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May 31, 1989

Re: Indian Point Unit No. 2  
Docket No. 50-247

Document Control Desk  
US Nuclear Regulatory Commission  
Mail Station P1-137  
Washington, DC 20555

SUBJECT: Justification for Continued Operation (JCO) for Bulletin 88-11  
"Pressurizer Surge Line Thermal Stratification"

By a letter dated May 18, 1989, the Commission notified Con Edison that the proposed schedule for Item 1.b of NRC Bulletin 88-11, "Pressurizer Surge Line Thermal Stratification" (Con Edison letter dated 3/3/89), is not approved. The May 18 letter also stated that based upon an agreement reached between the NRC staff and the Westinghouse Owners Group (WOG) during an April 11, 1989 meeting, a bounding analysis as related to Item 1.b of the Bulletin shall be completed and made available for NRC audit, and a Justification for Continued Operation (JCO) shall be submitted to the NRC in the event the results of the bounding analysis did not confirm the adequacy of the pressurizer surge line for the design life of the plant.

Accordingly Con Edison has completed a bounding analysis and concluded that Indian Point Unit 2 is capable of full power operation with sufficient margin for the time period needed to complete a comprehensive stress and fatigue evaluation as required by task Item 1.d of the Bulletin. Attachment A to this letter contains Con Edison's JCO. We currently anticipate that the requirements of Item 1.d of Bulletin 88-11 will be addressed by January, 1991.

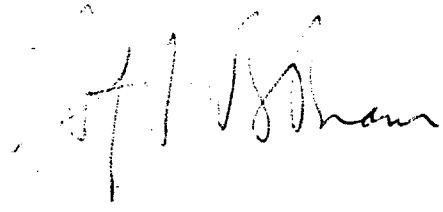
In addition, Con Edison has completed Action 1.a of the Bulletin during the current refueling outage; this action required an ASME Section XI, VT-3 visual examination of the surge line. The results of this inspection did not indicate any gross discernable distress or structural damage in the surge line. These results are available for review at the site.

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Should you or your staff have any questions regarding this matter, please contact Mr. Jude G. Del Percio, Manager, Regulatory Affairs.

Very truly yours,



Subscribed and sworn to  
before me this 28 day  
of May, 1989.

Karen L. Lancaster  
Notary Public

**KAREN L. LANCASTER**  
Notary Public, State of New York  
No. 60-4643659  
Qualified in Westchester County  
Term Expires 7/30/89

Attachment

cc: Mr. William Russell  
Regional Administrator - Region 1  
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Mr. Donald S. Brinkman, Project Manager  
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Senior Resident Inspector  
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Attachment A

Justification for Continued Operation Regarding  
Pressurizer Surge Line Stratification  
NRC Bulletin 88-11  
Indian Point Unit No. 2

Consolidated Edison Company of New York, Inc.  
Indian Point Unit No. 2  
Docket No. 50-247  
May, 1989

BACKGROUND

It was first reported in INPO SER 25-87 that temperature measurements at a German PWR indicated thermal transients different than design. Recent measurements at several domestic PWR's have indicated that the temperature difference between the pressurizer and the hot leg results in stratified flow in the surge line, with the top of the flow stream being hot (pressurizer temperature) and the bottom being colder (hot leg temperature). The top-to-bottom temperature difference can reach 250°F to 300°F in certain modes of operation, particularly Modes 3, 4, or 5 during heatup and cooldown.

Surge line stratification causes two effects:

- o Global bending of the pipe is different than that predicted in the original design.
- o Fatigue life of the piping could be reduced due to the global and local stresses caused by stratification and striping.

More recently, the NRC has issued Bulletin 88-11 "Pressurizer Surge Line Thermal Stratification," December 20, 1988, identifying actions to be taken by licensees.

- a) Conduct visual inspection - walkdown
- b) Update stress and fatigue analysis to account for stratification and striping
- c) Obtain monitoring data, as necessary

The bulletin encourages licensees to perform actions b) and c) above through collective efforts with other plants. In October 1988, Con Edison and other members of the Westinghouse Owners Group (WOG) authorized a program to perform a generic evaluation of surge line stratification in Westinghouse PWR's that will address portions of Bulletin 88-11.

