DUKE POWER COMPANY
OCONEE UNIT 2

Report No.: RO-270/76-17

Report Date: January 20, 1977

Occurrence Date: December 27, 1976

Facility: Oconee Unit 2, Seneca, South Carolina

Identification of Occurrence: Quadrant tilt limit exceeded

Conditions Prior to Occurrence: Unit at 100% full power

Description of Occurrence:

On December 27, 1976, the reactor protective system on-line channel check was performed on Oconee Unit 2. This test involves tripping of the AC supply breaker to one of the two redundant parallel control rod drive power supplies. When the AC breaker for the B control rod drive power supply was tripped, group 6 rods partially fell into the core, stopping in a scattered pattern. The group 7 rods also dropped from approximately 10% withdrawn after a momentary pause. Due to the assymetric configuration of the group 6 control rods, an indicated tilt of 9.1% was observed on the out-of-core detectors. This tilt exceeded the limits of Technical Specification 3.5.2.4 for actual incore tilt and hence, a reactor shutdown was initiated. Approximately six minutes later the reactor tilt was restored within limits; however, it was discovered that rod 6 in group 6 was not properly responding. Two minutes later the reactor was manually tripped from 40% full power.

Apparent Cause of Occurrence:

The apparent cause of this incident was the failure of several electrical components supplying the control rod drive assemblies. The control rod drives are six phase star connected stators connected for operation in a pulse stepping mode. To obtain control rod motion, a rotating magnetic flux field is created by alternately energizing the windings. Two windings must be continuously energized to maintain control rod position.

When the B power supply breaker was tripped, two of six phases each of groups 6 and 7 were rendered inoperable due to component failures. Therefore, the rods in these two groups started falling when the control system started to command rod motion and at least two motor phases were not energized. The B power supply breaker was reclosed in approximately 2 seconds; thereby stopping the further dropping of group 6 and 7 rods.

This incident did not affect the reactor protective system's ability to trip the control rods. This is because the RPS employs two redundant, independent trip mechanisms to ensure that all six phases of the control rod drive assemblies are de-energized and proper rod motion is assured.

Analysis of Occurrence:

This occurrence was caused by the dropping of group 6 and 7 control rods and resulted in the core tilt exceeding the limits specified in Technical Specification 3.5.2.4(c). The limits on quadrant power tilt set forth in this specification have been established with consideration of potential effects of rod bowing and fuel densification to prevent the linear heat rate peaking increase associated with a positive quadrant tilt from exceeding allowable limits. It has been established that the maximum linear heat rate prior to this occurrence was approximately 11.0 kw/ft. A conservative analysis of the maximum linear heat rate during this transient indicates that a maximum heat rate of 13.2 kw/ft could have been achieved. This is well below the established limits on linear heat rate.

Additionally, as described above, this occurrence did not affect the ability of the reactor protective system to function properly, if required. It is therefore concluded that the health and safety of the public was not affected by this occurrence.

Corrective Action:

The control rod drive power supply components were replaced and proper operation of the control rod drive system was demonstrated. Control rod 6, group 6 was exercised and performed properly. The determination of the reactor tilt was identified as being caused by the dropped control rods and the tilt was closely monitored during the reactor restart. It is concluded that all systems performed properly.