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December 22, 1993

Docket No. 50-213
B14507

Re: 10CFR50.90

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Gentlemen:

Haddam Neck Plant
Proposed Revision to Technical Specifications
Reactor Coolant Pump Flywheel Surveillance

Pursuant to 10CFR50.90, Connecticut Yankee Atomic Power Company (CYAPCO) hereby proposes to amend Facility Operating License DPR-61 by incorporating the changes identified in the Attachments into the Technical Specifications of the Haddam Neck Plant.

Background

Currently, Technical Specification Surveillance Requirement 4.4.10 identifies Regulatory Guide (RG) 1.14,[1] as providing the criteria for the inspections of the reactor coolant pump (RCP) flywheels at the Haddam Neck Plant. This RG recommends volumetric and surface examinations on different areas of the RCP flywheels at varied inspection frequencies. In order to satisfy these recommendations, CYAPCO has established an examination schedule which requires that at least two flywheels be examined during each refueling outage. An illustration of the RCP flywheel is provided in Figure 1 for your information. This figure details both critical and noncritical areas of the RCP flywheel.

CYAPCO has determined that the existing program as discussed in RG 1.14 can be optimized by revising the RCP flywheel inspection frequency and examination methods. By optimizing the existing RCP flywheel program, CYAPCO will alleviate current testing requirements that are overly restrictive for predicting RCP flywheel integrity and gain increased flexibility in utilizing personnel during subsequent RCP flywheel examinations. Therefore, CYAPCO proposes to replace the current RCP flywheel inspection frequency and examination methods with an alternate program.

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(1) U.S. Nuclear Regulatory Commission, Regulatory Guide 1.14, "Reactor Coolant Pump Flywheel Integrity," Revision 1, August 1975.

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Description of the Proposed Changes

The proposed changes to revise the current inspection frequency and examination methods are as follows:

In Surveillance Requirement 4.4.10, replace the phrase:

> "each reactor coolant pump flywheel shall be inspected per the recommendations of Regulatory Position C.4.b of Regulatory Guide 1.14, Revision 1, August 1975."

with the phrase:

> "the areas of higher stress concentration at the bore and keyway of each reactor coolant pump flywheel shall be ultrasonically examined at least once during each 10-year inspection interval. Scheduled examinations shall not exceed any 10-year period of operational service."

Safety/Assessment

The proposed changes will replace the current inspection frequency examination methods with a revised program. The changes are acceptable based on CYAPCO's review of RG 1.14, a structural evaluation of the effects of a decrease in the inspection frequency, RCP flywheel inspection history, and industry experience. In addition, these proposed changes will provide the opportunity for increased flexibility in personnel allocation during subsequent RCP flywheel inspections. Investigation of these bases have led CYAPCO to the conclusion that the existing surveillance requirement is overly conservative and can be relaxed. Each of the bases is further addressed as follows:

Review of Regulatory Guide 1.14

CYAPCO has reviewed the history of RG 1.14 and its relationship to the current inspection program. Safety Guide 14, "Reactor Coolant Pump Flywheel Integrity," was issued on October 27, 1971. The safety guide was superseded by RG 1.14, Rev. 1, which was issued by the NRC Staff in August of 1975 for comment. This version of RG 1.14 is currently used by CYAPCO for RCP flywheel inspection and examination. Subsequently, no revisions have been made to incorporate the results of past operating experience into the RG 1.14 inspection frequency and examination methods. Amendment 87[2] to the Haddam Neck Plant Technical Specifications added the surveillance requirement to conduct RCP flywheel inspection according to RG 1.14 in order to resolve a Systematic Evaluation Program (SEP) topic. This requirement was implemented into the Technical

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(2) U.S. NRC letter, F. M. Akstulewicz to J. F. Opeka, "Technical Specifications for Inservice Inspection of Reactor Coolant Pump Flywheel," dated November 12, 1986.

