CONNECTICUT YANKEE ATOMIC POWER COMPANY

BERLIN, CONNECTICUT
P. O. BOX 270 HARTFORD, CONNECTICUT 06101

TELEPHONE
203-666-6911

July 8, 1980

Docket No. 50-213
B10027

Director of Nuclear Reactor Regulation
Attn: Mr. Dennis M. Crutchfield, Chief
Operating Reactors Branch #5
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

References: (1) D. G. Eisenhut letter to W. G. Counsil dated February 25, 1980.
(2) W. G. Counsil letter to D. G. Eisenhut dated March 20, 1980.
(3) W. G. Counsil letter to D. G. Eisenhut dated April 3, 1980.

Gentlemen:

Haddam Neck Plant
Westinghouse (W) Low Pressure Turbine Disc Integrity

Reference (1) was a request for both site-specific and generic information on the Haddam Neck Plant turbine, and Connecticut Yankee Atomic Power Company's (CYAPCO) assessment of the safety significance of that information. In Reference (2), CYAPCO provided the information, and the assessment that continued full power operation for the six weeks remaining to the scheduled refueling outage date of May 3, 1980 would not compromise the continued safe operation of the plant.

The purpose of this letter is three-fold. First, CYAPCO would like to correct some erroneous data submitted with Reference (2). Attachment 1 to this letter is a corrected copy of Page 1 of Attachment 3 to Reference (2). Please note the corrected information, under Question I.C., on the turbine overspeeds of August 1, 1976 and December 3, 1977. We regret any inconvenience this oversight may have caused.

Secondly, CYAPCO is supplying, as Attachment 2, further information in support of the conclusions reached in Reference (2) and summarizing discussions with the Staff which took place subsequent to submittal of Reference (2).

Finally, CYAPCO would like to express its displeasure regarding the manner in which the Staff's concerns were dispositioned. To establish the basis for CYAPCO's concern, a review of the sequence of events is appropriate.

Reference (1) requested a response within 20 days of the date of the letter, in accordance with the provisions of 10CFR50.54(f). In light of the fact that CYAPCO did not receive the Reference (1) letter until 8 of those 20 days had passed, the Task Force established in relation to this subject had only 17 days to address the issue which included the five extra day (three working days) extension from the Staff. Further, CYAPCO was unable to obtain the complete site-specific information until March 18, 1980, the day before the extended response deadline. We verbally requested a second extension to allow us sufficient time for review and assessment. The Staff informed us that although they were sympathetic to our dilemma, Senior NRC Management had indicated that further extensions were impossible. CYAPCO, therefore, had one day in which to review the Westinghouse (W) data, perform the required calculations, and prepare the response. As a result, Reference (2) was actually submitted one day late, being delivered by expedited mail at the Staff's request. One day following your receipt of Reference (2), on March 21, 1980, the Staff verbally informed CYAPCO that we had two weeks, or until April 4, 1980, to shut down for inspection of the two low pressure (LP) turbines at the Haddam Neck Plant or face a Show-Cause Shutdown Order. No technical justification for the two week interval was ever offered; just that it was a Senior NRC Management "directive". In addition, no written confirmation of this directive was ever received despite repeated requests from CYAPCO.

CYAPCO immediately requested a meeting which was scheduled for the following week on March 28, 1980. In the intervening week, CYAPCO completed preliminary investigations of various aspects of the alleged problems with the number one discs of the LP turbines. At the meeting, CYAPCO presented further information (discussed in Attachment 2 to this letter) which supported our conclusions of Reference (2) and which tended to refute the existence of a problem with the turbine discs. We also proposed further investigations on the subjects of ultra-conservative fracture mechanics and disc operating environment (the results of which are also in Attachment 2). CYAPCO was informed that further investigation of the fracture mechanics would be a "waste of time". The Staff was, however, receptive to the arguments presented on the steam conditions in the area of operation of the turbine discs of concern. We were encouraged to pursue this aspect of the alleged problem, but then were reminded that the original two-week deadline and the imposition of 10CFR50.54(f) would still be enforced. This meant that only one week remained for an extensive effort of investigating those W units which had been inspected and found to have cracks, and those found with no cracks, and to compare their steam cycles and operating histories with each other's and with the Haddam Neck Plant's in an attempt to draw a correlation. This accelerated schedule was impractical to work within.

