NRC Form 366 (9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES 8/31/85

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Catawba Nuclear Station, Unit 1	0 5 0 0 0 4 1 3	1 OF 0 6

TITLE (4)
Axial Flux Difference Requirements Not Met Due to Computer Malfunction

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)
0 3	1 7	8 6	8 6	— 0 1 7	— 0 0	0 4	1 6	8 6	N/A	0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9): 1

POWER LEVEL (10): 0 1 5 1 5

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)

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)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
20.405(a)(1)(iii)	X 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)	
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)
Roger W. Ouellette, Associate Engineer - Licensing	7 0 4 3 7 8 1 - 7 5 1 3 0

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 March 17, 1986, at 1815 hours, during a unit shutdown, it was discovered that Axial Flux Difference (AFD) was outside of the Technical Specification required target band. The Operator at the Controls (OATC) had been monitoring AFD with the Excore Power Distribution Monitor (NUCL 06) Program on the Operator Aid Computer (OAC). However, an undetected software malfunction that occurred earlier had disabled one channel of the OAC analog scanner. This disabled the NUCL 06 program, causing a false indication, which appeared to be correct, to be displayed. The failure to detect AFD outside the required target band prevented the compliance with several Technical Specification action statements. The unit was at 55% power when the AFD problem was discovered.

This incident is assigned Cause Code X, Other, due to the failure of the analog scanner on the NUCL 06 program. Also, a contributory Cause Code A, Personnel Error, is assigned due to the OATC relying solely on the OAC for AFD indication, instead of utilizing additional control room indications which were indicating correct AFD.

This incident is reportable pursuant to 10 CFR 50.73, Section (a)(2)(i)(B).

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BACKGROUND

Axial Flux Difference (AFD) is defined as the power generated in the top half of the core minus the power generated in the bottom half of the core expressed in terms of percent total power. The Nuclear Instrumentation (NI) (EIIS:IG) power range detectors are used to detect this difference in power level between the upper and lower half of the core. There are four channels of power range NI (N-41, N-42, N-43 and N-44) located at the four corners of the core. There is an A and B detector associated with each channel. A detectors measure the neutron flux in the upper half of the core, while B detectors measure the neutron flux in the bottom half of the core. Signals from the A and B detectors for each channel are sent to the Operator Aid Computer (OAC) (EIIS:ID) and an AFD meter on the Control Board for display of AFD. The AFD indication is used to identify an imbalance in power production between the top and bottom sections of the reactor core. Since each of the four power range channels monitor a separate quadrant of the core, an axial (top to bottom) power imbalance may be pinpointed to any of the four core quadrants. Control Rod manipulation is performed to keep actual AFD % close to target AFD %, which is 0% at 0% power and changes linearly with power, to its full-power value. For Unit 1, cycle 1 at the present burnup, the full-power target AFD is approximately 0%.

Technical Specification (Tech Spec) section 3.2.1 describes the Limiting Conditions for Operation for AFD. Catawba Unit 1 is presently at a Cycle 1 core average accumulated burnup of greater than 5000 megawatt days/metric ton uranium. Tech Specs require that AFD shall be maintained within a target band of +3% and -9% for this condition. AFD is allowed to deviate outside this target band at power levels greater than or equal to 50% but less than 90% provided the AFD is within the specified Acceptable Operation Limits and the cumulative penalty deviation time did not exceed 1 hour during the previous 24 hours. At greater than 15% but less than 50% of Rated Thermal Power, AFD may deviate outside the target band provided the cumulative penalty deviation time did not exceed 1 hour during the previous 24 hours. Action Statement 3.2.1.a states that if AFD drifts outside of the required target band with thermal power greater than or equal to 90% of Rated Thermal Power, within 15 minutes, either restore AFD to within target band limits, or reduce Thermal Power to less than 90% of Rated Thermal Power. Action Statement 3.2.1.b states that, if AFD is outside the required target band for more than 1 hour of cumulative penalty deviation time during the previous 24 hours, or outside the Acceptable Operation Limits with Thermal Power less than 90% but equal to or greater than 50% of Rated Thermal Power, Thermal Power must be reduced to less than 50% within 30 minutes. Also, the Power Range Neutron Flux High Setpoints must be reduced to less than or equal to 55% of Rated Thermal Power within the next 4 hours.

