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New York Power Authority

May 12, 1987
IPN-87-026

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

Subject: Indian Point 3 Nuclear Power Plant
Docket No. 50-286
Criteria for Postulated High Energy Line Break (HELB) Locations - Elimination of Arbitrary Intermediate Breaks

References: 1. Letter to the NRC from Mr. J. C. Brons, dated March 6, 1987, entitled: "Criteria for Postulated High Energy Line Break (HELB) Locations."

Dear Sir:

This letter requests NRC approval to eliminate "arbitrary intermediate breaks" from design considerations for the steam generator blowdown system piping replacement. The Authority intends to replace 2 inch diameter carbon steel steam generator blowdown system piping with 4 inch diameter stainless steel piping during the Cycle 5/6 refueling outage.

Reference 1 informed the NRC of the Authority's intention to define postulated high energy line rupture locations in accordance with Standard Review Plan Section 3.6.2, "Determination of Rupture Locations and Dynamic Effects Associated with the Postulated Rupture of Piping" and Branch Technical Position (BTP) MEB 3-1, "Postulated Rupture Locations in Fluid Systems Piping Inside and Outside Containment." For ASME Section III Class 2 and 3 piping, BTP MEB 3-1 states that breaks should be postulated at the terminal ends and at intermediate locations selected by either a method based on piping discontinuities or a method based on high stress location. Using the high stress method, the postulated intermediate break locations are defined as those locations which, based on piping stress analysis results, exceed the stress and fatigue limits specified in BTP MEB 3-1. However, if no stresses at given locations exceed this specified stress limit, arbitrary intermediate breaks are selected to provide a minimum of two postulated breaks between the terminal ends of the piping system.

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Arbitrary intermediate breaks are often postulated at locations where piping stresses are well below ASME Code allowables and within a few percent of the stress levels at other locations in the system. Such postulation necessitates the installation and maintenance of complicated mitigating devices to afford protection from dynamic pipe rupture effects such as pipe whip or jet impingement. When piping stress levels at these selected break locations are only slightly greater than that at the rest of the system, the installation of mitigating devices does little to enhance overall plant safety. Accordingly, the Authority requests NRC approval to eliminate the arbitrary intermediate breaks from design considerations for the steam generator blowdown system piping replacement. The approval of this request will result in a time and cost savings for the installation of the replacement piping.

The replacement of the steam generator blowdown system piping will begin during the Cycle 5/6 refueling outage which commenced on May 2, 1987. Based on the current outage work schedule, the Authority will initiate the installation of the mitigating devices associated with the arbitrary intermediate breaks on June 15, 1987. Accordingly, the Authority respectfully requests NRC review and approval of the requested elimination of the arbitrary intermediate breaks from the design considerations on or before June 15, 1987.

The Authority discussed the elimination of the design consideration of arbitrary intermediate breaks with the NRC staff during a January 15, 1987 telephone conversation. During this telephone conversation, the NRC provided guidelines, which must be satisfied in order to justify the elimination of arbitrary intermediate breaks. Attachments 1 through 5 to this letter address these guidelines.

Should you or your staff have any questions regarding this matter, please contact Mr. P. Kokolakis of my staff.

Very truly yours,

John C. Brons
Executive Vice President
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cc: See next page

cc: Resident Inspector's Office
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ATTACHMENT 1 to IPN-87- 026

STEAM GENERATOR BLOWDOWN SYSTEM PIPING REPLACEMENT JUSTIFICATION FOR THE ELIMINATION OF ARBITRARY INTERMEDIATE BREAKS

NEW YORK POWER AUTHORITY
INDIAN POINT 3 NUCLEAR POWER PLANT
DOCKET NO. 50-286

Technical justification for the elimination of the arbitrary intermediate pipe breaks required to be postulated in high energy, seismically analyzed piping to comply with Standard Review Plan 3.6.2 is provided below:

1. <u>Operating Experience Does Not Support the Need for the Criteria</u>

   The combined operating history of commercial nuclear plants, both domestic and foreign, has not shown the need to provide protection from the dynamic effects of arbitrary intermediate breaks.

