## 6.2.24 STEADY STATE VIBRATION TEST

### 6.2.24.1 Purpose

The purpose of this test was to monitor pipe vibrations of the Emergency Feedwater System during all significant plant operating modes that are likely to cause vibration in the subject system and are postulated to have moderate to high probability of occurrence during the plant's lifetime.

Vibration monitoring is limited to a qualitative examination of the system at the specified mode.

### 6.2.24.2 Test Method

The Emergency Feedwater System (EFS) is tested for steady state vibrations with both pumps operating simultaneously at the maximum design flow rate supplying water to Steam Generator 2E24A, then to Steam Generator 2E24B.

Following verification that the Emergency Feedwater Pumps 2P7A and 2P7B are operating and that flow through each EFS train is 575 (±25) gpm, a visual inspection is made to verify that the steady state vibration of the system piping is acceptable.

### 6.2.24.3 Test Result

With both pumps operating simultaneously at the maximum design flow rate, no excessive or abnormal vibration of the subject piping was noted.

### 6.2.24.4 Conclusion

Piping system vibration was examined as required by the Test Procedure and was determined to be acceptable.

7.1 CONCLUSION (August 1, 1979 to October 31, 1979)

During the period of this report 50% testing has been essentially completed. All Core Protection Calculator tests at 50% have been completed satisfactorily. On October 4, 1979 an outage began for inspection of the reactor internals. This inspection found no abnormal results, nor any further evidence of the cause of the hot leg temperature variations observed at power. Additional instrumentation has been installed during this outage to further understand the variations.

On October 18, 1979 the #2 Diesel Generator failed during a surveillance test. This required an outage which continued through the end of this reporting period while this engine was replaced. When power operation is resumed, the remaining 50% tests will be completed before ascension to 80% power.

ATTACHMENT A

ANO-2 HOT LEG TEMPERATURE ANOMALY

INTRODUCTION

Shortly after ANO-2 reached the 50% power plateau, a temperature bias was noted between RTDs located on different sides of the reactor hot legs. The bias, which has a magnitude of approximately 3°F at 50% power was discovered by comparing the output of the various hot leg temperature indications. Review of earlier data indicated that the bias had also existed at 20% power but had not been recognized due to the smaller magnitude.

Instrumentation problems were ruled out as the source of the bias by careful calibration checks and by demonstrating that the bias was a function of power but not of temperature. During these tests, with the hot leg temperatures being closely monitored, the bias was observed to "flip". When a "flip" occurred, the lower reading hot leg temperature indicators increased and the higher reading indicators decreased. The "flips" occurred on both hot legs and had durations ranging from 30 seconds to 2 minutes and a magnitude of between 2.5 to 3°F.

This phenomenon, both the temperature bias and the "flips", has been referred to as the $T_h$ anomaly, and a test plan was designed to understand the causes and evaluate the effects.

INVESTIGATION

A series of tests were performed to further characterize and understand this phenomenon. Variations of temperature, pressure, power, and CEA position (including single CEA insertions and drops) were conducted, while monitoring the following parameters:

1. $T_{hot}$ - installed RTDs
2. $T_{cold}$ - installed RTDs
3. Fixed incore flux detectors
4. Core outlet thermocouples (incore detectors)
5. Excore flux detectors
6. Vibration and loose parts monitoring accelerometers attached to the RCS, both permanent and temporary
7. 2 rings of temporary thermocouples mounted on the O.D. of the A hot leg

Results of these investigations were as follows:

1. Radial reactor internals motion is very small and within expected bounds
2. No evidence of loose parts was found, or of any identifible impacting within the reactor.
3. There is no evidence that the phenomenon originates within the core. Incore flux and temperature detectors do not correlate with the bias or the flips.
4. The effect is most likely due to thermal hydraulic causes, occurring between the top of the core and the $T_{hot}$ RTDs.

INSPECTION

Based on the above data and results, and because of uncertainty about the exact cause of the phenomenon, the plant was shutdown for an inspection of the reactor on October 4, 1979. This inspection included:

1. Visual and dimensional checks of the holddown ring and upper guide structure flange.
2. Visual inspection of the upper guide structure, core barrel (including core shroud) and reactor vessel.
3. Visual inspection of seven (7) fuel bundles removed from the core.
4. Dimensional checks of the core barrel to reactor vessel hot leg interface.

During this inspection, no indications were found which would indicate the cause or any effect of the temperature switching anomaly. Internal components show typical light discoloration caused by an oxide film resulting from operating conditions. Interface surfaces, such as alignment keys and guide lugs display signs of normal contact. These dicoloration and contact areas are consistent with data recorded during previous inspections and can therefore be attributed to the movement of the interface surfaces as a result of differential thermal expansion between the carbon steel vessel and the stainless steel internals. In addition, because of close clearances between the keys and keyways, a lateral shift of the internals during assembly could result in contact between one side of the alignment keys and/or guide lugs and their respective keyslots.

During the inspection, a dimensional survey was made in the flange-holddown ring and outlet nozzle regions. All dimensions are shown to meet the acceptance criteria established. The radial gap between the core support barrel and reactor vessel outlet nozzles was shown to be within acceptance limits.

FURTHER INVESTIGATION

In order to further understand the observed phenomenon, and to evaluate their effects on plant operation, additional instrumentation, including permanently installed $T_{hot}$ RTDs, additional temporary thermocouples, and temporary reactor vessel displacement transducers, has been added to the plant.

This instrumentation, plus that already installed, will be monitored during start-up and further operation to continue to monitor the anomaly.