DESCRIPTION OF INCIDENT

On March 17, 1986, at 1510 hours, unit shutdown began at a rate of 10% per hour to comply with the action statement of Tech Spec 3.0.3. Tech Spec 3.0.3 was entered when it was discovered that the surveillances for nine containment penetrations had exceeded their required performance date (see LER 413/86-16). At 1710 hours and Reactor Power at 80%, the rate of power reduction was changed to 25% per hour. Control rods were then inserted at a faster rate, and Reactor makeup water was added to the Reactor Coolant (NC) System (EIIS:AB) to dilute boron. This was done to allow for later rod withdrawal (in addition to maximum dilution) needed to counter the Xenon buildup that was anticipated if and when the power decrease was halted. During this time period, AFD was being monitored on the Excore Power Distribution Monitoring (NUCL 06) Program on the OAC for the effects of increased control bank insertion.

At 1815 hours, and at 55% Reactor power, personnel discovered the AFD meters on the control board were pegged low at -30%. Personnel checked the meters on the NI cabinets at the rear of the control room which confirmed that the AFD meters were correct and the NUCL 06 Program was inaccurate. Digital voltmeter (DVM) readings were taken to manually calculate AFD. Calculations revealed that AFD was approximately -22% for all channels, which did not agree with the AFD meters, since they were pegged low. (It was later determined that the DVM readings were erroneously taken.)

At 1830 hours, power was reduced below 50%. The OAC was taken out of service and then reinitialized. This returned the NUCL 06 Program to service which showed that AFD was presently -28%. AFD penalty time was calculated from the strip chart for excore detector N-41. From the strip chart, it was determined that AFD exceeded its limits at 1515 hours. Reactor power was held at 49% to comply with Tech Spec requirements on penalty time.

Control rods were withdrawn to restore AFD to within its Tech Spec target band. The setpoint for each channel of excore detectors were readjusted from their normal setpoint of 109% to 55% between 2015 and 2315 hours as required by Tech Specs. Between 2026-2129 hours, Reactor makeup water was added to the NC System to counter Xenon buildup. At 2240 hours, AFD had moved to within its target band. A total of 315 minutes penalty time had accumulated. Therefore, no power increase over 50% could be made until less than 60 minutes of penalty time remained in a 24 hour period.

At 2230 hours, on March 17, 1986, control rods were inserted in Control Bank D to stop the positive AFD swing that was now taking place. Also, more Reactor makeup water was added to the NC System to counter the inward control rod motion. At 0040 hours, on March 18, 1986, Control Rod Bank D was at 74 steps and the AFD positive oscillation was halted.

At 2300 hours, all the AFD penalty time had elapsed and power was increased at 5% per hour. At 1200 hours, on March 19, 1986, Unit 1 returned to 100% power.

CONCLUSIONS

By examining the NSSS Logs, personnel determined that the channel of the analog scanner responsible for the upper and lower power range excore detectors' signals on the NUCL 06 program became disabled sometime between 1000 and 1039 hours. It was during this time period that personnel were in the process of performing periodic test PT/1/A/4600/05A, Incore and NI System Correlation Check. It was concluded that the operation of a movable Incore Detector caused an internal flag to be set that failed a channel of the analog scanner. This caused the signals for upper and lower power range detectors to freeze at their latest scanned value. Therefore, the display for Actual AFD%, which is the difference between upper and lower power, also remained unchanged. However, AFD Deviation % which is the difference between Target AFD% and Actual AFD%, did give the appearance of scanning during this incident. This was due to Target AFD%, which is a function of Total Power %, changing slightly as Total Power % changed. This gave the Operator at the Controls (OATC), who was focusing on AFD Deviation % on the NUCL 06 screen, the impression that the program was updating and was correct. Due to the failure of the analog scanner for upper and lower power range detectors, this incident is assigned Cause Code X, Other.

The OATC, who has responsibility for reviewing operating data in order to ensure safe operation of the plant, was monitoring AFD Deviation % by use of the NUCL 06 screen on the OAC. After the undetected scanner failure occurred, unit shutdown was required due to compliance with Tech Spec 3.0.3 for missed surveillances of containment penetrations. Other personnel were present in the Control Room to assist in controlling anticipated Xenon problems. During the power reduction, the AFD% meters located on the control board were not utilized to monitor AFD%. Although the OAC has a finer resolution, Operations Training stresses that it should not be used as the primary source of information when meters, recorders etc. are available. The OATC questioned the other personnel during the power reduction as to the reason AFD% was not changing much when the rods of Control Bank D were reaching their insertion limit. The other personnel, who also did not originally notice the AFD meters pegged low, provided the explanation that this condition was expected since the rods were passing through the center of the core and bank C had not entered the core. Satisfied with their opinions, the OATC did not stress his concerns to his supervision. Also, on the NUCL 06 program screen the values for upper power and lower power were frozen at 100% while total power was decreasing as expected. If this had also been noticed, the AFD problem could have been stopped earlier. Due to the OATC's failure to utilize the control board meters to assist in monitoring AFD%, a contributory Cause Code A, Personnel Error, is assigned to this incident.

