Omaha Public Power District
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402/636-2000

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LIC-92-048S

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

References: 1. Docket No. 50-285
2. Letter from NRC (L. J. Callan) to OPPD (K. J. Morris) dated September 23, 1988 (IER 88-28)
3. Letter from NRC (L. J. Callan) to OPPD (K. J. Morris) dated December 5, 1988 (IER 88-39)
4. NRC Regulatory Guide 1.35, "Inservice Inspection of Prestressed Concrete Containments", Revision 3, dated July, 1990
5. Letter from NRC (W. C. Walker) to OPPD dated September 26, 1991 "Containment Tendon Meeting Summary" (TAC No. M80908)

Gentlemen:

Subject: Special Report on the Prestressing System - Excessive Grease Voids Found in the Helical Wall Tendons

The Omaha Public Power District (OPPD), holder of Operating License DPR-40, submits this special report pursuant to the requirements of the Fort Calhoun Station (FCS) Unit No. 1, Technical Specification (TS) Surveillance Requirement 3.5(7), "Prestressing System". This report provides an interim status of actions taken in response to the results of surveillances conducted under this requirement.

The FCS TS Surveillance Requirement Acceptance Criteria 3.5(7)f.(v)(f) states that, "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 non-conformance with the acceptance criteria, and it requires the results to be reported to the Commission within 90 days via a special report in accordance with TS 5.9.3.

From October 18, 1991 through November 13, 1991, the nineteenth year Prestressing System Surveillance was performed on the helical wall tendons of the FCS Containment Building by Precision Surveillance Corporation (PSC). Grease was added to 21 tendons and then grease void measurements were performed on these 21 tendons. Grease void measurements on eight of the 21 tendons indicated greater than 5% net duct void which is reportable pursuant to Technical Specification 3.5(7)f.(v)(f). Results of the grease void measurements are presented in Attachment 1.

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Reference 4, which is the basis for TS 3.5(7)f.(v)(f), requires reporting of measured grease voids in excess of 5% net duct volume, however, industry experience shows greater voids can be expected due to installation practices. According to PSC, a review of research completed by Inryco in 1984 and 1985 found that there are three original installation factors which can lead to grease voids. These installation factors are:

1. The coefficient of expansion of the grease which is injected at temperatures ranging from 120°F to 220°F.

2. Inadequate tendon bundle soak time (the void between the wires requires time to absorb grease.

3. Air entrapment.

Under original installation practice for Visconorust 2090-P filler grease, shrink back due to cooling could cause voids up to 6%; inadequate tendon bundle soak time could cause voids up to 7%; and air entrapment could cause voids up to 2%. Therefore, a total of up to 15% net grease void could be expected. According to PCS these observations have been consistent from site to site.

The PSC participant on the American Society of Mechanical Engineers (ASME) Section XI IWL Work Group Committee presented this research to the Committee in November, 1991. As a result, the Committee adopted with the NRC participant's concurrence, acceptable void limits of 10% for tendons which are passively refilled and 15% for tendons which are refilled with pressurized grease. Five of the eight OPPD tendons with greater than 5% net grease void are considered acceptable under these criteria. Tendons 1087, 3105 and 4009, which failed to meet the Criteria of ASME Subsection IWL, "Requirement of Class CC Concrete Components of Light-Water Cooled Power Plants", are discussed below.

Tendon 1087, which had a measured grease void of 17.8%, passes adjacent to one of the vents which leaks grease into Room 71. The volume of grease which may have leaked out of the vent is estimated at 1 to 2 cups of grease each year. In the 19 years since tendon installation, approximately another 1.8 gallons would have leaked out if 12 ounces of grease leakage per year is assumed. The volume of the vent is about 0.9 gallons. Since tendon 1087 was both pressure filled and passive-filled, a measured grease void of 15% could be expected due to installation practices. Therefore, with 2.7 gallons leaking into and out of the concrete vent, the remaining unaccounted void is less than 15%.

Although tendon 4009 passes through the repoured area, it does not pass near a vent. Row 4000 tendons are the closest to the Containment liner, and the vents penetrate through the 1000 and 2000 rows. Also, the sheath for tendon 4009 does not pass close to any known vents. The measured void is only 1.6 percent greater than what may be expected from construction practice, which amounts to 1.34 gallons. Except for possible minor grease dripping from the Stressing Gallery grease cap (which has been observed from many tendons), no observable leak path exists for tendon 4009.