The NRC further confounded the turbine disc cracking issue, by their position that the matter is nuclear safety-related. CYAPCO contested the existence of a safety question on this issue. For instance, Regulatory Guide 1.26, which delineates the Staff's quality classification system for safety-related components in water-cooled nuclear power plants, specifically excludes turbines and condensers from classification as safety-related. Historically, the issue of low trajectory turbine missiles has been the only safety issue, and, therefore, the only instance of NRC involvement with the turbines in PWR's. CYAPCO presented compelling arguments, with the concurrence of W, that even in the

highly unlikely event of a failure of one of the number one discs of allegedly questionable integrity, no external missile would be generated. The safety question, thus, becomes a moot point. The only response from the Staff was a somewhat uncertain reference to the possibility of a fire which could possible spread sufficiently (despite in-place fire protection systems and equipment to prevent just such an occurrence) to damage safety-related equipment.

Discussion then turned to reduced power operation. The Staff informed CYAPCO that by their calculations if we could take steps to limit a turbine overspeed transient to 120%, the plant would most probably be allowed to continue operation. CYAPCO responded that a load reduction to approximately 90% (later confirmed at 88%) would limit overspeed on a loss-of-load trip to 120%. We were strongly urged to study this option.

Throughout the three-week period from March 14, 1980 to April 4, 1980, the atmosphere which surrounded this subject was one of extreme urgency. CYAPCO was first forced into the position of docketing information from others with only cursory review, and which, on subsequent reasoned investigation, we consider unrealistically conservative and inappropriate. Then, given the difficult task of obtaining extensive information from W and numerous utilities, correlating the data, comparing with the Haddam Neck Plant's history, and then drawing accurate and meaningful conclusions, all within the span of one week, CYAPCO was forced into a choice between a Shutdown Order and continuing operation, but at a reduced power level of 88% for the four remaining weeks until the scheduled refueling outage. Our decision was docketed in Reference (3).

CYAPCO finds this course of events extremely disconcerting. While we realize that NRC must act based on docketed information, too-restrictive and inflexible response requirements in a rush-to-judgment, can be, and in this case as regards the Haddam Neck Plant, were, counter-productive. The reduction of the Haddam Neck Plant's output to 88% cost CYAPCO's consumers approximately $2.2 million with no positive effects on their health and safety; in fact, arguments to the contrary can be presented, such as replacement generation by less environmentally acceptable means, or increased use of (imported) oil.

Subsequent inspection of the LP turbine rotors during the current refueling outage has verified the validity of CYAPCO's arguments -- NO indications were found on the number one discs which were the basis for NRC's concerns over shutdown of the plant. A complete inspection report will be docketed in the near future.

CYAPCO wishes to emphasize that we are firmly committed to cooperating with NRC in enhancing the safety of nuclear power generation in general, and the Haddam Neck Plant in particular. However, we feel the cooperation must be reciprocal in all cases; we must not be rushed into conclusions requiring very costly derates or shutdowns, when a more detailed review, which may take very little extra time, of plant-specific conditions and operating history, may indicate otherwise.

CYAPCO is docketing this information in order to provide a complete record of the arguments presented to the Staff in the meeting of March 28, 1980, and in telephone discussions. We further wish to go on record in expressing our disappointment in the way this item was handled by the Staff, with the hope that future safety questions will be resolved in a more deliberate and thoughtful manner.

Very truly yours,

CONNECTICUT YANKEE ATOMIC POWER COMPANY

W. G. Counsil

W. G. Counsil
Senior Vice President

Attachment

DOCKET NO. 50-213

ATTACHMENT 1

HADDAM NECK PLANT

WESTINGHOUSE (W) LOW PRESSURE TURBINE DISC INTEGRITY

CORRECTED COPY OF PAGE 1 OF ATTACHMENT 3

TO W. G. COUNSIL LETTER TO D. G. EISENHUT DATED MARCH 20, 1980

JUNE, 1980

ATTACHMENT 3

ANSWERS TO SITE-SPECIFIC GENERAL QUESTIONS

I.A. The Haddam Neck Plant turbine is a tandem compound four flow, three casings, condensing, 1800 RPM turbine utilizing 44-inch last row blades in each low pressure element. The low pressure element is designated as a Building Block 81.

I.B. The Haddam Neck turbine is operating with new LP rotors which have not been inspected for disc cracking. Operating hours postulated to time of inspection for each turbine is 30,175 hours. CYAPCO intends to inspect both LP turbines during the refueling outage which starts in May, 1980.

I.C. The following tabulation is a listing of turbine trips and overspeed since the initial operatin date of July 18, 1976 for the new LP rotors.

