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Callaway Plant

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Gentlemen:

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CALLAWAY PLANT UNIT 1
FACILITY OPERATING LICENSE NPF-30
SPECIAL REPORT 89-10
5TH YEAR INSERVICE CONTAINMENT
VESSEL TENDON SURVEILLANCE FAILURE

The enclosed Special Report is an engineering evaluation submitted to satisfy Technical Specification action statement 3.6.1.6(b) regarding sheathing filler grease voids in excess of 5% noted during the 5.5 year containment vessel tendon surveillance. Since compliance with all remaining surveillance requirements for Technical Specification 3.6.1.6 was demonstrated, it is concluded that voids in excess of 5% of the net duct volume have not resulted in any degradation of the post-tensioning system, thus assuring the structural integrity of the containment vessel.

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Enclosure

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EVALUATION OF THE FIFTH YEAR INSERVICE TENDON SURVEILLANCE FOR THE CALLAWAY NUCLEAR PLANT

The Callaway Plant Technical Specification 4.6.1.6.1 requires the demonstration of containment vessel structural integrity through a surveillance of the containment post-tensioning system at the end of 1.5, 3.5 and 5.5 years following the initial structural integrity test, and at 5 year intervals thereafter. The 5.5 year surveillance of the system began on July 17, 1989. On August 10, 1989, it was discovered that the net refill volume of the sheathing filler grease exceeded 5% of the net duct volume for tendons (see Attachment 1, Tendon Greasing Summary). This void condition failed to meet Tech. Spec. 4.6.1.6.1(d)(2) which requires verification of operability of the sheathing filler material, by assuring the "amount of grease replaced does not exceed 5% of the net duct volume, when injected at ±10% of the specified installation pressure." Since a void greater than 5% was discovered after filling, restoration of the tendon sheathing filler grease, specification action statement 3.5.1.6(b), was immediately satisfied with the exception of the Special Report. The NRC staff concurred with this position in a meeting on the same subject for the first year surveillance on July 19, 1985.

The Callaway containment vessel is a post-tensioned, reinforced concrete structure comprised of a vertical cylinder with a hemispherical dome roof and is supported by a reinforced concrete slab. A continuous access gallery is provided beneath the foundation slab for inspection of the vertical tendons. Three concrete buttresses are provided for anchorage of the horizontal tendons. Anchorages are designed such that the tendons can be detensioned, inspected and retensioned readily during the life of the plant. The vertical cylinder wall is provided with a system of vertical and horizontal (hoop)

tendons. Vertical tendons are continuous to form inverted U's that extend over the dome. The configuration of the tendons in the dome is based on a three-way system consisting of two groups of vertical tendons oriented at 90 degrees with respect to each other and a horizontal (hoop) group extending from the spring line to approximately 45 degrees from the horizontal. Hoop tendons in both the wall and the dome are placed in a 240 degree system in which three tendons form two completed rings using three buttresses for anchoring the tendons. Each tendon is comprised of 170 - 1/4" wires, terminating at each end with a cold formed buttonhead at the anchorage fixture.

The essential criterion for the operability of the sheathing filler material is to prevent corrosion of both the tendon wires and the anchorage components. The material used in the Callaway Plant post-tensioning system, Visconorust 2090P-4, accomplishes this by a characteristic which gives the filler grease an affinity to adhere to steel surfaces, an ability to emulsify any moisture in the system which nullifies its rusting tendency, and resistance to moisture, mild acids and alkalis. In addition, protection is afforded by each tendon wire being individually pre-coated with a grease, Amber 1601, prior to installation.

Results from the first and third year tendon surveillances revealed voids in excess of 5% for all tendons surveyed, without a loss of integrity to the system. From lab test on the removed wires and grease, and from visual inspections of the tendon components, the filler grease is performing its intended function of prohibiting corrosion of the tendon.

The void in the tendon sheathing, as indicated by the refill volume and varied from 6.83% to 19.23% (see Attachment 1),

may be attributed to a number of factors:

1) Visconorust 2090P-4 has a coefficient of expansion which yields an expansion of about 1% per every 20°F. Initial filling temperatures of the filler grease averaged 160°F. Cold weather conditions can cool the filler material to 40°F, giving a contraction of 6% of the net duct volume. During the fifth year inservice surveillance of the tendons, the temperature of insitu filler grease average 90°F, giving a contraction of 3 to 4% from initial fill.

2) Characteristics of the initial filling method may induce air entrapment into the filler grease. Pumping operations can introduce air into filler material and may add up to as much as 2% of the net duct volume. The tendons at Callaway Plant were initially greased between April and October, 1981 by INRYCO using current industry standard filling procedures.

3) Calculated voids between the wires which comprise the tendon bundle are approximately 7% of the net duct volume. During the initial filling operations, the tendon bundle was cold (ambient temperature of 65°F) and as the heated filler grease (exit temperature of 140°F) was pumped into the sheathing void, it solidified on the surface of the tendon bundle, leaving small voids between the wires. As the filler grease gradually heated the tendon bundle, it is likely that the voids between the wires allowed migration of the filler grease into the tendon bundle. Because this process is slow and gradual, it is reasonable to expect that it took place substantially after the filling operation was complete and possibly during the surveillance refill operation. In

addition, this type of migration could also occur at other areas such as where tendons are in contact with the sheathing.

In addition, visual inspection of the exterior concrete of the containment building after the initial greasing and during the surveillance revealed no signs of grease seepage from the tendon duct. Therefore, refill volumes in excess of the lost grease during the surveillance indicates that the void existed within the tendon duct boundary.

The Callaway Plant tendons, requiring net refill volume of the filler material in excess of the 5% criteria, have not shown any abnormal visual deterioration. The lift-off force for those tendons was found to fall within the predicted limits. Laboratory examination of the filler grease has been performed as of this date and found to be within the tolerance limits as specified in the Tech. Spec. Visual inspection of the different components of the anchorage system revealed proper coverage by the filler material with no signs of corrosion or presence of water.

As indicated by the above, the function of the filler grease protecting the post-tensioning system was maintained. As long as sufficient filler grease has been introduced into the system to completely coat the wires and anchorage system, corrosion protection is assured. Voids can be expected due to the characteristics of the filler grease and initial filling operations as noted above. Since each wire is individually pre-coated with Amber 1601, the degree of filling interstitial spaces, which comprise the net duct volume, is not directly related to the degree of coating which occurs, and therefore, is not a major indicator of the operability of the post-tensioning system. Based on the lift-off results, visual inspection

and results from the first and third year surveillances, we have concluded that the structural integrity of the tendon and anchorage system has not been adversely affected by the measured void.

Additionally, since compliance with all remaining surveillance requirements for Tech. Spec. 4.6.1.6.1 was demonstrated, it is concluded that "voids in excess of 5% of the net duct volume" have not resulted in any degration of the post-tensioning system, assuring the structural integrity of the containment vessel structure.

In addition, future scheduled surveillances of the post-tensioning system and full pressure integrated leak rate tests will monitor the structural parameters of the containment to detect any potential abnormal degradation, assure continued operability of the system, and verify containment vessel structural integrity on a continuing basis.

This report has been filed to meet the 30 day action statement as specified in Technical Specification Action Statement 3.6.1.6(b).

TENDON SURVEILLANCE GREASING SUMMARY

TENDON	% GREASE ADDED
V41	10.8
V84	6.83
12AC	7.96
20AC	12.08
42AC	10.38
52AC	9.13
20CB	12.70
20BA	11.87
44BA	8.92