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402/636-2000

May 11, 1992
LIC-92-168S

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Station P1-137
Washington, DC 20555

References: 1. Docket No. 50-285
2. NRC Regulatory Guide 1.35, "Inservice Inspection of Prestressed Concrete Containments", Revision 3, dated July 1990
3. Letter from OPPD (W. G. Gates) to NRC (Document Control Desk) dated February 11, 1992 (LIC-92-048S)

Gentlemen:

SUBJECT: Special Report on the Containment Tendon Prestressing System, Excessive Grease Voids Found in Dome and Helical Wall Tendons

Pursuant to Fort Calhoun Station (FCS) Technical Specification (TS) Surveillance Requirement 3.5(7) "Prestressing System", and as committed in Reference 3, Omaha Public Power District (OPPD) is submitting this special report on excessive grease voids found in the containment dome and helical wall tendons.

FCS Technical Specification Surveillance Requirement Acceptance Criteria 3.5(7)f.(v)(f) states: *"The difference between the amount of grease injected into a tendon to replace the amount which was removed during inspection shall not exceed 5% of the net tendon sheath (duct) volume when injected at the original installation pressure."* TS 3.5(7)g requires an immediate investigation to determine the causes and extent of any nonconformance with the acceptance criteria and also requires the results to be reported to the Commission within 90 days via a special report in accordance with TS 5.9.3.

As described in Reference 3, the nineteenth year Prestressing System Surveillance (PSS) was performed on the helical wall tendons of the FCS Containment Building from October 18, 1991 through November 13, 1991 by Precision Surveillance Corporation (PSC). From January 22, 1992 through February 13, 1992, the dome tendon portion of the nineteenth year PSS was performed on the FCS Containment Building by PSC. In accordance with commitments made in Reference 3, additional grease void measurements were performed during the dome tendon PSS. These additional tests included: grease void measurements on tendons passing near vents and high temperature lines and a surveillance (including a liftoff test and wire removal) on a dome tendon which had lost grease through its main grease seal.

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During the dome tendon phase of the nineteenth year PSS, twenty tendons were inspected and measured for grease voids. The measurement results are summarized in Attachment 1. These twenty tendons included: four randomly selected surveillance tendons, ten dome tendons with evidence of grease seal failure and an additional six helical wall tendons selected specifically to investigate the extent of grease voids as reported in Reference 3. Grease voids greater than 5% net duct volume were found on six dome tendons and five helical wall tendons. This is reportable per FCS TS Surveillance Requirement Acceptance Criteria 3.5(7)f.(v)(f) and NRC Regulatory Guide 1.35, Revision 3 (Reference 2).

As described in Reference 3, tendons filled with Visconorust 2090-P filler grease can experience voids of up to 15% (net) due to original installation practices. As a result, the American Society of Mechanical Engineers (ASME) Section XI IWL Work Group Committee adopted acceptable grease void limits of 10% for passively refilled tendons and 15% for tendons refilled with pressurized grease. Seven of the eleven tendons with net grease voids greater than 5% (D114N, D120P, D214N, D229N, H1105, H2005, H3106) are acceptable under the IWL limits. As discussed below, four of the eleven tendons with net grease voids greater than 5% (D318P, D218N, H1078, and H2015) failed to meet the IWL limits.

Main grease seal failures were found on eight of the ten dome tendons suspected of grease seal failure. The remaining two were determined to have leaking washer gaskets. Four of the dome tendons with main grease seal failures had grease voids less than 5%; two had grease voids less than 15%; D318P had a grease void of 35.7% and D218N had a grease void of 36.0%. Liftoff tests performed on tendons D318P and D218N found that both met the respective acceptance criteria and no abnormal deterioration was discovered.

Light corrosion was found on the anchor head of tendon D318P, which most likely was caused by contaminants introduced during one of the surveillances conducted in 1974. Tendon D318P was detensioned for inspection twice in 1974, and had a wire removed during the second surveillance. Although approximately 20 gallons of grease was unaccounted for, tendon D318P's anchorage was well coated with grease because it is below the main grease seal. Tendon D318P was refilled with grease and accepted "as is."

Light corrosion was also found on the shim of tendon D218N's anchorage, most likely due to failure of its main grease seal. Tendon D218N has never been opened for inspection prior to this surveillance. Tendon D218N was detensioned to allow removal of a sample wire for tensile testing. A small spot of rust suspected to have been caused by contamination introduced during construction was found on the sample wire. The sample wire passed the tensile test. Tendon D218N was refilled with grease and accepted "as is."

To investigate the anti-corrosion effectiveness of thin films of grease, OPPD committed (Reference 3) to test a dome tendon that had lost a significant amount of grease. The surveillance testing of dome tendon D218N fulfills this commitment. The results show that enough grease adheres to the tendon wires to protect them from corrosion even when large grease voids occur. Following completion of surveillance testing, all ten dome tendons which had failed main grease seals or leaking washer gaskets were repaired and refilled with grease.

Helical wall tendons H1078 and H2015 were tested for grease voids as part of the investigation into the effect that the ungrouted concrete vents have on nearby tendons. These vents are in containment wall pour CW-10 and were used to construct containment wall pour CW-9A over the Personnel Airlock.

Tendon H1078, which had a measured grease void of 15.7%, passes adjacent to the concrete vent located near the east wall of Room 69. Since tendon H1078 was both pressure filled and passive filled, a measured grease void of 15% could be expected due to installation practices. A consistent slow leakage of grease from this vent is known to have occurred although the volume that has leaked out is not documented. Tendon H1078 will be reinspected for grease voids again during the next tendon surveillance currently scheduled for 1996.