The WOG program is designed to benefit from the experience gained in the performance of several plant specific analyses on Westinghouse PWR surge lines. These detailed analyses included definition of revised thermal transients (including stratification) and evaluations of pipe stress, fatigue usage factor, thermal striping, fatigue crack growth, leak before-break, and support loads. The overall analytical approach used in all of these analyses has been consistent and has been reviewed, in detail, by the NRC staff.

As of March 1989, plant specific analyses have been performed on five domestic Westinghouse PWR's. In addition, twelve Westinghouse plants have completed or are currently performing an interim evaluation of surge line stratification which includes finite element structural analysis of their specific configuration under stratified loading conditions.

WOG Program Status

As part of the current WOG Program, surge line physical and operating data has been collected and summarized for all domestic Westinghouse PWR's (55 units). Information relating to piping layout, supports and restraints, components, size, material, operating history, etc, has been obtained. This data has been evaluated in conjunction with available monitoring data and plant specific analyses performed by Westinghouse. The results of this evaluation were presented to the NRC in a meeting on April 11, 1989. The evaluation is being formalized into a Westinghouse topical report (WCAP 12277, Proprietary and WCAP-12278, non-proprietary version) scheduled for submittal to the NRC on June 15, 1989.

This Westinghouse topical report forms the basis for the following justification for continued operation.

JUSTIFICATION FOR CONTINUED OPERATION

A. Stratification Severity

Thermal stratification ( $\Delta T > 100^\circ\text{F}$ ) has been measured on all surge lines for which monitoring has been performed and which have been reviewed by the WOG to date (eight surge lines).

The amount of stratification measured and its variation with time (cycling) varies. This variation has been conservatively enveloped and applicability of these enveloping transients has been demonstrated for plant specific analyses.

Various surge line design parameters were tabulated for each plant. From this, four parameters judged to be relatively significant were identified as follows:

- A. Pipe inside diameter
- B. Piping slope (average)
- C. Entrance angle of hot leg nozzle
- D. Presence of mid-line vertical riser

These parameters were used in a grouping evaluation which resulted in the definition of 10 monitoring groups corresponding to various combinations of these parameters at Westinghouse PWR's. Approximately 40% of the plants fall into one group for which a large amount of monitoring data has already been received and for which the enveloping thermal transients, discussed above, are applicable. Indian Point Unit 2 nuclear station is within this group.

B. Structural Effects

Significant parameters which can influence the structural effects of stratification are:

- a. Location and design of rigid supports and pipe whip restraints
- b. Pipe layout geometry and size
- c. Type and location of piping components

Although the material and fabrication techniques for Westinghouse surge lines are reasonably consistent and of high quality, the design parameters listed above vary among Westinghouse PWRs. This variation in design is primarily a result of plant specific routing requirements.

A preliminary evaluation, comparing the ranges of these parameters to those of plants for which plant-specific analysis and interim evaluations are available (approximately 20% of Westinghouse PWR's), has been performed. This comparison indicates a high degree of confidence that, from a combined transient severity and structural effects standpoint, the worst configuration has most likely been evaluated. This conclusion is supported by plant-specific analyses covering five plants and interim evaluations of six additional plants (interim evaluation is in progress on six more plants as of March 1989). These analyses and evaluations have included various piping layouts, pipe sizes, support and restraint designs and piping components. Although the full range of variation in these parameters has not been evaluated, experience gained from these evaluations indicates that further evaluations will not result in a more limiting configuration than those already evaluated.

C. Operating Procedures

The WOG currently has available the surveys of operating procedures performed in support of existing plant-specific analyses. Experience indicates that heatup and cooldown procedures have a significant effect on stratification in the surge line. All conclusions reached by the WOG to date have assumed a steam bubble mode heatup and cooldown procedure which may result in a temperature difference between the pressurizer and reactor coolant system (RCS) hot leg of more than 300°F. In many cases, individual plant operating procedures and technical specifications provide limits on this value. It is also known that some procedures utilize nitrogen, during at least part of the heatup/cooldown cycle, as a means of providing a pressure absorbing space in the pressurizer. Based on information currently available to WOG, a high confidence exists that the steam bubble mode heatup, assumed to date, is conservative with respect to Westinghouse PWRs.

At Indian Point 2 Nitrogen is used up to an RCS temperature of 350°F before switching to steam bubble mode. The use of nitrogen minimizes the severity of stratification in the surge line.

