involvement in the BWROG activities involving stability. A Supply System Principal Engineer has been spending approximately half time participating in these activities. This includes work as a primary representative on the Stability Committee ATWS/Stability Task Force and the committee involved with the long-term hardware proposal. The Supply System will also monitor BWROG progress in developing optimum corrective action limits for power distribution control during plant startup and power maneuvering (B).

9. A review will be performed to identify actions to be taken to improve the effectiveness of the Supply System's participation in industry activities. This will be completed by February 1, 1993 (B).

10. A Management Oversight and Risk Tree (MORT) analysis has been completed for this event. Management has reviewed this report and initiated the following actions:

    a. Action will be taken to strengthen our reactivity management program. Our existing process will be reviewed and contact will be made with other utilities to emulate the best features of their programs. This will include a review of the clarity of responsibilities between the Supply System and the contractor. These actions will be completed by April 15, 1993 (A, C).

    b. An assessment will be conducted to ensure the objective of a strong link between design bases and operating constraints is met. These actions will be completed by April 15, 1993 (B, C).

c. A corporate level review will be made of the overall relationship between Engineering Services, the fuel vendor, operators, STAs, and the SNEs to assure that responsibilities and duties for all aspects of fuel design, operation, fuel design related independent review, quality assurance, limit setting and recommendations on operating modes is well defined, active, effective and understood by all concerned. Included in this evaluation will be a review of all barriers that are assumed to be in place (such as ANNA) to prevent reactivity related events are actually being used in a fashion that the barrier is effective in performing its intended function. This item is complimentary to item 9a. This action will be complete by April 15, 1993 (C).

Date of Full Compliance

The Supply System was in full compliance prior to plant startup on August 30, 1992.

II. Violation Not Assessed a Civil Penalty

Technical Specification 4.0.4 states that entry into an operational condition or other specified applicable condition shall not be made unless the surveillance requirements associated with the Limiting Condition for Operation have been performed within the applicable surveillance interval, or as otherwise specified.

Technical Specification 3.2.2 states that the following requirement is applicable in Operational Condition 1, when thermal power is greater than or equal to 25 percent of rated thermal power:

"The APRM flow biased simulated thermal power-upscale scram trip setpoint (S) and flow biased neutron flux-upscale control rod block trip setpoint (Srb) shall be established according to the following relationships:

Trip Setpoint	Allowable Value
S < (0.66W + 51*)T	S < (0.66W + 54%)T
Srb < (0.66W + 42%)T	Srb < (0.66W + 45%)T

where: S and Srb are in percent of RATED THERMAL POWER

W = Loop recirculation flow as a percentage of loop recirculation flow which produces a rated core flow of 108.5 million lbs/hr

T = Lowest value of the ratio of FRACTION OF RATED THERMAL POWER divided by the MAXIMUM FRACTION OF LIMITING POWER DENSITY. T is always less than or equal to 1.11

Contrary to the above, several thermal limits printouts indicated on August 14 and 15, 1992, that "S" and "Srb" were less conservative than the Allowable Values, and the licensee did not make appropriate flow biased setpoint adjustments before exceeding 25 percent power.

This is a Severity Level IV violation (Supplement I).

Validity of the Violation

The Supply System acknowledges the validity of the violation. The root cause for the Technical Specification violation associated with the "T" factors for the APRM setpoints was less than adequate procedures. The Technical Specification requirements were not adequately written into the procedure requiring the adjustment prior to 25 percent power. A contributing root cause was management methods which failed to recognize and take corrective action for the non-compliant condition created by Technical Specification Surveillance 7.4.2.1.

Technical Specification 3.2.2, Power Distribution Limits/APRM Setpoints, is applicable in Operational Condition 1 when thermal power is greater than or equal to 25 percent of rated thermal power. The purpose of this Technical Specification at less than full power conditions is to provide added protection against a highly peaked power distribution by temporarily adjusting the APRM setpoints to a more conservative value. This is done by evaluating Power Distribution data and determining the "T" factor used to adjust the setpoints. Technical Specification 4.0.4 states that entry into an Operational Condition shall not be made unless the surveillance requirements associated with the Limiting Condition for Operation have been performed within the applicable surveillance interval or as otherwise specified. Surveillance Requirement 4.2.2.c states the surveillance is to be performed "...Initially and at least once per 12 hours when the reactor is operating with Maximum Fraction of Limiting Power Density (MFLPD) greater than or equal to the Fraction of Rated Thermal Power (FRTP)." During the power ascension associated with this event the plant reached 25 percent power at 2320 hours on August 15, 1992. At that time, the "T" factor was approximately 0.85. A further decrease occurred between 0100 and 0300 hours with the "T" factor at the time of the event being 0.73. Plant Procedure PPM 7.4.2.1, Power Distribution Limits, implements the requirements of this Technical Specification. The procedure required the "T" factor to be evaluated and the APRM setpoints to be adjusted every twelve hours when "T" is less than one.

Corrective Steps Taken/Results Achieved

Plant Procedure PPM 7.4.2.1, Power Distribution Limits has been modified to require a "T" factor adjustment prior to exceeding 25 percent core power.

