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SUBJECT: LER 89-007-00:on 891110,design oversight results in potential for operating in unanalyzed condition.

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DUKE POWER

January 12, 1990

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287
Voluntary LER 270/89-07

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report (LER) 270/89-07 concerning a design oversight which resulted in a potential for operating in an unanalyzed condition during a dropped rod event concurrent with large tilt and imbalance.

This report is being submitted on a voluntary basis. This event is considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

H. B. Barron
Station Manager

RSM/ftr

Attachment

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NRC Form 366 (9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/88

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Oconee Nuclear Station, Unit 2	0 5 0 0 0 2 7 0	1 OF 0 6

TITLE (4) Design Oversight Results in a Potential for Operating in an Unanalyzed Condition During a Dropped Rod Event Concurrent With Large Tilt and Imbalance

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
1 1	1 0	8 9	8 9	0 0 7	0 0	0 1	1 2	9 0		0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10)	0 5 2	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
		20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	X OTHER (Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
		20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	Voluntary
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
	AREA CODE
Henry R. Lowery, Chairman Oconee Safety Review Group	8 0 3 — 8 8 5 - 3 0 3 4

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

On November 10, 1989, at 1100 hours, Unit 2 experienced a dropped rod from 100% full power while performing a control rod movement test. Reactor Operators returned the unit to automatic and a runback to 55% full power was completed. Subsequent attempts to recover the dropped rod were unsuccessful. Management consulted the Nuclear Design group to discuss the possible effects of continued operation with the dropped rod. It was first thought that this would be acceptable because the present Technical Specification (TS) limits on tilt and imbalance were not being exceeded. Later, Nuclear Design questioned if current TS setpoints for tilt and imbalance were justifiable in a dropped rod situation because the combination of high tilt and high imbalance occurring simultaneously had not been previously analyzed. Therefore, the unit was considered to be operating in an unanalyzed condition. Immediate corrective action was to take the Unit to cold shutdown and repair the dropped rod. The root cause of this incident is Design Deficiency, design oversight due to failure to recognize the potential for operation in an unanalyzed condition during transients with large tilt and imbalance, such as those caused by a dropped rod. Subsequent analysis by Nuclear Design proved conservatism in TS setpoints for tilt and imbalance during such transients. This report is submitted as a voluntary LER.

BACKGROUND

In order to maintain the integrity of the fuel cladding and to prevent release of fission products, it is necessary to operate within the nucleate boiling heat transfer region where the heat transfer coefficient is large and the cladding temperature is only slightly greater than the coolant temperature. This is accomplished by applying limits to such parameters as power imbalance and quadrant power tilt during both normal operating conditions and anticipated transients.

Reactor power imbalance is the power in the top half of the core minus the power in the bottom half of the core expressed as a percentage of rated power.

Technical Specification (TS) 2.1 defines power imbalance limits for specified reactor coolant system [EIIS:AB] flows to maintain integrity of the fuel [EIIS:AC] cladding. TS 2.3 shows the power imbalance boundaries established to prevent fuel thermal limits, Departure from Nucleate Boiling Ratio (DNBR) and centerline fuel melt limits from being exceeded.

Quadrant Power Tilt is defined by the following equation and is expressed in percent.

$$\text{Quadrant Tilt} = 100 \times \frac{\text{Power in any core quadrant}}{\text{Average power of all quadrants}} - 1$$

TS 3.5.2 describes the imbalance and quadrant power tilt limits, monitoring frequency, and actions to be taken when limits are exceeded.

EVENT DESCRIPTION

On November 10, 1989, at 1100 hours, with Unit 2 at 100% full power, PT/O/A/600/15, "Control Rod Movement" was being performed. As required by the test, the Unit's Integrated Control System (ICS) [EIIS:JA] was in "manual" in preparation for moving the rods [EIIS:AA] while on-line. During the test, safety rod group was selected to be placed on the Auxiliary Power Supply. During the sequence of steps of transferring from the Group Power Supply [EIIS:EI] to the Auxiliary Power Supply [EIIS:EC], rod 9 of safety group 4 fell into the core. Reactor Operators took immediate actions to return the ICS to automatic allowing the unit to runback as designed. At 1115 hours, the runback was complete at 55% full power. The Performance Reactor Unit personnel were notified of the dropped rod to evaluate the possible need for maneuvering limits before it was attempted to recover the rod. Since no maneuvering limits were needed, operators then attempted to recover the rod using OP/O/A/1105/09,

"Control Rod Drive Procedure"; however, this was unsuccessful. Work Request 24993C was then issued for investigation and repair of the dropped rod.

Investigation by Instrumentation and Electrical (I&E) personnel discovered that the 'AA' phase of the stator winding on rod 9 of group 4 was open and they suspected a faulty electrical connection in the reactor building [EIIS:NH] to have caused the rod to drop. However, at this time, repair could not be initiated due to the Unit status and ambient conditions on the reactor vessel head service structure in the reactor building.

