PSNH

Public Service of New Hampshire

New Hampshire Yankee Division

SEABROOK STATION
Engineering Office

February 19, 1985

SBN-764
T.F. B7.1.2

United States Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. George W. Knighton, Chief
Licensing Branch No. 3
Division of Licensing

References: (a) Construction Permits CPPR-135 and CPPR-136, Docket Nos. 50-443 and 50-444
(b) PSNH Letter SBN-761, dated February 7, 1985, "Elimination of Arbitrary Intermediate Pipe Breaks", J. DeVincentis to G. W. Knighton

Subject: Elimination of Arbitrary Intermediate Pipe Breaks; Re-Transmittal of Attachment D, Potential for Stress Corrosion Cracking

Dear Sir:

We previously submitted a request for "Elimination of Arbitrary Intermediate Pipe Breaks" [Reference (b)]. Enclosure D of our request evaluated the "Potential for Stress Corrosion Cracking in PWR Piping Systems".

Enclosure D, in its entirety, is being re-transmitted with this letter as several words were inadvertently omitted.

Very truly yours,

John DeVincentis

John DeVincentis, Director
Engineering and Licensing

Enclosure

cc: Atomic Safety and Licensing Board Service List

B001
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ENCLOSURE D

SEABROOK STATION

POTENTIAL FOR STRESS CORROSION CRACKING IN PWR PIPING SYSTEMS

The following review, encompassing a literature survey, service experience, and fabrication/installation and operational requirements, provides convincing proof that stress corrosion cracking of stainless steel and carbon steel in primary and secondary pressure boundary piping systems is an unlikely event for the Seabrook Station. This review focused primarily on austentic stainless steel (Types 304 and 316).

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 subject 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 cracking to occur, three conditions involving 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 of the pressure boundary in the PWR plant, considerable effort is expended to avoid susceptible corrosive environments. This is accomplished by (1) imposing strict material and fabrication/installation requirements to avoid the presence of critical levels of containments known to cause stress corrosion cracking of stainless steel such as chlorides, fluorides, various forms of sulphur, caustics, and oxygen; and (2) rigid control of water chemistry.

Numerous measures are taken to prevent the introduction of contaminants into the system such as (1) assuring that materials coming in contact wi[illegible] stainless, 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; (4) use of high quality water (low chloride, fluorides, and controlled pH) for pre-operational flushing and testing; and (5) final cleaning of O.D. surfaces followed by chloride and fluoride checks prior to pre-operational 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 cold work which are known to promote stress corrosion cracking. Precise heat treatment practices are required to be used to promote optimum metallurgical structures for resisting stress corrosion cracking. Procedures are reviewed to assure the use of effective, but safe cleaning solutions. Cold work (bending) after solution annealing is prohibited except for small diameter pipe. Heavy sensitization is avoided by prohibiting stress relieving after welding and control of heat input during welding. During plant operation, primary and secondary water chemistry is carefully monitored to assure compliance with specification requirements shown in Table 1. Note in particular that oxygen levels are maintained for the primary side by a combination of hydrogen and hydrazine and for the secondary side by hydrazine additions.

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

REFERENCES

1. Pacific Northwest Laboratories Report - Stress Corrosion in Nuclear Systems - March 1973
2. WPPSS - WNP-1/4 Intergranular Stress Corrosion Task Force Report - June 1980
3. Pacific Northwest Laboratories - Stress Corrosion in Nuclear Systems - September 1975
4. NUREG-0791 - Investigating and Evaluating Cracking Incidents in Pressurized Water Reactor - September 1980
5. Private telephone conversations with W personnel
6. Corrosion Engineering - Fontana & Green - 1967
7. NACE Corrosion Data Survey - 1974

SEABROOK STATION

WATER CHEMISTRY SPECIFICATIONS FOR LINES CONTAINING ARBITRARY BREAKS

SYSTEM	NO. OF ARBITRARY BREAKS	ASME CLASS	PIPE MAT'L	OPERATING TEMP. (^{o}f)	HYDROGEN CONCEN. (cc/kg H_2O)	MAX. OXYGEN (ppm)	MAX. CHLORIDES & FLUORIDES (ppm)	pH (@ 25^{o}C)	pH CONTROL AGENT	O_2 CONTROL AGENT
REACTOR COOLANT	8	1	SS	557	25-50	0.005	0.15	4.2-10	Lith. Hydrox.	H_2 + Hydr.
SAFETY INJECTION	9	1	SS	557	25-50	0.005	0.15	4.2-10	Lith. Hydrox.	H_2 + Hydr.
CHEM. & VOLUME CONTROL	8	1&2	SS	557	25-50	0.10	0.10	6.0-8.0	Lith. Hydrox.	H_2 + Hydr.
CHEM. & VOLUME CONTROL	8	2	SS	490	-	0.10	0.10	6.0-8.0	Lith. Hydrox.	H_2 + Hydr.
CHEM. & VOLUME CONTROL	38	2	SS	120	25-50	0.10	0.10	6.0-8.0	Lith. Hydrox.	H_2 + Hydr.
STEAM GENERATOR BLOWDOWN	35	2	CS	557	-	-	-	8.5-9.2	Morpholine	Hydrazine
MAIN STEAM (PRIMARY LINES)	8	2	CS	557	-	0.005	-	8.8-9.2	Morpholine	Hydrazine
MAIN STEAM TO AUX. EQUIP.	2	2	CS	557	-	0.005	-	8.8-9.2	Morpholine	Hydrazine