D. Pipe Stress and Remaining Life

The design codes for surge line piping have requirements for checking pipe stress limits and the effects of fatigue loadings. These stress limits provide a means of controlling stress from primary loads such as pressure, deadweight, and design mechanical loading, as well as stress from secondary loads such as thermal and anchor motion effects.

Stratification in the surge line is a secondary load which will only affect the qualification of secondary stresses. The qualification of primary stresses is not affected by this loading.

Secondary stresses are controlled to prevent excessive displacements and gross plasticity and to prevent excessive fatigue loadings in the pipe. The basic characteristic of a secondary stress is that it is self limiting; thus, a failure from a single application of a secondary loading is not expected.

The effects of secondary stresses on the remaining life of the surge line have been evaluated on a generic basis through the WOC program. The following summarizes the results of this evaluation.

All plant specific analyses performed as of March, 1989 have demonstrated compliance with applicable ASME Codes and a surge line fatigue life in excess of a 40 yr. plant life. Review of plant specific fatigue calculations indicates that the surge line fatigue life is primarily dependent on the number of heatup and cooldown cycles, rather than years of operation.

Considering the worst case years of operation (28.5 yr) in combination with the worst case number of heatup-cooldown cycles (75) at any Westinghouse PWR, and assuming a 40 year life for all surge lines, it is estimated that no more than approximately 50% of fatigue life has been used at any Westinghouse plant to date.

For a design life considering 200 heatup-cooldown cycles (used in plant specific analyses), this would indicate approximately 100 remaining cycles. This number of remaining cycles far exceeds the postulated worst case number of ten cycles for the two year time frame needed to resolve the stratification issue.

The previously calculated design basis primary and secondary stresses for the Indian Point Unit 2 surge line have been reviewed and found to be acceptable with respect to the code allowables with significant margin. The calculated secondary stresses are enveloped by the generic bounding analysis.

E. Leak Before Break

All the plant specific analyses performed to date that have included the loadings due to stratification and striping have validated the "leak-before-break" concept and have substantiated a 40-year plant life. Fatigue crack growth calculations, performed as part of these plant specific analyses, have demonstrated that any undiscovered crack as large as 10% of the wall thickness would not grow to cause leakage within a 40 year plant life. Nevertheless, any postulated through wall crack propagation would most likely result in "leak-before-break" and thus permit a safe and orderly shutdown. Also, the Indian Point Unit 2 Technical Specification 3.1.F has recently been amended to enhance RCS leak detection capability as part of our leak-before-break program.

F. Inspection History

The NDE inspection history at Indian Point 2, as well as all other domestic Westinghouse designed PWR's, has not revealed any service induced degradation in the surge line piping that has been attributed to thermal stratification.

For the stratification issue, the potential effects of excessive displacements have been investigated through a detailed visual observation of the surge line during the walkdown required per Bulletin 88-11 Action Item 1.a. Con Edison personnel performed the walkdown during the current refueling outage. The results of this investigation did not indicate any gross discernable distress or structural damage to the surge line.

Summary of Conclusion From WOG Program

Based on information assembled on surge lines for all domestic Westinghouse PWR's, and evaluation of that information in conjunction with plant-specific and other interim evaluation results, the WOG concludes that:

- o A high degree of confidence exists that further evaluation will confirm that the worst combination has already been evaluated for stratification severity, structural effects, and operating procedures.
- o All plant-specific analyses to date have demonstrated a 40 year life of the surge line. Assuming that further evaluation leads to the same conclusion for the remaining Westinghouse PWR's, the worst case remaining life is approximately 100 heatup-cooldown cycles.
- o Through wall crack propagation is highly unlikely, however "leak-before-break" principles confirm that a safe and orderly shutdown would be achievable if a through wall leak ever developed.
- o NDE inspection histories demonstrate the current integrity of Westinghouse PWR pressurizer surge lines.



- o While additional monitoring, analyses, and surveys of operating procedures are expected to further substantiate the above conclusions, the presently available information on surge line stratification indicates that Westinghouse PWR's may be safely operated while additional data is obtained.

Overall Conclusion

Based on the above discussions, Con Edison believes it is acceptable for Indian Point 2 to continue full power operation for the time period needed to complete a comprehensive stress and fatigue evaluation as required by task item 1.d of the Bulletin.