The net grease void in tendon 3105 was measured by passive fill at 11.1 gallons or 13.5 percent of net duct volume. Based on the information cited above, up to 10% net grease void could be expected from construction practices, therefore, at least 2.9 gallons has leaked out. Only a grease film was discovered on the top anchorage when the top grease can was removed, where other tendons had at least a gallon of grease coating their top anchorages. While inspecting the containment along the path of tendon 3105, grease filled paint blisters were discovered in the Upper Electrical Penetration Room at 1023' 10". This area is immediately underneath the penetrations of the Main Feedwater and Main Steam lines. Tendon 3105 passes adjacent to penetration M-[illegible] a Main Feedwater line. During operation, the temperature in the tendon duct near the Main Feedwater and Main Steam line penetrations exceeds the melting point of the originally installed Visconorust 2090-P filler grease, thus, pressurizing the grease causing it to flow wherever it can find a path.

Tendons 1087, 3105 and 4009 will be inspected for grease voids during the next tendon surveillance which is currently scheduled for 1996. Several tendons in the vicinity of vents and high temperature lines are currently being inspected for grease voids as part of the surveillance being performed by PSC on the dome tendons. In addition, a lift-off test and wire removal on one of the dome tendons, which has lost a significant amount of filler grease, will be performed by PSC, as discussed in the meeting between OPPD and NRR on September 13, 1991 (Reference 5). Tests results will demonstrate the anti-corrosion effectiveness of thin films of grease. Since no grease voids, in excess of the IWL acceptance criteria discussed above were identified in tendons 2121, 3075, 3087, 3091 and 3104, OPPD has no additional actions presently planned regarding inspecting these tendons.

OPPD will submit a supplement to this special report within ninety days, discussing the results of the ongoing tendon investigations.

If you should have any questions, please contact me.

Sincerely,

W. G. Gates

W. G. Gates
Division Manager
Nuclear Operations

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Attachment

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

Attachment 1

Grease Void Measurements

Tendon	Tendon Net Duct Volume Gallons	Grease Loss Gallons Top	Grease Loss Gallons Bottom	Refill Gallons Top	Refill Gallons Bottom	Net Void Gallons	Net Void Percent	Grease Refill Method
1018	83.05	3.0	3.5	8.5	0.0	2.0	2.4%	Passive
1046	83.02	1.5	4.0	2.0	1.0	-2.5	-3.0%	Pressurized/Passive
1058	83.02	1.3	3.0	5.8	0.0	1.5	1.8%	Passive
2029	84.59	3.0	40.0	5.8	37.8	0.5	0.6%	Pressurized/Passive
2121	84.74	2.0	21.0	8.0	23.8	8.8	10.3%	Pressurized/Passive
2145	83.70	2.5	7.3	13.5	0.0	3.8	4.5%	Passive
3008	82.31	1.0	18.0	20.0	0.0	1.0	1.2%	Passive
3105	82.50	0.0	23.5	34.6	0.0	11.1	13.5%	Passive
3104	82.34	1.0	0.0	8.0	0.0	7.0	8.5%	Passive
4141	81.90	3.0	30.5	31.0	2.0	-0.5	-0.6%	Pressurized/Passive
4154	82.25	2.0	16.5	21.8	0.0	3.3	4.0%	Passive
1083	82.96	0.0	0.0	3.0	0.0	3.0	3.6%	Passive
1087	82.98	0.0	0.0	6.0	8.8	14.8	17.8%	Pressurized/Passive
1092	83.29	0.0	0.0	2.0	0.0	2.0	2.4%	Passive
2010	84.65	0.0	0.0	2.0	0.0	2.0	2.4%	Passive
3075	82.31	0.0	0.0	6.0	0.0	6.0	7.3%	Passive
3079	82.40	0.0	0.0	4.0	0.0	4.0	4.9%	Passive
3087	82.38	0.0	0.0	7.0	0.0	7.0	8.5%	Passive
3091	82.40	0.0	0.0	5.0	0.0	5.0	6.1%	Passive
4009	83.98	0.0	0.0	9.8	0.0	9.8	11.6%	Passive
4012	81.97	0.0	0.0	2.3	0.0	2.3	2.7%	Passive