Specifications as a result of the Standard Review Plan (SRP),[3] Section 5.4.1.1 which was identified under an NRC Staff SEP Topic V-7, "Reactor Coolant Pump Overspeed."[4] This condition was to be generically reviewed by the NRC Staff under Generic Issue B-68, "Pump Overspeed During LOCA," but was subsequently removed from NRC review as a recommendation of NUREG-0933.[5] NUREG-0933 determined this issue was of small safety significance and low risk reduction value relative to cost so that its priority ranking was low. As a result of this review, the NRC Staff dropped this issue from further consideration. However, results of this conclusion were never incorporated into RG 1.14. As such, this requirement remains in the Technical Specifications.

Structural Evaluation on Extension of RCP Flywheel Inspection Frequency

In support of the justification to decrease the inspection frequency from once every 3 years to once during each 10-year inspection interval, CYAPCO performed a structural evaluation which calculated the most limiting critical flaw size for the RCP flywheels. The structural analysis evaluated two possible failure modes: 1) failure due to plastic overload, and; 2) failure due to brittle fracture. The critical flaw sizes based on brittle fracture evaluations proved to be more limiting than critical flaw sizes based on plastic overload evaluations for both normal operating and faulted conditions. For failure due to brittle fracture, the most limiting critical flaw size based on normal operating conditions was calculated to be approximately 10.0" deep, while the critical flaw depth under faulted conditions was calculated to be 8.5" deep. After applying the ASME Section XI margins of safety and accounting for fatigue crack growth, the allowable beginning of cycle (10-year interval) flaw depths were 1.037" for faulted conditions and 1.0095" for normal operating conditions. Since both of these flaw sizes are significantly larger than the minimum detectable flaw size of .25", it is concluded that increasing the flywheel reinspection period to once per 10 years is structurally acceptable. In addition, the critical angular velocity for a 1.0"-deep flaw was calculated to be approximately 248 percent of the overspeed condition. This is significantly greater than the maximum normal operating speed. Finally, since the most limiting flaw size is approximately 1.0" it can be concluded that ASME Section XI and Section III structural margins will be maintained

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(3) Standard Review Plan Section 5.4.1.1. — Regarding General Design Criteria 4, "Environmental Missile Design Bases," of Appendix A of 10CFR50.

(4) D. M. Crutchfield letter to W. G. Counsil regarding Systematic Evaluation Program, Topic V-7, "Reactor Coolant Pump Overspeed - Haddam Neck Plant," dated June 21, 1982.

(5) NUREG-0933, "A Prioritization of Generic Safety Issues," (Main Report and Supplements 1—12) dated July 1991.

throughout the RCP flywheel design life. These margins will be maintained with the provision that a 1.0"-flaw would be detected during the 10-year RCP flywheel inspection. However, as noted above, current ultrasonic testing techniques are able to detect a minimum flaw of .25". This detection capability is at least 4 times more sensitive than what is necessary to detect the limiting flaw size of approximately 1.0".

Historical Inspection Information

In support of revising both current inspection frequency and examination methods, a review of historical operating experience of the RCP flywheels was performed. For the past 25 years of commercial operation, CYAPCO has had an extensive Inservice Inspection (ISI) Program in effect for the RCP flywheels. Based on the results of this ISI program, CYAPCO has generated an inspection data base matrix as detailed in Attachment 3, which identifies nonstructurally significant flaws in critical areas of only one of the four RCP flywheels. These flaws were repaired early in the plant life and are believed to have been caused by welding/material anomalies specifically associated with the No. 4 RCP flywheel. Since 1973, no cracks have been identified on any of the RCP flywheels in the critical areas of the bore and keyway locations. Additionally, no cracks have exceeded the critical flaw size which would cause failure of the RCP flywheel in a normal operating or overspeed condition. Furthermore, CYAPCO notes that all of the No. 4 RCP flywheel cracks were of a limited depth, approximately ¼" deep. Also, for these areas, the bore seal weld and associated heat affected zones were totally removed.