2. <u>System Piping Stresses Are Well Below Code Allowables</u>

   Branch Technical Position MEB 3-1 requires the postulation of intermediate breaks in ASME Section III Class 2 and 3 piping where the stresses are in excess of only 80% of the Code allowables.

   Welded attachments are not located near (approx. 5 pipe diameters) arbitrary intermediate breaks. Therefore, local bending stresses from welded attachments will not affect the stress levels at the arbitrary break locations. However, any arbitrary intermediate break located near welded attachments, such as trunnions or lugs, will not be deleted.

3. <u>Arbitrary Intermediate Breaks Complicate the Design Process</u>

   Since the design of piping systems is generally an iterative process, the locations of the highest stress points usually change several times as the design evolves. The alternate criteria of Standard Review Plan Section 3.6.2 (NUREG 0800) provides little relief from moving arbitrary break locations as the revised break locations must still be evaluated as to their effects on essential equipment and structures.

4. <u>Unanticipated Thermal Expansion Stress</u>

   Unanticipated stresses due to restraint of thermal expansion can be introduced into the piping system if pipe rupture protection devices come into contact with pipes. The potential for this happening is greater than that for a mechanistic failure at an arbitrary break point.

To prevent a consequent decrease in the overall reliability of the pipe system, an additional as-built verification step is involved in the design process for each installed pipe whip restraint. Elimination of arbitrary intermediate breaks would significantly reduce the effort involved in designing and installing pipe rupture protection devices.

5. <u>Improved Inservice Inspection</u>

Pipe whip restraints are normally adjacent to or surrounding the welds at locations where changes in pipe direction occur. Access for inservice inspection will be improved by the elimination of congestion created by these pipe rupture protection devices and the supporting structural framing associated with arbitrary break locations.

6. <u>Substantial Cost Savings</u>

The elimination of pipe whip restraints and jet shields is the primary financial benefit realized by the elimination of the arbitrary intermediate breaks. Plant operation costs will also be reduced through a reduction of manhours needed for inspection and maintenance.

7. <u>Reduction in Radiation Exposure</u>

The elimination of pipe whip restraints and jet shields associated with arbitrary breaks and the large structures necessary to support them will result in more efficient maintenance, inspection and decontamination operations, thus reducing personnel radiation exposure.

8. <u>Improved Operational Efficiency</u>

The elimination of pipe whip restraints associated with arbitrary breaks will eliminate the need for cut back insulation or special insulating assemblies near the close fitting restraints and will reduce the heat load in plant buildings.

9. <u>Proper System Design and Operating Procedures</u>

The Mechanical Engineering Branch, in Branch Technical Position MEB 3-1, recognizes that "...pipe rupture is a rare event which may occur only under unanticipated conditions such as those which might be caused by possible design, construction, or operation errors; unanticipated loads or unanticipated corrosive environments." For Indian Point 3, there are many ways in which those unanticipated conditions may be detected.

The system design, as discussed in Attachment 3, minimizes unanticipated conditions arising from operation errors and also from unanticipated loads, while control of water chemistry and materials used during fabrication, installation, startup testing and operation minimize exposure to potentially corrosive environments, as discussed in Attachment 4.

10. <u>Adequacy of Equipment Qualification</u>

The elimination of arbitrary intermediate breaks will not degrade the environmental qualification levels of safety-related equipment. The break postulation for environmental effects is performed independently of break postulation for pipe whip and jet impingement.