Corrective Action to be Taken

The frequency specified for the surveillance requirement for power distribution limits and the determination of the "T" factor for APRM setpoints is condition-based and leads to some confusion. The Supply System will pursue a Technical Specification change to eliminate the confusion and to eliminate the requirement for calculating "T". A Technical Specification change request will be submitted by January 31, 1994 following completion of the necessary analysis.

Date of Full Compliance

The Supply System was in full compliance when PPM 7.4.2.1 was revised on August 29, 1992.

APPENDIX B

During an NRC inspection conducted on October 5 through 21, 1992, a deviation from a licensee commitment to the NRC was identified. In accordance with the "General Statement of Policy and Procedure for NRC Enforcement Action," 10 CFR Part 2, Appendix C, the deviation is listed below.

On March 31, 1989 the licensee requested an amendment to Technical Specification (TS) 3/4.2.6 and TS 3/4.2.7, in support of the licensee's response to NRC Bulletin 88-07, Supplement 1, "Interim Recommendations for Stability Action,". The proposed TS amendment included changes to core stability region boundaries which were different from those contained in Bulletin 88-07, Supplement 1, but were justified on the basis of the installation and use of a "... stronger, faster, more sophisticated means of monitoring the stability of the core... " by means of the Advanced Neutron Noise Analysis (ANNA) monitor. On June 23, 1989, the NRC approved TS Amendment No. 71 that approved the licensee requested changes to the TS defined region boundaries on the basis of the licensee's commitment to install and use, when required by TS, the ANNA stability monitor.

> Contrary to the above, prior to the August 15, 1992, power oscillation event, the installed ANNA stability monitor was not effectively stronger, faster, or more sophisticated because the monitor design and installation did not account for 0.3 Hertz filters which had been installed in the local power range monitor input circuits to ANNA, which rendered the ANNA stability monitor ineffective.

Reason for the Deviation

The Supply System acknowledges the validity of the deviation. The root cause for the problem was a design configuration and analysis deficiency. The interface between the existing plant hardware and the ANNA hardware received a less than adequate review and analysis. A contributing cause was an inadequate review and test of the design change to assure operability after installation.

The Advanced Neutron Noise Analysis (ANNA) Monitoring System was installed in 1989. This system monitors the signal of six Average Power Range Monitors (APRMs) and 18 Local Power Range Monitors (LPRMs). Its purpose is to provide advance warning of both global (in-phase) and regional (out-of-phase) oscillations. The ANNA Monitoring System is governed by Technical Specification 3/4.2.7 and 3/4.2.8, Stability Monitoring. The action statements of these Technical Specifications requires a decrease in thermal power or an increase in core flow within 15 minutes if the decay ratio measured by ANNA is greater than 0.75 when operating in Region C. The decay ratio is the ratio between the amplitude of two consecutive peaks in the neutron signal. The decay ratio is less than one for a stable system. A decay ratio of 0.75 is selected as a decay ratio limit for operator response such that sufficient margin to an instability occurrence is maintained. The natural frequency of a BWR is approximately 0.3 to 0.5 Hertz. The ANNA Monitoring System monitors between 0.2 and 0.7 Hertz. The LPRM/APRM signals normally have 0.3 Hertz low pass filters to remove noise from the signal used for normal power

monitoring. However, this same was used by the ANNA monitoring system which, on subsequent design review, needed a 5 Hertz filter to give accurate readings. The use of 0.3 Hertz filters on the input to ANNA resulted in non-conservative values of decay ratio in the region of interest. For example, calculations by Siemens Power Corporation for data associated with this event show that with a 0.3 Hertz filter ANNA would calculate a decay ratio of 0.62 while the decay ratio calculated utilizing unfiltered signals would be 0.89. Thus, the design of the ANNA Monitoring System and its associated signal conditioning did not provide for accurate decay ratio determinations. An additional problem was discovered with surveillance procedure PPM 7.4.2.7.3, Core Stability Monitoring. This procedure did not reflect the fact that the input to ANNA was filtered. As a result, the peak to peak amplitude reflected in the procedure was non-conservative.

Corrective Steps Taken/Results Achieved

The six APRM and eighteen LPRM input signals to ANNA have been modified to eliminate the 0.3 Hertz low pass filter. All ANNA signals now have a 5.0 Hertz low pass filter.

1. The six APRM and eighteen LPRM input signals to ANNA have been modified to eliminate the 0.3 Hertz low pass filter. All ANNA signals now have a 5.0 Hertz low pass filter.

2. A new plant procedure, PPM 2.1.8, ANNA Stability Monitoring System, was written to describe the operation of ANNA outside of Region C on the power to flow map.

3. A short-term corrective action involved splitting signals for the LPRMs and APRMs input into ANNA, the stability monitoring program. This implementation approach associated with the modification decreased the flexibility of ANNA. The Supply System has evaluated the impact of this reduction in flexibility and recommendations have been made for increased flexibility (see Corrective Action to be Taken below).

4. A reliability improvement evaluation will be performed of the core stability monitor (ANNA). This investigation will include assessment of power supply, CPU redundancy, automatic alarm features, and enhanced surveillance techniques to verify continued hardware and software operability. This evaluation has been completed and recommendations have been made for increased reliability (see Corrective Action to be Taken below).

Corrective Action to be Taken

A management review is underway to evaluate the recommendations on ANNA flexibility and reliability. This will be completed by March 1, 1993.