Current RCP flywheel inspections require RCP flywheel disassembly in the critical areas of the bore and keyway locations. Continued use of these methods in the current inspection program is considered overly conservative. Past inspection data indicates that no active flaw mechanisms are present in the bore and keyway areas. Also, current ultrasonic testing methods are capable of detecting a minimum flaw size of .25" which is at least four times more sensitive than that required to detect the critical flaw size of 1". In addition, the flywheel material has been found to be favorable to inspect based on acoustic properties and recent improvements to the inspection procedure (e.g., use of a calibration block which resembles the RCP flywheel) which have increased the effectiveness of the RCP flywheel inspection program. Therefore, CYAPCO believes continued use of visual and surface examination techniques are overly conservative.

Industry Experience

By letter dated November 8, 1991, Southern California Edison Company (SCE)[6] requested an extension to a temporary waiver of compliance on RCP flywheel inspection. This letter cited a survey of industry experience on operating history of RCP flywheels which identified no reportable indications from inservice inspection of reactor coolant pump flywheels and no recorded failures. This review was based on discussions with plant personnel, the RCP supplier, inservice inspection representatives at many plants, and a review of the Nuclear Plant Reliability Data System data base. In addition, representatives from Westinghouse (the supplier of the Haddam Neck Plant RCP flywheels) and ABB/Combustion Engineering were contacted and advised SCE that no problems were associated with RCP flywheels from any inservice inspection. Furthermore, it is the understanding of SCE that this experience included over 10 million RCP flywheel operating hours. The NRC Staff approved the SCE waiver of compliance by letter dated November 22, 1991,[7] based on the conclusion that an extended flywheel inspection interval has minimal safety significance.

Personnel Optimization

The proposed change will extend the current inspection frequency on the high stress areas of the bore and keyway from 3 years to 10 years. These changes relieve test burden on personnel. Therefore, for future RCP flywheel inspections, the proposed changes offer a more effective utilization of plant personnel.

Accident and Safety Analysis Review

A review of the effects of the RCP flywheel surveillance interval revisions on the Haddam Neck Plant licensing basis was performed by CYAPCO. The two potential issues evaluated are the RCP locked rotor accident and the accident analyses concerning missile protection inside containment. A RCP flywheel failure could cause flywheel components to become jammed inside the RCP motor housing causing a locked rotor condition. However, the RCP flywheel is so massive in relation to the motor housing that should a failure occur, the components of the RCP flywheel would most likely not be retained in the motor housing. Although failure of a RCP flywheel is not considered a design basis accident, the Haddam Neck Plant is designed to reduce the potential for missiles which may have secondary effects. Prior analyses regarding Haddam

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(6) R. M. Rosenblaum letter to the U.S. NRC, "Request for an Extension of Temporary Waiver of Compliance Reactor Coolant Pump Flywheel Inspection," dated November 8, 1991.

(7) M. J. Virgilio letter to H. B. Ray, "Inservice Inspection of Reactor Coolant Pump Flywheels," dated November 22, 1991.

Neck Plant SEP Topic III-4.C, "Internally Generated Missiles,"[8] have determined that failure of a RCP flywheel and subsequent containment missiles is not a credible event. The increase of the surveillance interval will not modify this conclusion. The NRC Staff reviewed SEP Topic III-4.C[9] and concluded that the probability of missiles resulting from overspeed and damage to safety-related components is acceptably low.