ATTACHMENT 2 to IPN-87-026
STEAM GENERATOR BLOWDOWN RECOVERY SYSTEM
SYSTEM DESCRIPTION AND DESIGN CRITERIA

NEW YORK POWER AUTHORITY
INDIAN POINT 3 NUCLEAR POWER PLANT
DOCKET NO. 50-286

The Indian Point 3 Steam Generator Blowdown System is being upgraded to improve system operation and to recover the process fluid previously sent to waste. When the new steam generator blowdown recovery system (SGBDRS) is installed, the blowdown fluid will be handled as follows: 1) cooled and processed through steam generator blowdown heat exchangers, filters and demineralizers and returned to the condensate system during normal plant operations, 2) routed into the existing blowdown flash tank and sent to waste during plant startup or shutdown, or 3) sent directly to the radwaste system in the event of a steam generator tube rupture. For the portions of the SGBDRS contained in safety-related areas, an upgrade in pipe size and material from 2-inch diameter carbon steel to 4-inch diameter stainless steel will take place.

The installation of the SGBDRS modification will be accomplished in two phases. The majority of the system will be installed during the 1987 refueling outage. The existing 2-inch diameter piping will be retained at the containment penetrations and near the steam generators. The changes to the penetrations and the steam generator connections will be completed during a subsequent outage.

The SGBDRS piping inside containment and from the containment penetrations to the downstream side of the containment isolation valves in the containment piping penetration areas is designated as Seismic Class I. The balance of SGBDRS piping in the containment penetration area is designated as Seismic Class II. Piping outside of safety-related areas is designated as Seismic Class III.

The pipe stress analysis for the new system was performed in accordance with the Equations 11, 12, 13 and 14 of the ANSI B31.1 Code.

The Seismic Class I piping and supports inside containment were analyzed using both, OBE and DBE seismic response spectra. The Class I piping outside the containment penetration is attached to Seismic Class II piping. Both were analyzed together using equivalent static analysis which conforms to the FSAR criteria for Seismic Class I and II piping under 6 inches in diameter. A multi-degree-of-freedom analysis showed that the fundamental frequency for the Class I portion was above the peak acceleration frequency and that the static analysis would yield conservative results for both piping and supports. A review of DBE and OBE stresses has revealed that stresses as a result of the DBE condition are not much larger in magnitude than OBE condition stresses. However, the Code allowable stress limit for DBE loading is 50% greater than that for OBE loading, thus the operating basis earthquake will govern in the design of the piping. Since all of the Seismic Class II piping was designed for OBE, it was therefore designed for the governing condition. Additional data regarding the seismic design criteria may be found in Section 16.1 of the Indian Point 3 FSAR.

The Class III piping is non-seismic but was analyzed seismically as Class II piping where it is connected to seismic equipment in order to determine seismic loads on the nozzles. For the yard piping between the PAB and the turbine building, the system was analayzed additionally for a statically applied 90 mph wind load.

The design, documentation, fabrication and testing of all new blowdown piping will conform to ANSI B31.1. All new blowdown piping is seamless, schedule 80S piping and meets the material requirements of ASTM specification A-312 for TP-316L material.

All Seismic Class I and II piping and welding material are furnished with certified test reports showing heat, chemical and physical test results. All other piping and welding material (i.e., Seismic Class III) are furnished with letters of compliance to the ASTM material specifications.

All full penetration welds in shop-fabricated Seismic Class I and II piping are 100% radiographed. All other welds are liquid penetrant and visually inspected.

The Quality Control System for all Seismic Class I and II piping fabrication, testing and documentation meets the requirements of 10 CFR 50 Appendix B and ANSI N45.2. Additionally, the provisions of 10 CFR 21 apply to these piping materials and services.

Based upon the above design, fabrication, testing and documentation criteria, the Authority believes that the Seismic Class I and II piping in the SGBDRS are virtually identical to ASME Section III, Classes 2 and 3 and as such, should be subjected to the same criteria regarding postulated pipe breaks, including a justification for the elimination of the arbitrary intermediate breaks.

ATTACHMENT 3 to IPN-87-026
TRANSIENT FORCES, WATERHAMMER AND VIBRATIONAL EFFECTS IN THE STEAM GENERATOR BLOWDOWN RECOVERY SYSTEM

NEW YORK POWER AUTHORITY
INDIAN POINT 3 NUCLEAR POWER PLANT
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The new Steam Generator Blowdown Recovery System (SGBDRS) was designed specifically to minimize water hammer or large operating transients. The new system will operate both with the existing steam generators and with the replacement steam generators and both were given consideration in the design.