This incident resulted in the violation of Tech Spec Section 3.2.1 when the AFD was not maintained within its target band. The failure to comply with the action statements of Tech Spec 3.2.1 subsequently resulted when the problem was not detected. Action Statement 3.2.1.a, which is applicable for power levels greater than or equal to 90%, was violated when AFD dropped outside the target band and was not returned within 15 minutes. Also, power was not reduced below 90% within 15 minutes of leaving the target band. Action Statement 3.2.1.b.1, which applies to power levels of less than 90% but greater than or equal to 50%, was violated when the AFD drifted outside the target band and power was not reduced to less than 50% within 30 minutes. Also, the Action Statement of 3.2.1.b.2 was violated due to the Power Range Neutron Flux High Setpoints not being reduced to less than or equal to 55% within 4 hours of drifting outside of the target band.

CORRECTIVE ACTION

(1) Power was reduced to below 50%.

(2) Personnel began manual calculation of AFD %.

(3) The OAC was reinitialized, which returned the NUCL 06 program to service.

(4) Reactor power was held below 50% until there was no AFD penalty time accumulated in a 24 hour period.

(5) All the setpoints for Power Range NI were reset to 55%.

(6) AFD % was returned to within its required target band.

(7) A patch was placed on the NUCL 06 program that will cause automatic re-initialization when the analog scanner fails.

(8) The software of the NUCL 06 program was changed to give an alarm when the power range upper and lower channels' OAC points fail to change when the OAC updates their values.

(9) An Operator Update was issued that stressed to Control Room Operators that the OAC should not be used as the primary indication for plant parameters where meters and recorders are available. Also stressed was the importance of keeping shift supervision informed about concerns or questions on plant conditions.

(10) An internal memorandum was routed to the responsible group that reminded personnel of expected responses to watch for during power changes.

(11) An investigation will be initiated to determine the exact cause of the analog scanner for the NUCL 06 program failure.

SAFETY ANALYSIS

During the power decrease that took place during this incident, the Tech Spec AFD limit was exceeded for 7 hours. The purpose of the Tech Spec AFD limits is to prevent the Heat Flux Hot Channel Factor, F_Q (Z), from increasing to a point where peak clad temperature would exceed 2200 degrees F under LOCA conditions.

F_Q(Z) is the maximum local heat flux on the surface of a fuel rod at core elevation Z, divided by the average fuel rod heat flux. This transient was modeled using the MODE-P Analysis Methodology. The analysis yielded AFD, axial power shapes, and F_Q at each hour during the transient. Another analysis was performed using the NUC MARGINS code that provided a better estimate of F_Q. Below is a table of the predicted parameters for both analyses.

TIME	%POWER	AFD%	CONTROL D POSITION	NODE-P CALC. F_Q	NUC-MARGINS F_Q	TECH SPEC F_Q LIMIT
1500	99	-8.6	205	1.78	1.90	2.33
1600	91	-16	184	1.93	2.06	2.54
1700	82	-23	165	2.17	2.32	2.83
1800	60	-33	90	2.93	3.14	3.87
1900	45	-29	86	3.19	3.43	4.64
2000	49	-17	211	2.45	2.61	4.64
2100	48	-16	228	2.39	2.55	4.64

The F_Q limit is determined from the equations given in Tech Specs 3.2.2. As power shifted to the bottom of the core, total core power decreased causing the F_Q limit to markedly increase. However, from the two models performed, it can be seen that F_Q did not exceed its limits. Therefore, peak clad temperature during a LOCA situation would not have exceeded 2200 degrees F.

The safety and health of the public were not affected by this incident.

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April 16, 1986

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

Subject: Catawba Nuclear Station, Unit 1
Docket No. 50-413

Gentlemen:

Pursuant to 10 CFR 50.73 Section (a) (1) and (d), attached is Licensee Event Report 413/86-17 concerning Axial Flux Difference requirements not being maintained due to a computer malfunction.

This event was considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

Hal B. Tucker/pm

Hal B. Tucker

RWO:slb

Attachment

IE22
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xc: Dr. J. Nelson Grace, Regional Administrator
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