Furthermore, potential accident overspeed conditions and subsequent events following a loss-of-coolant accident (LOCA) which could cause a loss of flywheel integrity have been previously evaluated as part of SEP, Topic V-7. The NRC Staff's safety evaluation noted that the probability of attaining an overspeed following a LOCA which is sufficient to cause loss of flywheel integrity is very remote. This probability would be the product of the conditional probabilities of a break of a large primary system coolant pipe, the probability of failure of the pipe restraints so that the break could become a double-ended guillotine break (calculations show a significantly smaller overspeed for a realistically constrained guillotine break), and the probability of a loss of electric power to the pump so that there is no electric braking effect and the pump is permitted to accelerate freely. Also, the pump would have to remain free spinning. Seizing of the shaft or motor components could prevent overspeed. The NRC Staff concluded that the necessary sequence of events to result in RCP overspeed and subsequent RCP flywheel failure were of low probability and that no further requirements were needed. CYAPCO notes that part of this NRC Staff determination was based on CYAPCO meeting an anticipated goal of 100 percent surface and volumetric examinations of the RCP flywheels during the 10-year inspection interval. Although the proposed changes revise this inspection as indicated above, CYAPCO believes there are no significant effects on the previous NRC Staff conclusions. In addition, the issue of RCP overspeed and subsequent containment missiles was reviewed generically by the NRC Staff under Generic Issue B-68, "Pump Overspeed During LOCA." NUREG-0933 detailed the generic review and recommended the issue be dropped from further NRC Staff review. It was concluded that this issue was of such small safety significance and low risk reduction value relative to cost that the review priority ranking be low and, therefore, removed from further review.

Significant Hazards Consideration

CYAPCO has reviewed the proposed changes in accordance with 10CFR50.92 and has concluded that the changes do not involve a significant hazards consideration (SHC). The basis for this conclusion is that the criteria of 10CFR50.92(c) are not compromised. The proposed changes do not involve an SHC because the changes would not:

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(8) W. G Counsil letter to the U.S. NRC "SEP Topic III-4.C, Internally Generated Missiles," dated February 12, 1982.

(9) D. M. Crutchfield to W. G. Counsil, "SEP Topic III-4.C, Internally Generated Missiles Haddam Neck Plant," dated May 10, 1982.

1. Involve a significant increase in the possibility of occurrence or consequences of an accident previously analyzed.

   The proposed changes will revise the surveillance frequency and examination methods for RCP flywheel inspections. The two affected accidents are the RCP locked rotor accident and the adequacy of missile protection inside containment. In the event of failure, RCP flywheel components could become jammed in the RCP motor housing and cause a locked rotor. However, CYAPCO does not consider this a realistic scenario. The RCP flywheel mass in relation to the motor housing is such that should a failure occur, the housing would most likely not be able to contain the flywheel fragments. Also, the Haddam Neck Plant is designed to reduce the potential for generated missiles which may have secondary effects. Prior SEP analyses have examined internally generated missiles and do not consider RCP flywheel failure with subsequent containment missiles a credible event. The modification of the surveillance requirement will not significantly affect this conclusion.

   As a result of the proposed changes, CYAPCO has determined that some small increase in accident probability will occur. If the probability of detecting a one-inch flaw using ultrasonic testing methods was 100 percent, there would be no increase in accident probability. However, ultrasonic testing examinations are not perfect and are subject to human and equipment errors. Therefore, some small increase in accident probability will occur. CYAPCO has determined that this increase in risk is acceptable. There is no evidence of active flaw mechanisms present and historical data indicates no flaws have been detected in the critical areas since 1973. Flaws prior to 1973 are believed to be from a manufacturer process flaw. Also, the RCP flywheel material is conducive to facilitate ultrasonic testing while an improvement in the RCP flywheel calibration procedure contributes to an increase in test effectiveness.

   The proposed changes reduce the scope of flywheel examinations and the frequency of inspections. Additionally, based on the structural evaluation, it has been determined that the 10-year inspection interval is sufficient to assure that the required margins of safety are maintained throughout the life of the flywheel. Use of multiple techniques increases the probability of detection due to fault in the technique or the testing procedure.

   The most limiting critical flaw size based on operating conditions with ASME Section XI margins of safety applied and with fatigue crack growth allowances provided, results in a beginning of cycle flaw depth of approximately 1". This flaw depth is applicable to both faulted and normal operation conditions. Current ultrasonic techniques used to inspect RCP flywheels can detect minimum flaws of .25" in depth. Current flaw detection methods are up to four times more sensitive than those required for detecting a 1"-deep flaw. Additionally, the critical angular velocity for a 1"-flaw depth is 248 percent overspeed, which is

significantly greater than the maximum operating speed (i.e., the normal operational environment includes a maximum 125 percent overspeed condition).