SGBDRS WITH EXISTING STEAM GENERATORS

The blowdown fluid from the existing steam generators is under conditions very close to saturation. Therefore, flashing is a major concern in the system design. The replacement piping was sized to minimize pressure drop and thus reduce the resultant steam fraction of the two phase flow. The pressure drop in the new 4" diameter piping will be less than 3 percent of that in the old 2" piping. Typical velocities in the new 4" piping range from 1 to 3 feet per second. The piping was routed so that it would slope continuously downward from the steam generator towards the blowdown heat exchanger or flash tank. In fact, the static head gain at the inlet to the blowdown heat exchanger exceeds the frictional pressure drop; thus, aiding in control of flashing and helping to prevent water hammer effects. There will be no thermal fatigue as temperature and pressure stay relatively constant throughout the line and no mixing takes place. To prevent water hammer upon an isolation signal, the minimum stroke time for any of the power operated (i.e., motor operated and air operated) valves is set at nine (9) seconds.

The greatest potential for water hammer in steam generator blowdown systems, occurs when flow is restarted following isolation. For the new Indian Point 3 SGBDRS, electrical interlocks will be provided between the air-operated flow control valves (HCV), motor-operated isolation valve and motor-operated blowdown valve in each blowdown line to open and close these valves in a pre-determined sequence in order to prevent or at least minimize flashing through the valves and thereby avoid the vibration and physical damage caused by flashing water.

Startup and shutdown of the recovery system is accomplished by means of opening and closing the HCV's. Since all of the air-operated and motor-operated valves have stroke times exceeding seven (7) seconds, no steam/water hammer effects are expected.

SGBDRS WITH REPLACEMENT STEAM GENERATORS

The replacement steam generators will be designed to assure that the blowdown fluid at the steam generator exit (i.e. blowdown nozzles) will be 70 psi below the saturation pressure at 1% blowdown flow and 60 psi below the saturation pressure at 3% blowdown flow at full power operation. Based upon these fluid conditions and the new 4 inch piping configuration, it has been calculated that the fluid will remain in the liquid phase even at the maximum design blowdown flow rate of 3%. Also, as previously stated for operation with the existing steam generators, no water/steam hammer effects are expected due to automatic or remote manual operation of the power operated valves, based on their long stroke times and protective interlocks. Additonally, since the Seismic Class I and II portions of the piping system are rigidly supported to withstand the DBE and OBE, they are inherently designed to limit vibration.

Based on the above, the Authority feels that the new Steam Generator Blowdown Recovery System at Indian Point 3 will not be subject to transient, water/steam hammer or vibratory effects that could contribute to pipe breaks. Therefore, no vibration monitoring will be included in the preoperational testing.

ATTACHMENT 4 to IPN-87-026
POTENTIAL FOR STRESS CORROSION CRACKING IN PWR PIPING SYSTEMS

NEW YORK POWER AUTHORITY
INDIAN POINT 3 NUCLEAR POWER PLANT
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The following discussion, based on a literature survey, industry service experience, and fabrication/installation and operational requirements, substantiates our conclusion that stress corrosion cracking of stainless steel and carbon steel in secondary piping systems is an unlikely event for Indian Point 3. This discussion focused primarily on austenitic stainless steel (types 304 and 316) being utilized in the new Steam Generator Blowdown Recovery System.

Carbon steel piping materials are considered immune to stress corrosion cracking basically because their overall corrosion rate in aqueous environments typical of PWR system service is high compared to the stainless steels and copper base alloys. A metal or alloy will be suject to the highly localized form of attack known as stress corrosion cracking only if the overall corrosion rate in the subject environment is low.