Tendon H2015 had a measured grease void of 29%. Since tendon H2015 was passive filled, a measured grease void of 10% could be expected due to installation practices. Tendon H2015 passes adjacent to the concrete vent in Room 71 (discussed in detail in Reference 3). Except for this concrete vent, no other visible leakage location could be found along the path of tendon H2015. Tendon H2015 will be included in the 1996 tendon surveillance for liftoff testing and detensioning for wire removal.

In Reference 3, helical wall tendons H3105, H1087, and H4009 were reported to have net grease voids in excess of the IWL acceptance limits. To measure the extent of the problem, OPPD committed to perform grease void tests on several other tendons which pass near high temperature lines and the concrete vents.

Grease void tests on tendons H1105 and H3106, which are parallel to tendon H3105, showed grease voids of 8.0% and 8.5% respectively. In November 1991, a grease void of 8.5% (Reference 3) was measured on tendon H3104, which is also parallel to tendon H3105. All three tendon (H1105, H3104 and H3106) grease void measurements are within the 10% IWL acceptance limit. Therefore, the grease void measurement on tendon H3105 is considered to be an isolated case.

Because the grease void measurements (Reference 3) on tendons H1087 and H4009 were outside of the IWL acceptance limits, additional grease void measurements were performed on tendons H1078, H1082, H2005 and H2015. Grease void measurements on tendons H1082 and H2005 were within the IWL acceptance limits while measurements on tendons H1078 and H2015 exceeded the IWL acceptance limits. As a result, additional tendons with grease voids exceeding 15% are suspected among the one hundred tendons passing through the area of the Personnel Airlock.

To continue the investigation, the following actions will be included in the scope of the 1996 tendon surveillance:

- Tendon H1078 will be inspected for grease voids.
- Liftoff testing and removal of a sample wire for tensile testing will be conducted on tendon H2015.
- Grease void inspections will be conducted on a sample of ten of the tendons passing through the area between containment pours CW-10 and CW-9A. The sample will be taken from the remaining eighty-six tendons passing through this area that were not tested during the nineteenth year PSS.

In conclusion, four tendons were found during the dome tendon surveillance to exceed the IWL acceptance criteria. For these four tendons, the source of the leakage has been determined or additional actions are planned for the 1996 surveillance. As noted above, repairs have been completed on the ten dome tendons found to have a main grease seal failure or a leaking washer. Investigations of tendons with grease voids in excess of IWL acceptance criteria have shown that thin films of grease are effective in preventing excessive corrosion, thus assuring the mechanical integrity of the tendon. During the nineteenth year PSS, no abnormal deterioration of the containment tendons was detected. Therefore, OPPD is confident in the ability of the containment structure to continue to perform its safety related function.

If you should have any questions, please contact me.

Sincerely,

W. G. Gates

W. G. Gates
Division Manager
Nuclear Operations

WGG/sel

Attachment

c: LeBoeuf, Lamb, Leiby & MacRae
R. D. Martin, NRC Regional Administrator, Region IV
D. L. Wigginton, NRC Senior Project Manager
S. D. Bloom, NRC Project Engineer
R. P. Mullikin, NRC Senior Resident Inspector
R. D. Hough, President, Precision Surveillance Corporation

Attachment 1
to LIC-92-168S

Grease Void Measurements

Tendon	Tendon Net Duct Volume Gallons	Grease Loss Gallons Top	Grease Loss Gallons Bottom	Refill Gallons Top	Refill Gallons Bottom	Net Gallons	Void Percent	Grease Refill Method
				Dome Tendons				
D114N*	56.97	0.0	1.0	2.0	4.5	5.5	9.7%	Pressurized
D118N*	55.98	1.0	0.0	3.0	0.0	2.0	3.6%	Pressurized
D119P	54.94	1.8	1.3	2.8	2.0	1.8	3.2%	Pressurized
D120P	54.09	1.0	1.0	2.3	2.5	2.8	5.1%	Pressurized
D214N	58.33	0.0	1.0	7.0	0.0	6.0	10.3%	Pressurized
D216N	57.62	0.0	0.0	0.0	0.8	0.8	1.3%	Pressurized
D216P*	57.51	0.0	1.0	3.0	0.0	2.0	3.5%	Pressurized
D218N*	56.18	1.3	1.3	20.8	2.0	20.3	36.0%	Pressurized
D229N*	46.69	1.0	0.0	7.0	0.0	6.0	12.9%	Pressurized
D235P*	38.69	0.0	1.0	0.0	1.8	0.8	1.9%	Pressurized
D301P	62.78	2.3	1.3	3.0	2.0	1.5	2.4%	Pressurized
D318P*	57.76	0.0	2.8	0.0	23.4	20.6	35.7%	Pressurized
D330N*	46.18	1.0	0.0	3.0	0.0	2.0	4.3%	Pressurized
				Helical Tendons				
H1078	84.47	0.0	0.0	5.3	8.0	13.3	15.7%	Pressurized/Passive
H1082	82.97	0.0	0.0	2.8	0.0	2.8	3.3%	Passive
H1105	84.23	0.0	0.0	6.8	0.0	6.8	8.0%	Passive
H2005	82.69	0.0	0.0	5.3	0.0	5.3	6.4%	Passive
H2015	82.76	0.0	0.0	22.8	1.3	24.0	29.0%	Passive
H3106	82.15	0.0	0.0	6.5	0.5	7.0	8.5%	Pressurized/Passive
H4104	82.00	1.0	0.0	4.8	0.0	3.8	4.6%	Passive

* Main grease seal failure