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KGoller
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DDavis
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LShao
KSeyfrit
MConnor
BShewmaker
RMuller (ACRS Staff
AGluckman (DOR/EB)
OIE (3)

DEC 23 1977

Docket No. 50-313

Arkansas Power & Light Company
ATTN: Mr. William Cavanaugh, III
Executive Director, Generation
and Construction
P. O. Box 551
Little Rock, Arkansas 72203

Gentlemen:

By letter dated August 24, 1977, you described a problem regarding low lift-off force for certain reactor containment building tendons at Arkansas Nuclear One, Unit No. 1 (ANO-1). This letter also noted a decrease in tensile strength of some wires withdrawn for testing and stated that a review of both aforementioned problems was underway. By letter dated November 4, 1977 you forwarded the results of this review in the form of a report.

We have reviewed the November 4, 1977 report and have determined that additional information is necessary in order that we may complete our review. Therefore, you should provide the information requested in the enclosure within 90 days of receipt of this letter.

Sincerely,

Originals signed by
Don K. Davis

Don K. Davis, Acting Chief
Operating Reactors Branch #2
Division of Operating Reactors

Enclosure:
Request for Additional
Information

cc w/enclosure:
See page 2

OFFICE	ORB #2	DOR	ORB #2			
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DATE	12/22/77	12/23/77	12/23/77			

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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See page 2

Working Copy

Arkansas Power & Light Company

cc
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Mr. Daniel H. Williams
Manager, Licensing
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Russellville, Arkansas 72801

Enclosure

Arkansas Nuclear One-Unit 1
Docket 50-313

REQUEST FOR ADDITIONAL INFORMATION

REACTOR CONTAINMENT BUILDING

TENDON SURVEILLANCE

I. The information provided to-date indicates that the following variations in strength may cause concern (see pages 2-1, 2-3, and 4-1 of November 4, 1977 report):

tendon 31H40
tendon 31H39
tendon 31H50
} lift-off forces lower than required

tendon 32H14 - some wire samples failed at less than guaranteed minimum ultimate strength.

This information involves only hoop tendons. The information given on page 4-2, however, is different. It indicates that the average lift-off force (per wire) for all vertical tendons is approximately +0.41% higher than expected, but that the average value of lift-off forces for both hoop and dome tendons is lower than expected [for dome tendons - 0.68% (approximately); for hoop tendons - 1.1% (approximately)]. Another contradiction can be found in information provided in figures 4.1, 4.2, and 4.3. It can be seen that, per wire, the lift-off force was lower than expected for: V95 (Vertical)

1D20; 3D21; 2D08 (Dome)
32H14; 32H24; 32H40; 32H32; 31H39; 31H41;
31H50; 31H40 (hoops)

1. Explain these contradictions and correct them.

2. Explain the significance of lower lift-off forces for the stability of the structure.

3. Explain the significance of ultimate strength of wire samples lower than the guaranteed minimum ultimate strength for the stability of the structure.

Items 2 and 3 involve a study of errors inherent in such a complex operation as lift-off force measurements and of tolerances which should be applied to the result evaluation.

II. In your letter dated August 24, 1977 you stated that 46 tendons have the same heat of material as tendon 32H14. In the November 4, 1977 report the problem of the heat is not mentioned. Explain this contradiction and possible omission of the heat problem.

III. The documents furnished ~~by the licensee~~ suggest that the acceptance values and the normalizing factors used in the one-year surveillance in 1975 be modified and that after such a revision the normalized tendon lift-off forces will exceed the required minimum values. This approach is questionable, since one of the goals of successive surveillance operations is to establish historic continuity in the evaluation of the safety of the structure. A modification of the basic criteria will destroy this continuity. It is imperative first to establish the significance of not satisfying the original criteria and normalizing procedures. To clarify this problem, answer the following questions:

1. It is indicated in your letter of August 24, 1977, that the lowest value recorded and accepted as valid for the ultimate strength of the wire samples was 229 ksi; the nighest was 246 ksi. The required ultimate strength of the wires required in ASTM A 421-74 is 240 ksi. The maximum deviation was therefore approximately -4.6%. It is also indicated that the stress at elongation of 1% was less than the required 192 ksi. In addition some samples with ultimate strength lower than 240 ksi had an elongation smaller than that required by the specification of 4.0%. The wire manufacturers have a great amount of statistical information available. Therefore present a study of the significance of these deviations. (See pages 5-2 & 5-3, Tables 5.1, 5.2, 5.3 and Appendix G).

2. There is a confusion between "sample" length and "gage" length. For example in the letter dated August 24, 1977 the expression "100 inch sample" is used; also on page 2-3 of the report the expressions "10 inch samples" and "100 inch samples" are used. In Tables 5.1, 5.2, 5.3 in Appendix H the expression "measure gage length" is used throughout. Clarify these contradictions.

3. Explain the meaning of the expression "guaranteed" minimum ultimate strength" (pages 5-3, 5-4). What are the tolerances and permitted deviations on the "guaranteed" values?

4. Clarify the meaning of "improper" wire removal procedures. If the reason for the difficulties is in the use of a sheave approximately 12 inches in diameter explain why this procedure did not damage the wires in vertical and dome tendons. See page 3 in Appendix I. The mention of "Bauschinger Effect" may be inappropriate since this effect has been mostly investigated for uni-axial tensile tests or torsion, and the problems presented in this documentation are much more complex (see page 5-4 of the report and page 3 of Appendix I). Describe the future wire removal procedure as planned at this time.