In order for stress corrosion to occur, three conditions namely stress, temperature and corrosive environment must occur simultaneously. Of these three, the corrosive environment is considered to be the key parameter since it is the most difficult to control. Stress and temperature are relatively fixed parameters although residual stresses from welding or operation may produce undesirable stress levels. Thus, to prevent stress corrosion cracking in the PWR plant, considerable effort is expended to avoid corrosive environments. This is accomplished by (1) imposing strict material fabrication and installation requirements to avoid the presence of critical levels of contaminants known to cause stress corrosion cracking of stainless steel such as chlorides, fluorides, various forms of sulfur, causitics, and oxygen; and (2) rigid control of operational water chemistry.

Numerous measures are taken during fabrication, installation and operation to prevent the introduction of contaminants into the system such as: (1) assuring that materials coming in contact with stainless steels during fabrication or operation do not contain harmful levels of impurities such as in crayons, insulation, gaskets, and lubricants, (2) cleaning prior to heat treatment and welding, (3) final cleaning and capping prior to shipment to site and (4) use of high quality demineralized water (low chloride, fluorides, and controlled pH) for preoperational flushing and testing.

In addition to the above, other requirements are imposed on material suppliers and component manufacturers to assure the use of optimum practices to control carbide precipitation (sensitization) and exclude cold work which are known to promote stress corrosion cracking. Precise heat treatment practices are required to be used to achieve optimum metallurgical structures capable of resisting stress corrosion cracking. Cold working (bending) after solution annealing is prohibited. Heavy sensitization is avoided by prohibiting stress relieving after welding and controlling of heat input during welding. Water chemistry is carefully monitored during plant operation, to assure compliance with specification requirements. Water chemistry standards for the Steam Generator Blowdown System are provided in Table 1. Oxygen levels for the secondary side are maintained by hydrazine additions.

Except for incidents of inadvertent chloride intrusions, no known stress corrosion failures have been reported in PWR operating plants.

BIBLIOGRAPHY

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WPPSS - WNP-1/4 Intergranular Stress Corrossion Task Force Report - June, 1980

Pacific Northwest Laboratories - Stress Corrosion in Nuclear Systems - September, 1975

NUREG - 0791 - Investigating and Evaluating Cracking Incidents in Pressurized Water Reactors - September, 1980

Private telephone conversations with Westinghouse personnel

Corrosion Engineering - Fontana & Green, 1967

NACE Corrosion Data Survey, 1974.

TABLE 1

INDIAN POINT 3 NUCLEAR POWER PLANT
STEAM GENERATOR BLOWDOWN SYSTEM WATER CHEMISTRY DATA

Parameter	IP-3 Blowdown Quality*	SGOG GUIDELINES
Specific Conductivity, umho/cm	2.0	N/A
Cation Conductivity, umho/cm	0.2	<0.8
Sodium, ppb	<5.0	<20
Sulfate, ppb	<1.0	<20
Chloride, ppb	<5.0	<20
Silica, ppb	<300	<300
Ammonia, ppb	<200	N/A
Oxygen, ppb	<5	N/A
pH	8.65	8.5-9.0 @ 8.8-9.5 @@

Oxygen control agent: Hydrazine
pH control agent: Ammonia

* Based upon average daily samples taken during early December, 1986.
@ Range is for operation prior to replacement of feedwater heaters.

@@ Range is for operation after replacement of feedwater heaters.

ATTACHMENT 5 to IPN-87-026
INTERMEDIATE BREAKS TO BE ELIMINATED
STEAM GENERATOR BLOWDOWN RECOVERY SYSTEM

NEW YORK POWER AUTHORITY
INDIAN POINT 3 NUCLEAR POWER PLANT
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LOCATION	PIPE SIZE	NUMBER OF BREAKS ELIMINATED	EST. NO. OF DEVICES ELIMINATED	
			WHIP RESTRAINTS	JET SHIELDS
Inside Containment	2"	7	0	0
	4"	5	0	0
Outside Containment (Pipe Penetration Area)	4"	6	4	4
TOTALS:		18	4	4