Later in the day station management met to discuss the effect of operating with a dropped rod at reduced power levels since the rod could not be readily repaired. During this meeting, a conference call was made with the Nuclear Design group to find out the effect on the core if Unit 2 was operated for an extended period of time with the dropped rod. At first, it appeared that operating with the dropped rod would be acceptable based on existing Technical Specification (TS) limits of tilt and imbalance. However, later that night Nuclear Design expressed reservations about operating with the existing Reactor Protective System (RPS) [EIIS:JC] imbalance trip setpoints and tilts in excess of the TS steady state limit because they had no documented analyses that could confirm conservatism in the TS setpoints under these conditions. The concern of the Nuclear Design group was that the dropped rod event had already pushed tilt outside of the steady state TS limit, and imbalance had been slowly increasing due to the power runback and subsequent xenon transient. The RPS imbalance trip setpoints had only been analyzed assuming tilt at the TS steady state limit. Therefore, Nuclear Design could not guarantee that the RPS would trip the reactor on imbalance prior to fuel damage occurring based on their existing analysis. Station management felt continued operation was not conservative due to the assumption that the unit was operating in an unanalyzed condition and decided to shutdown the unit and attempt to repair the rod. The unit was brought to 240 degrees Fahrenheit to make access to the reactor vessel head service structure and to repair the rod.

Since the concerns of the unanalyzed condition while in transients with high tilt and imbalance also applied to Oconee Units 1 and 3, a temporary note was placed on those units' Shift Supervisor's turnover sheet until a specific analysis could be completed by the Nuclear Design personnel confirming conservatism in the existing TS setpoints on tilt and imbalance.

When the reactor building was cleared for entry, I&E personnel repaired the loose electrical connection on the control rod drive stator and the rod was successfully tested. After other forced outage repairs were completed, the unit was returned to full power operation.

CONCLUSIONS

Oconee Unit 2 was shutdown because it was assumed that it was operating in an unanalyzed condition. Nuclear Design could not ensure at the time that the Reactor Protective System (RPS) would trip the reactor prior to fuel damage occurring because the RPS imbalance trip setpoint had only been analyzed assuming tilt at the TS steady state limit. The root cause of this event is Design Deficiency, design oversight due to the failure to recognize the potential for operating in an unanalyzed condition during transients with large tilt and imbalance, such as those caused by a dropped rod.

Subsequent to this event, it was discovered that the B&W Nuclear Service Company had, in fact, evaluated the transient with large tilt and imbalance and, based on engineering judgement, had concluded that the existing RPS trip setpoints were acceptable. Meanwhile, the Nuclear Design group performed a specific analysis for conditions of maximum allowable tilt and imbalance occurring simultaneously, the results of which supported the B&W Nuclear Service Company evaluation and confirmed conservatism in the existing Technical Specification limits. Therefore, the unit had not been operated in an unanalyzed condition and the event is not reportable as previously thought. This report is submitted as a voluntary LER.

A review of events occurring within the last 12 months revealed no other similar events with the same root cause. Therefore, this event is classified as nonrecurring. There were no radiation exposures, radioactive releases, or injuries associated with this event. The health and safety of the public was not compromised. This incident did not involve any component failure: therefore, it is not NPRDS reportable.

CORRECTIVE ACTIONS

Immediate

1. Unit 2 was shut down to 240 degrees Fahrenheit to make control rod drive repairs.

Subsequent

1. Rod 9 of Group 4 was repaired and tested by Instrumentation and Electrical personnel.

2. A temporary note was added to the Shift Supervisor's turnover sheet (until analysis could be performed) to enter Technical Specification 3.0, Limiting Condition for Operation, if in a condition with an unrecoverable dropped rod.

3. Nuclear Design performed a specific analysis for conditions of maximum allowable tilt and imbalance occurring simultaneously. This analysis confirmed conservatism in the existing Technical Specification limits on tilt and imbalance.

SAFETY ANALYSIS

Power distribution in a reactor is measured by kw/ft, which represents a value for linear power density. Operation of a reactor must be in such a way as to never exceed a certain limiting kw/ft value in order to prevent fuel and/or cladding damage. In order to prevent the peak power density during operation from exceeding the limiting kw/ft value, power distribution limits must be established.

The Technical Specification applicable to power distribution establishes limits for quadrant power tilt and imbalance. As long as operation is within these Technical Specification limits, the clad temperature will not exceed 2200 degrees Fahrenheit following a Loss of Coolant Accident and therefore fuel integrity is ensured.

This event did not result in any of the maximum limits of imbalance or quadrant power tilt from being exceeded. After the dropped rod had pushed quadrant power tilt outside of the steady state Technical Specification limit and it was seen that imbalance was slowly increasing, Nuclear Design questioned if the Reactor Protective System (RPS) trip setpoints would trip the reactor on imbalance prior to fuel damage occurring because their current analysis for imbalance trips only assumed tilt at the steady state limit. Since the unit was assumed to be operating in an unanalyzed condition, the unit was shut down.

Nuclear Design subsequently performed specific analysis for conditions of maximum allowable tilt and imbalance occurring simultaneously which confirmed conservatism in the current Technical Specification limits. This proved that no clad damage or centerline fuel melt would have occurred even if the quadrant power tilt and imbalance had been allowed to reach the RPS trip setpoints.

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		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Oconee Nuclear Station, Unit 2	0 5 0 0 0 2 7 0	8 9	— 0 0 7	— 0 0	0 6 OF 0 6

TEXT (If more space is required, use additional NRC Form 366A's) (17)

In the worst case, if it was assumed that localized fuel damage did occur and that the clad was breached, the other FSAR required boundaries which were intact, the reactor coolant system and the reactor building, would have contained any fission products from being released to the environment.

Therefore, it is concluded that this event did not impact the health and safety of the public. Eventhough a potential safety concern was generated because of a postulated unanalyzed condition, this condition has since been analyzed and proven to have been within the current Technical Specification limits.