Date	Description	Overspeed (% Above 1800 RPM)
7/18/76	Turbine Overspeed Trip Test (No Load)	2%
8/1/76	Turbine Trip From 76% Load	15.6%
9/10/76	Plant Trip From Full Load	No Overspeed
9/18/77	Turbine Trip From Full Load	24.4%
10/9/77	Plant Trip From Full Load	No Overspeed
12/1/77	Reactor Trip From 10% Load	No Overspeed
12/2/77	Turbine Overspeed Trip Test (No Load)	2%
12/3/77	Turbine Trip From 70% Load	20.8%
1/1/78	Reactor Trip From 80% Load	No Overspeed
4/30/78	Plant Trip From 50% Load	No Overspeed
5/4/78	Plant Trip From 100% Load	No Overspeed
11/2/78	Reactor Trip at 100% Load	No Overspeed
3/12/79	Turbine Overspeed Trip Test	2%

DOCKET NO. 50-213

ATTACHMENT 2

HADDAM NECK PLANT

WESTINGHOUSE (W) LOW PRESSURE TURBINE DISC INTEGRITY

SUMMARY OF ARGUMENTS PRESENTED TO THE STAFF IN THE MEETING OF MARCH 28, 1980 AND IN SUBSEQUENT TELEPHONE CONFERENCES

JUNE, 1980

- The steam environment in the area of the two number one discs of concern is not conducive to stress corrosion cracking (SCC). From actual plant operating data, the calculated conditions at the exit from the third stage (there are three blade rows on the number one discs) show 0.5% moisture at the blade path or disc rim. This assumes the turbine is functioning as efficiently as it was designed, i.e., the maximum energy possible has been drawn from the steam at this point so that the 0.5% moisture is a worst case. It also assumes the steam has reached equilibrium after passing through the three blade rows in approximately 0.002 seconds. In actuality, because of the rapid expansion in such a short time, initial moisture formation is delayed until the steam expands further into the wet steam region on the Mollier diagram. The point at which moisture initially forms is widely accepted as the Wilson Line. This is a line of constant moisture on the Mollier diagram at approximately 3%. This point in the turbine is further downstream. In addition, the possibility of SCC is further reduced by the elevated temperature of the disc hub -- approximately 40 F more than the steam temperature -- which tends to keep the steam temperature up, thereby keeping it in the dry steam region of the Mollier diagram. Moisture must be present for SCC cracking to be initiated.

  These two points are strongly reinforced by the experience with the original LP rotors in this turbine (see Reference (2), Attachment 3, Page 3, answer to Question IV-1). And, although it is somewhat limited, industry experience is also supportive. There have been no cracks found in units operating with calculated disc exit conditions of 1.5% or less moisture.

  Given this information, we have concluded that it is quite probable there is no stress corrosion cracking in the disc bores. If there is, it is probable that progression of cracking has been intermittent.

- CYAPCO does not believe that the ultra-conservative, first-cut type calculations supplied to us by W on March 18, 1980 are a realistic basis for assessing rotor structural integrity. At the March 28 meeting, we told the Staff we intended to pursue more detailed and sophisticated analyses. The Staff advised us it would be a "waste of time". Despite this, the following argument is emphasized. The calculation of critical crack size is particularly sensitive to the crack geometry. Based on actual industry experience, a crack depth-to-width ratio of 1/2 is realistic for a structural integrity analysis, rather than the 1/4 used in the original analysis. Using an aspect ratio of 1:2 (instead of 1:4) increases the critical crack size, A_{cr}, by a factor of 1.72. Another parameter having additional impact on A_{cr} is the radial stress distribution in the disc. The tangetial disc stresses are non-linear and decrease significantly with distance from the bore. Since a detailed finite element analysis was not performed for the disc geometry including the keyway, the use of σ_{bore} is conservative. It is our position that $\sigma_{crack\ tip}$ and/or σ_{mean} should be used for a structural integrity evaluation. Based on these two factors alone, we estimate critical crack size to be 4.7 inches. When compared to the calculated maximum expected crack size, A, of 1.76", a ratio of A/A_{cr} = 1.76/4.7 = 0.37 results, which is dramatically less than 1.0. This calculation is for the 28% design overspeed of the Haddam Neck turbine.

- With regard to the safety concerns, CYAPCO has had extensive discussions with W. Turbine missile analyses have been completed for three, similar Building Block 81 units, with the same disc design, two with 32% design overspeed and one with 20% design overspeed. In each case, the analyses show that if a number one disc ruptures at design overspeed, any disc fragments will be contained within the casing and no external missile will be generated. CYAPCO has, therefore, concluded, with the concurrence of W that even in the highly unlikely event of a number one disc rupture at the Haddam Neck Plant (if we have a loss of load trip, and if the turbine reaches 128% speeds, and if the crack is as large as the critical crack size, and indeed, if the crack even exists), any disc fragments would be contained and no missile would be generated. In addition, Regulatory Guide 1.26, which describes the Staff's system for classification of safety-related components, specifically excludes turbines and condensers. The only safety issue with PWR turbines has been that of low trajectory turbine missiles.

  It is, therefore, CYAPCO's considered opinion that there is no safety question.