These proposed changes will not affect the probability of, or the consequences of, a previously evaluated equipment malfunction or degrade the performance of safety equipment. Therefore, the proposed changes do not involve a significant increase in the possibility or consequences of an accident previously analyzed.

2. Create the possibility of a new or different kind of accident from any accident previously analyzed.

These proposed changes cannot create the potential for a new or different kind of accident from those previously analyzed. The proposed changes do not introduce any new failure modes. Since the plant will continue to operate as designed, the proposed changes will not modify the plant response to the point were a new accident can be considered.

3. Involve a significant reduction in a margin of safety.

The proposed changes to revise the inspection frequency and examination methods for RCP flywheels has no significant reduction on the margin of safety. The mechanical and structural margins remain unchanged by the proposed changes. In addition, the proposed changes do not alter operating parameters, instrument setpoints, or trip setpoints. These changes extend the inspection period for RCP flywheels from 3 years to 10 years and reduce the scope of inspection to critical areas. However, based on a structural evaluation, current ultrasonic testing methods can detect a flaw size of .25" which is four times more sensitive than that needed to detect a flaw size of 1". Additionally, based on operating history, no cracks have been identified in the critical areas of the bore and keyway since 1973. The previous cracks were from a manufacturing flaw of limited depth (i.e., approximately 1/2" deep) and were repaired.

Moreover, the Commission has provided guidance concerning the application of standards in 10CFR50.92 by providing certain examples (March 6, 1986, 51FR7751) of amendments that are considered not likely to involve an SHC. Although the proposed changes are not enveloped by a specific example, the proposed changes would not involve a significant increase in the probability or consequences of an accident previously analyzed. In regard to the proposed changes, the two areas of concern are the RCP flywheel locked rotor accident and the adequacy of missile protection inside containment. The failure of a RCP flywheel could cause components to jam in the motor housing and cause a locked rotor condition. However, this is not a realistic scenario when the mass of the RCP flywheel components is considered. The RCP flywheel is so massive that should a failure occur, the housing would most likely not contain the RCP flywheel components. Although failure of the RCP flywheel is not considered a design basis accident or event, the Haddam Neck Plant is designed

to reduce the effects of potential missiles which may have secondary effects. Also, prior analysis has concluded that failure of a RCP flywheel with subsequent containment missiles is not a credible event.

CYAPCO has reviewed the proposed license amendment against the criteria of 10CFR51.22 for environmental considerations. The proposed changes do not involve an SHC, nor increase the types and amounts of effluent that may be released off-site, nor significantly increase individual or cumulative occupational radiation exposure. Based on the foregoing, CYAPCO concludes that the proposed changes meet the criteria delineated in 10CFR51.22(c)(9) for a categorical exclusion from the requirements for an environmental impact statement.

The Haddam Neck Nuclear Review Board has reviewed and approved the proposed changes and has concurred with the above determination.

The marked up technical specifications are contained in Attachment 1. The retype of the proposed changes to the technical specifications in Attachment 2 reflects the currently issued version of technical specifications. Pending technical specification changes or technical specification changes issued subsequent to this submittal are not reflected in the enclosed retype. The enclosed retype should be checked for continuity with technical specifications prior to issuances.

Revision bars are provided in the right-hand margin to indicate a revision to the text. No revision bars are utilized when the page is changed solely to accommodate the shifting of text due to additions or deletions.

CYAPCO hereby requests the NRC Staff process and issue this proposed amendment at your earliest convenience, to be effective within 30 days upon issuance.

In accordance with 10CFR50.91(b), we are providing the State of Connecticut with a copy of this proposed amendment.

Should you have any questions, please contact my staff.

