ATTACHMENT

LASALLE COUNTY UNITS 1 AND 2
INTERIM REPORT
CONTAINMENT TENDON DEFICIENCY

The tendons that are the subject of this deficiency are used to pre-stress the primary containment. Several hundred tendons run horizontally around the containment at different elevations and vertically up the containment wall. The tendons are tensioned after the concrete containment wall is poured. Each tendon consists of a group of ninety (90), 0.250" diameter wires made from high strength steel (A421 Grade BA) with a minimum tensile strength of 240,000 psi. At each end, the tendon emerges from its guide tube, embedded in the concrete wall, and passes through a moveable anchor head with 90 holes in it -- one for each wire. Each wire end is upset, forming a button head that will not pass back through the anchor head. The anchor head is then hydraulically tensioned to about 740,000 pounds and shimmed in place against a steel bearing plate. One end of each wire is upset in the shop to form the button head while the other end is upset in the field after the tendon is pulled into its tube and the anchor head is installed.

Often, when the wire end is being upset, either at the shop or in the field, the button head will develop defects of several types. Because of this, after upsetting, the button heads are inspected to Inland Ryerson (the tendon supplier) Specification 1610 which describes the defects and their acceptance criteria. The upset wires undergo a 100% visual inspection for cracks at the shop and in the field, and a minimum 10% examination for size of flaw with a go-no-go gauge.

Walsh Construction Company, the LaSalle structural contractor and tendon installer, was experiencing an unusually high number of button head rejections when upsetting the Unit 2 vertical tendons. As a result, Walsh also inspected the shop-installed button heads on the problem tendons on which rejectable button heads had been identified.

Field Inspection

The upper (shop) ends of 7 tendons, containing a total of 630 wires, were inspected. The size of the defect openings was measured optically with a small 7X Bausch and Lomb measuring magnifier. The scale had divisions every 0.005", thus the accuracy of any single measurement is estimated to be $\pm$0.0025."

Of the 630 tendons inspected, 27 were rejectable, 30 more were borderline cases. Subsequent inspection of the borderline cases with feeler gauges identified additional nonconforming wire.

Laboratory Studies

Following the field inspection, several button heads that had been rejected and cut off were studied in the laboratory. A piece of wire was mounted and polished and microscopically examined for inclusions or other microstructural defects. The steel was not unusually dirty and appeared to be normal. Another button head with a large split was cooled in liquid nitrogen and impacted sharply to break it open. The fracture surfaces, which included the surfaces of the previously existing split were examined for inclusions using energy dispersive x-ray analysis in the scanning electron microscope. A few scattered particles of an aluminium and iron compound, possibly and oxide, were found on the fracture surface and appeared to be embedded in the material. This is not unusual as the particles could have been either contamination or the result of aluminum killing of the steel. In any case, they were not judged to be detrimental or the cause of the large splits.

Hardness of the wire was in the range 40-44 RC.

Discussion

The tendon button head deficiencies identified at the "shop end" of seven (7) LaSalle Unit 2 tendons are considered to be the result of the fabricator's shop inspection procedure where the inspection of finished button head was done after the ends had been greased. This fact and locally inadequate lighting in sections of the inspection area resulted in the failure to identify the nonconformance condition. At issue is the apparent breakdown in the QA/QC program of the tendon supplier and not a concern over the safety and strength of button heads with defects larger than presently permissible. It is judged that flaws of the type and number observed do not affect the integrity of the installed tendons. This judgement is based upon preliminary tests performed by the tendon fabricator (Inland-Ryerson) in which wire samples with gross button head flaws were shown to have tensile strengths in excess of the minimum required (240,000 psi).

In order to support this judgement for the different heats of material used on LaSalle Units 1 and 2, and other units for which tendons were supplied by the same fabricator, a test program has been undertaken. This program will include:

(i) 200 single wire tensile tests
(ii) a full 90 wire tendon low-cycle dynamic test and subsequent tensile test
(iii) a full 170 wire tendon low-cycle dynamic test and subsequent tensile test
(iv) a 30 wire tendon high-cycle dynamic test

The various wires to be tested will cover numerous heats of material with tensile strengths including the minimum strength of wire employed at LaSalle County. The button heads will contain flaws, some grossly in excess of the current button head acceptance criteria.

This test program which is designed to provide a formal basis for a revised button head acceptance criteria, is expected to be concluded and the results evaluated by Commonwealth Edison in the first quarter of 1979. A final report to complete the reporting requirements of 10 CFR 50.55(e) will be submitted to Region III by April 15, 1979. Although it is judged that no remedial action is required on tendons installed at the LaSalle site, the final report to be submitted will identify any corrective action required.

The vendor nonconformance report that documents the deficiencies observed on LaSalle Unit 2 is on file at the plant site for review (Inland Ryerson Report NC/CA No. 676-19). A complete report on the wire test program results and wire inspection results on both LaSalle Units 1 and 2 shall be submitted by April 15, 1979 as a part of the final report.