5. In several locations in the report it is indicated that some buttonheads are "offsize". The original design of buttonheads by the manufacturers is very sophisticated. Therefore explain what is meant by "offsize" and justify the statement that this did not influence the strength of the tendons. (see page 2-1 and Appendix D). Discuss other imperfections of the buttonheads such as cracking, offset etc.

6. On page 2-2 it is stated that with two revisions of the basic criteria, all the tendons are considered acceptable. This statement seems to be inappropriate since, as indicated above, the use of new criteria may be objectionable in itself. Therefore qualify this statement.

7. On page 2-2 of the Report it is indicated that the "available" equipment could not perform adequately the wire continuity test. Explain why the needed equipment was not available for this important test.

8. "No corrosion" is indicated on page 2-2. Explain the procedure establishing this negative condition, expecially whether the procedure used permitted the discovery of any small pitting. See also Appendix G.

9. Discuss in detail the testing of wires. You should cover all important facets of the testing procedure including, but not limited to:

   a. failing inside of gripping jaws. Influence of the shape of the jaws.

   b. the influence of curvature and twisting of tendons as installed on the resistance of wire to removing, which may have predeformed the wires in a complex way.

   c. rate of speed of the testing machines.

   d. ambient temperature during testing.

   e. possible eccentric loading by the machines, bending or twisting of the wire samples.

   f. influence of the type of machine.

   g. comparison of testing methods used by the manufacturers, by Pittsburgh Testing Laboratory, by Hales Testing Laboratory and by any other organization participating in testing of wire samples. Conformance with ASTM specifications.

   h. influence of the temperature of filler and its pressure.

i. influence of the average temperature of tendons in place.

j. machine calibration

10. Add to information provided regarding filler (page 3-1 and Appendix C) a discussion clarifying the problem of shrinkage of the filler when cooling (outside of trumpets). What procedures have been used to check on possible voids at intermediate points in tendons, due to the cooling shrinkage?

11. Indicate whether local bending of bearing plates has been checked.

12. Indicate how accurately the absence of pitting in anchor hardware has been observed, and the minimum size observable.

13. In Appendix B the normalizing formulae are presented. Discuss the possibility that factors neglected in these formulae may be more important than factors which have been included. (See Appendix B and page 4-1). Some of the neglected factors are:

    - First surveillance formula does not include concrete creep and concrete shrinkage or thermal effects and concrete placing variation.

    - Integration along the tendon may introduce questionable properties of materials.

    - Subsequent surveillance formula do not appear to include the following: thermal effects, shrinkage, detailed effects on creep, bearing plate displacements, changes in concrete, Young's elasticity modulus and Poisson's ratio, jack orientation, cracking of concrete.

    - Indicate the tolerances in normalizing factors.

14. Table 4.1 and 4.2, pages 6-1 and 6-2 and Appendix F indicate that the elongations have been measured between the outside face of the bearing plate and the inside face of the anchor head. Discuss whether the precision of these measurements is sufficient to establish the adequacy and the correctness of lift-off forces.

15. Discuss ram calibration. In page 4-3 of the report it is indicated that load cell calibration is "traceable" to the National Bureau of Standards. This expression is too vague. Indicate whether the NBS did in effect calibrate the load cells and if not, what is the significance of this procedure for the reliability of the calibration. It is also indicated in the same page that the uncertainty of the measurements is 0.5% (two times standard deviation). Define the standard deviation for such a small number of measurements and discuss the basis for accepting an uncertainty of twice the

standard deviation in this case. Discuss also whether the participation of NBS, University of California, University of Arkansas, Wiss, Janney, Elstner and Assoc. Inc. and Zabel Calibration Service in different phases of the calibration operations leads to compatible results. (See Appendix F).

16. On page 5-1 of the report it is stated that 13 wires from 23 surveillance tendons showed anomalies which were judged to be inconsequential. This is presented in some detail in 8 paragraphs on the same page. However, this information appears to indicate lax quality control during erection and not sufficient attention provided during previous surveillance operations. Discuss this problem.

17. On page 5-4 of the report a brief discussion is given of the metallurgical investigation, presented in a more detailed way in Appendix I. The appropriateness of including the use of 12" sheave and the "Bauschinger" effect as explanations of the weakness of some wire samples has been questioned above.

    a. Discuss the manufacturing, testing, and quality controls of Suzuki, Limited, also the possible effect of transporting the wires through long distance shipping.

    b. Explain whether the fact presented in page 2 (Appendix I) that one wire showed evidence of rust on the failed end, whereas the other failed wire did not, corresponds to a normal condition, to be expected, or may indicate some special circumstance causing different behavior of the two wires.

18. Appendix A describes the Surveillance Procedure. State whether this procedure is in accordance with Regulatory Guide 1.35, with the ASME/ACI Pressure Vessel Code, Section III, division 2, with the Technical Specifications and with Bechtel's Topical Report BC-TOP-5.

19. Appendix E presents data sheets on retensioning, retensioning force and elongations. Discuss the possible errors in this operation and the tolerances which should be used to evaluate the results. On page 4-3 it is stated that Ram #1 failed, was repaired and recalibrated. Discuss the consistency of results obtained by using a recalibrated Ram. Evaluate the possible errors. See question 15 above on calibration. (See also Appendix F).

20. Appendix H presents data sheets on tendon wire tests. Discuss the possible errors and tolerances to be applied to results. See also question ~~X~~ 9. above on wire testing.

21. The list of references presented in the report (Appendix I, page 4a) includes only references which date from 1958, 1963 and 1971. Present some references which are more up to date, especially on "Bauschinger Effect."

22. Indicate (Appendix I) whether the chemical analysis agrees with Suzuki results.

23. Conclusions are presented on page 2-4 of the November 4, 1977 report. Modify these conclusions in accordance with the answers to these questions.