MEETING SUMMARY DISTRIBUTION

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

September 16, 1976

Docket Nos. 50-219
50-220

Facilities: Oyster Creek Nuclear Generating Station; Nine Mile Point Unit No. 1

Licensees: Jersey Central Power & Light Company (JCP&L); Niagara Mohawk Power Corporation (NMPC)

SUMMARY OF MEETING TO DISCUSS ALTERNATIVE SOLUTIONS TO FEEDWATER NOZZLE CRACKING PROBLEMS

On September 7, 1976, the NRC staff met with representatives of JCP&L and NMPC and representatives of their consultant, MPR Associates. General Electric (GE) was also represented. An attendance list is attached. MPR has been working on a study, funded by JCP&L and NMPC, to determine alternatives to GE's presently-proposed solution involving thermal sleeve welding to prevent cold feedwater bypass leakage. The meeting had been requested by the NRC staff in order that the staff could become familiar with the studies being undertaken. No commitments were made on the part of the licensees or the NRC staff.

MPR discussed the background of the feedwater nozzle problem and noted that their studies are directed toward Oyster Creek and Nine Mile Point as a near-term solution. Oyster Creek and Nine Mile Point are unique in that the reactor vessel wall is thicker and the sparger design is rectangular, rather than circular as at most other BWRs. The thermal sleeve is stainless steel and has a clearance fit.

The theses for crack initiation and growth were reviewed, and it was noted that mixing tee tests performed in support of the Fast Flux Test Facility (FFTF) nozzle design program had yielded valuable data corroborating the GE analysis which determined thermal cycling to be the probable mechanism for crack initiation. An MPR analysis relating frequency of thermal cycling, temperature differential, and depth of temperature penetration into the metal led to the derivation of crack depths due to thermal stress alone, which MPR estimated to be approximately 1 inch after about 35 years at 1/4 Hz thermal cycling and approximately .25 inches after about 35 years at 1 Hz thermal cycling.

There remains some question concerning the GE-postulated mechanism for crack growth, especially when considering the deepest crack found to date. This crack, in the bore of a nozzle, was in an area of theoretically low pressure stress. Additionally, pressure stress cycling alone would not cause crack growth except near each nozzles' 0° and 180° positions where pressure stresses are at a maximum. However, deep cracks have been found in other areas. Even though these inconsistencies exist, MPR has concluded that temperature cycling must be stopped both because of crack initiation and crack growth.

MPR's analyses indicate that, even without leakage flow, the temperature in the nozzle's annular area would approximate the temperature of the feedwater. Therefore, because of the temperature differential between reactor water and feedwater, the potential for cyclic fluctuation of temperature would still exist. Because of this, the MPR design is based upon:

1. stopping bypass leakage, and

2. stopping mixing of water in the annular area.

MPR has looked at three thermal sleeve modifications which they believe could separately satisfy the design requirement to stop bypass leakage. These are:

1. Interference fit thermal sleeves designed for worst case temperature differential (between average temperature of nozzle safe end at contact area and average temperature of sleeve at safe end) of 250°F. To maintain an interference fit even with design basis 550°F - 100°F thermal shocks, the yield strength of the material used would be a minimum of 70,000 PSI and the required initial fit woudd be .030 inches interference. It has been determined that Inconel 718 is a satisfactory material, and that the initial insertion of the interference fit sleeves would present a minimal problem.

2. Aspirated thermal sleeves, welded to the feedwater pipe at a safe (radiological health) distance outside the nozzle safe end. A flow model has been designed to determine if this scheme is feasible and flow tests are being planned.

3. Piston rings (Inconel or Haynes 25) at the sleeve to nozzle safe end juncture. Such rings would reduce, but not eliminate, leakage. It is estimated that leakage would become less than or equal to 10% of its present value.

To further the studies of designs to prevent mixing, MPR has developed one preliminary design based upon the Oyster Creek and Nine Mile Point rectangular sparges, which are claimed to provide better resistance to vibratory effects seen in later circular spargers. The inconel thermal sleeve, which would be fitted with piston rings for ease of installation and removal, would allow a small amount of bypass leakage. The sparger itself is carbon steel, except that all attachment points to the vessel wall will be inconel. At the blend radius area of the nozzle, there are two circular flow shrouds which seal the annular area and prevent mixing. Leakage holes are incorporated in the outer seal to allow flow of the small amount of bypass water out of the annular area.

MPR stated that testing of the various designs is planned, although no schedule can be established at this point.

The NRC staff expressed appreciation to MPR, JCP&L, and NMPC for presenting this information. The NRC's present task of formulating an Interim Inspection Criteria Document was discussed and the NRC staff noted its present intention to invite all licensees to a joint meeting when the criteria document has been completed.

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