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SUBJECT: Forwards response to NRC Bulletin 88-009, "Thimble Thinning in Westinghouse Reactors."

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November 7, 1988

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Gentlemen:

Docket 50-305
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Response To NRC Bulletin 88-09

NRC Bulletin No. 88-09 entitled "Thimble Tube Thinning in Westinghouse Reactors" was transmitted to Wisconsin Public Service Corporation (WPSC) by letter dated July 26, 1988. By attachment to this letter WPSC provides our response to the aforementioned bulletin.

If you have any further questions regarding this response please contact me or a member of my staff.

Sincerely,

D. C. Hintz
Vice President - Power Production

DCL/jms

Attach.

cc - Mr. Robert Nelson, US NRC
US NRC, Region III

Subscribed and Sworn to
Before Me This 7th Day
of November 1988

Joanne M. Stevic
Notary Public, State of Wisconsin

My Commission Expires:
June 23, 1991

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N311.2

Attachment

To

Letter from D. C. Hintz (WPSC) to Document Control Desk (NRC)

Dated

November 7, 1988

N311.3

Response to NRC Bulletin 88-09

"Thimble Tube Thinning in Westinghouse Reactors"

Bulletin 88-09 requests that Wisconsin Public Service Corporation (WPSC) establish a program to monitor thimble tube performance. This program is to include:

- Thimble tube wear acceptance criteria with technical justification,
- An appropriate inspection frequency with technical justification,
- An inspection methodology that is capable of adequately detecting wear of the thimble tubes.

The staff at the Kewaunee Nuclear Power Plant (KNPP) has been monitoring thimble performance since the March 1985 refueling outage. While a formal procedure based program does not exist, the actions that have been taken, as summarized below, address the criteria described in Bulletin 88-09.

During the 1985 refueling outage a qualified Nondestructive Examination (NDE) vendor with a 10CFR50 Appendix B QA program was contracted to perform an eddy current inspection of all 36 thimble tubes. This inspection was done in response to wall thinning problems identified at other Westinghouse reactors. The eddy current inspection results showed that thinning was occurring at the lower core plate, and to a much lesser degree, at the diffuser plate and core support forging. The average wall loss at the core plate identified during this inspection was 41%.

During the 1987 refueling outage the same vendor was contracted to re-inspect the thimble tubes using eddy current methodology. This inspection showed an average wall loss of 52% at the lower core plate. See Table 1 for a summary of the 1985 and 1987 examination results.

Due to the extent of the wall loss identified during the 1987 eddy current inspection and recurring unrelated thimble tube blockage problems, WPSC decided to replace all 36 thimble tubes. This replacement was performed during the 1988 refueling outage. The new thimble tubes are slightly larger than the original tubes in both outside diameter (.313 vs .301 inches) and wall thickness (.051 vs .049 inches). A baseline eddy current inspection on the new thimble tubes was also performed during this outage. The data obtained will be used to provide more accurate wall loss determinations during future inspections.

The above actions demonstrate that WPSC has been aggressive in thimble tube monitoring and has already taken conservative corrective action when necessary (i.e. thimble tube replacement).

Future plans for monitoring thimble tube performance include eddy current inspections in 1993 and, contingent on the 1993 inspection results, in 1998. A five year inspection frequency is justified based upon inspection results from the original thimbles (41% average wall loss following 11 years of service, 52% average wall loss following 13 years of service). The examination frequency after 1998 will be dependent on the results of the previous two tests.

Eddy current inspection has been chosen to monitor the thimble tubes as it is accepted by the industry as the most cost effective and accurate means of deter-

mining the extent of the thimble tube degradation. By using a mix-phase angle to eliminate interferences from core structures and the baseline data obtained in 1988 an accurate wall loss determination is possible.

An acceptance criteria of 60% maximum wall loss was established based on the following relationship*:

$$P = [2E/(1- \lambda^2)] (t/D)^3$$

Where P = critical value of external pressure = 2485 psig
(Reactor Coolant System Design Pressure)

E = Modulus of elasticity = 29×10^6 psi
(Metals Handbook, Vol. 1, 8th Edition, American Society for Metals)

λ = Poissons Ratio = .29
(Reactor Handbook, Vol. 1, Materials, Tipton)

D = Thimble Tube Outer Oiameter = .313 in.

t = Critical Thimble Tube Wall Thickness

* - Piping Handbook 5th Edition, Crocker

Using the values shown above and solving the relationship for t, a critical wall thickness of .011 in. was determined. This corresponds to 22% of the nominal thimble tube wall thickness of .051 in. or a 78% wall loss. For added conservatism and to account for any unexpected inspection inaccuracies an acceptance criteria of 60% was chosen. If a thimble tube is found to have a 60% wall loss as determined by the mix-phase angle results of an eddy current inspection, corrective action will be necessary. This action may include, but is not limited to, isolating the thimble via the installed valve, axially relocating the thimble to move the wear scar away from the contact area, or replacement of the thimble.

This inspection frequency and acceptance criteria will be documented in the Recommended Actions for the Operational Experience Assessment (OEA) associated with NRC Bulletin 88-09. It will also be added to the WPSC Commitment Tracking Program. These actions will assure monitoring of the thimble tubes at the frequency discussed above, and corrective actions.

In summary, KNPP does not have a formal proceduralized program for monitoring thimble tube performance. However, an effective monitoring program is evidenced by the actions taken over the last three years. These actions in conjunction with the inspections scheduled for the replacement thimbles address the criteria described in NRC Bulletin 88-09. Timely completion of future inspections is ensured through our existing OEA and Commitment Tracking programs. Additionally, WPSC is participating in the Westinghouse Owners Group project to develop an appropriate thimble tube inspection acceptance criteria.

Table 1

Thimble	% Wall Loss* 1985	1987
G6	43	49
I5	20	31
M7	44	55
G9	29	47
C8	41	78
J10	44	50
E6**	92	68
G2	41	***
B6	54	67
D7	26	31
G13	51	57
I7	55	55
E2	24	36
E10	35	53
L4	50	61
L9	54	58
H10	47	53
K7	46	57
C11	52	55
G4	20	62
H8	44	48
D5	20	25
J3	49	54
J12	48	58
F12	26	50
H1	24	45
G11	45	51
C3	47	57
H3	41	56
K4	40	47
F8	45	48
C9	53	57
J8	40	45
A8	50	57
I11	47	57
F5	29	45
Average	40.7	52.1

* Wall loss at the lower core plate determined from Mix-Phase Angle results of Eddy Current Inspection.

** Results of 1985 inspection questionable due to distorted signals (not included in average).

*** Blocked thimble.