

ATTACHMENTINTERIM REPORT #3
POST TENSIONING ANCHORHEAD FAILURE
BYRON STATION UNIT 1

Commonwealth Edison Company submitted Nonconformance Reports No. 442, dated November 21, 1979; No. 451, dated November 28, 1979; and No. 478, dated January 18, 1980, for Byron Unit 1. These nonconformances concerned the failure of four (4) field anchorheads used in the post tensioning system for the Containment Building. The post tensioning system is a 170 wire BBRV system supplied by INRYCO, Inc. It is comprised of 120 dome tendons, 162 vertical tendons and 201 horizontal tendons for each Containment Building. Each tendon consists of 170, 0.250 inch diameter wires conforming to ASTM A-421, Grade BA steel. A steel anchorhead is provided at each end of the tendon to serve as termination and anchor point for the tendon.

Subsequent to the anchorhead failures reported in Commonwealth Edison Company's initial nonconformance report, two other field anchorheads failed. It has been noted that three of the four failed anchorheads came from the same steel mill heat and from the same heat treating lot within that mill heat. The fourth field anchorhead failed on January 18, 1980, and was from a different steel mill heat. However, the mill heats with failed anchorheads were supplied by the same steel fabricator. The fabricator provided five steel mill heats of field anchorheads and these five heats represent all the Unit 1 field anchorheads required of which anchorheads from four of these heats have been previously stressed.

These anchorhead failures are all associated with the horizontal tendon group. Both the dome and vertical tendons have been in the stressed state for several months, and approximately two-thirds of the horizontal tendons were stressed when the first anchorhead failure occurred.

After the second failure, immediate steps were taken in the field to detension other horizontal tendons with anchorheads from the same mill heat as the failed anchorheads. In addition, to minimize asymmetric loads on the Containment Building, additional horizontal tendons were detensioned using acceptable field procedures. Immediate steps were again taken after the fourth failure occurred to detension all tendons from the second failed anchorhead mill heat. Also, a third mill heat was identified as suspect from the structural test program completed to date and all tendons with anchorheads from this mill heat were detensioned. At this stage of detensioning, tendons from all three tendon groups (dome, horizontal and

vertical) were being affected.

As indicated in Reference (b), in an effort to resolve the anchorhead failures at Byron Station, INRYCO, Inc. has undertaken a test program consisting of metallurgical and structural load tests. The majority of these tests are being conducted at their Inland Steel Laboratory. INRYCO, Inc. has also retained Battelle Laboratory in Ohio to provide a second opinion.

The structural load tests consist of anchorheads tested to 150% of guaranteed ultimate tensile strength of the tendon wire. The purpose of these tests is to determine if sufficient strength exists in the anchorheads, and to compare test results with the behavior predicted by the analytical model. To date, these tests have demonstrated inferior performance of the failed anchorhead mill heats as compared to anchorheads from other mill heats. Also, these tests have shown that the actual anchorhead failure is consistent with the failure mode predicted by the analytical model.

Metallurgical tests are being performed to determine if the failures are related to the process of anchorhead fabrication or if something external to this exists. Examination of the fracture surfaces of the failed anchorheads indicate that the fracture mode is brittle. Further investigation using the scanning electron microscope has detected intergranular cracking in the failed anchorheads. Current testing is directed towards isolating the factors responsible for intergranular cracking. Heat treatment and environmental related factors are being explored.

In order to resume post tensioning work at Byron Station, an acceptance criteria is being developed by INRYCO, Inc. to establish acceptability of replacement anchorheads. This acceptance criteria will ensure that replacement anchorheads do not contain the flaws detected in the failed anchorheads through the test program. This acceptance criteria currently addresses the following items:

1. Surface crack detection using magnetic particle testing;
2. Material certifications for specified Rockwell hardness;

3. Heat treatment procedures and certifications;
4. Sampling plan for structural load tests;
5. Sampling plan for minimum mechanical properties;
6. Sampling plan for detecting intergranular cracking using the scanning electron microscope; and
7. Testing for specified chemistry.

Documentation for replacement anchorheads will be provided by INRYCO, Inc. to demonstrate conformance to the acceptance criteria prior to use of replacement anchorheads in the field.

Currently, a portion of the test program is still in progress. Testing has not yet reached the point at which conclusive results are available to resolve this deficiency. However, Commonwealth Edison expects that final resolution will be completed by June 30, 1980. At that time, a final report will be submitted documenting the reason for the anchorhead failures, corrective action required, and corrective action to prevent future recurrence.