Very truly yours,

CONNECTICUT YANKEE ATOMIC POWER COMPANY

J. F. Opeka
Executive Vice President

cc: See Page 10

cc: T. T. Martin, Region I Administrator
A. B. Wang, NRC Project Manager, Haddam Neck Plant
W. J. Raymond, Senior Resident Inspector, Haddam Neck Plant

Mr. Kevin T.A. McCarthy, Director
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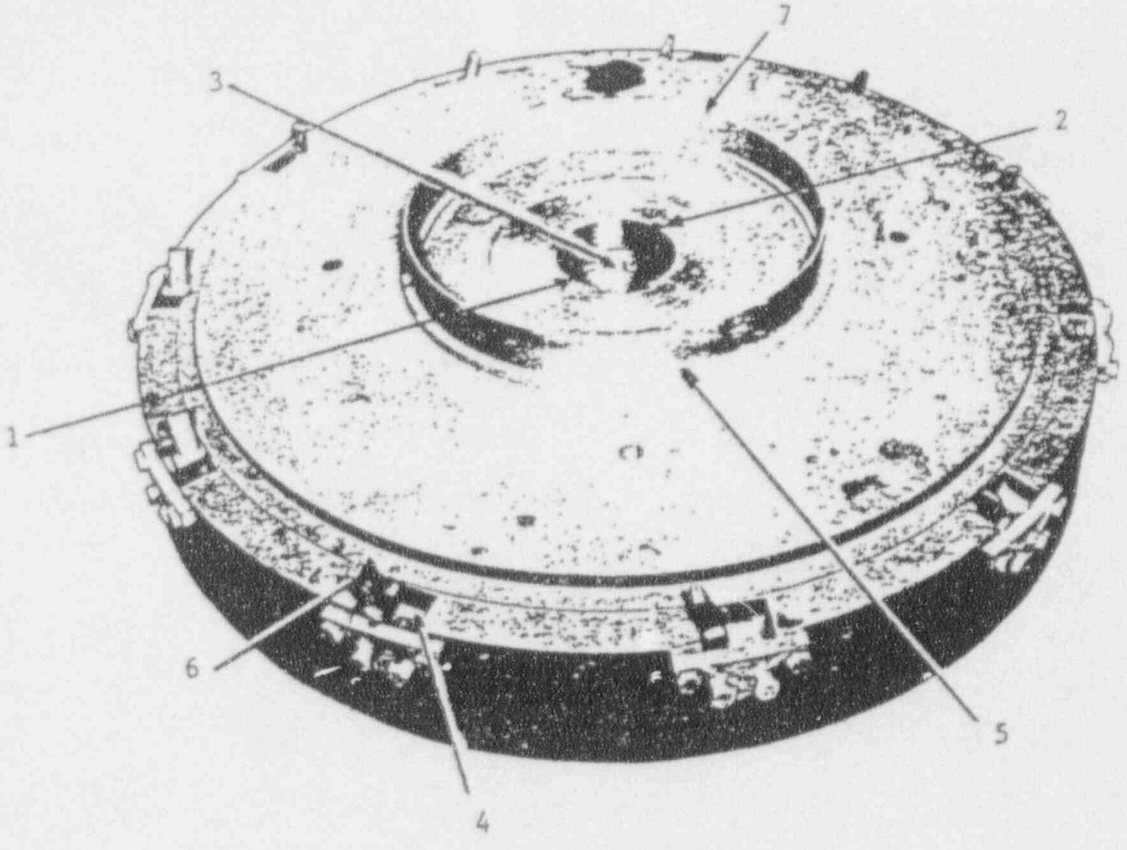
Subscribed and sworn to before me

this 22 day of December, 1993

Lorraine J. D'Amico

Date Commission Expires: 3/31/98

FIGURE 1 FLYWHEEL AREAS/PARTS



Bottom View of Flywheel

Critical Areas/Parts

1 = Bore Area 2 = Keyway Area 3 = Bore Seal Weld

Non-Critical Areas/Parts

4 = Bore Pawl Area 5 = Seal Baffle Fillet Weld Area

6 = Pawl 7 = Seal Baffle