NRC FORM 366 (12-81)

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT

APPROVED BY OMB 3150-0011 EXPIRES 4-30-82

CONTROL BLOCK: ① (PLEASE PRINT OR TYPE ALL REQUIRED INFORMATION)

0 1	NCMGS2 ② LICENSEE CODE	00-00000-00 ③ LICENSE NUMBER	41111 ④ LICENSE TYPE	⑤ CAT

CON'T

0 1	REPORT SOURCE L ⑥	05000370 ⑦ DOCKET NUMBER	101583 ⑧ EVENT DATE	120183 ⑨ REPORT DATE

EVENT DESCRIPTION AND PROBABLE CONSEQUENCES ⑩

During rapid power reduction due to problems with a steam generator feedwater isolation valve, the reactor coolant system average temperature decreased below 551°F for app. four minutes with reactor power at 30%, and again for app. 13 minutes with reactor power decreasing from 11% to 3%. This exceeding of the minimum temperature for criticality (T.S.3.1.1.4) is reportable pursuant to T.S.6.9.1.11(b). Operators were cognizant of and responding to all major plant parameters, and were ready to insert rods or take other measures had the need arisen. Health and safety of the public were unaffected.

	SYSTEM CODE	CAUSE CODE	CAUSE SUBCODE	COMPONENT CODE	COMP SUBCODE	VALVE SUBCODE
0 9	RB ⑪	D ⑫	Z ⑬	ZZZZZZ ⑭	Z ⑮	Z ⑯

⑰ LER/RO REPORT NUMBER	EVENT YEAR		SEQUENTIAL REPORT NO.		OCCURRENCE CODE	REPORT TYPE		REVISION NO.
	83	—	062	/	03	L	—	0

ACTION TAKEN	FUTURE ACTION	EFFECT ON PLANT	SHUTDOWN METHOD	HOURS ㉒	ATTACHMENT SUBMITTED	NPRD-4 FORM SUB.	PRIME COMP. SUPPLIER	COMPONENT MANUFACTURER
G ⑱	Z ⑲	A ⑳	A ㉑	0024	Y ㉓	N ㉔	Z ㉕	Z999 ㉖

CAUSE DESCRIPTION AND CORRECTIVE ACTIONS ㉗

This is attributed to administrative deficiency, the control operator excessively borated the reactor coolant system during rapid power reduction by boration. No training or guidelines were available to assist the operator in his necessarily rapid assessment of the correct boration time. Procedures were revised to address borating, and the approved method of rapid power reduction changed to insertion of control rods.

	FACILITY STATUS	% POWER	OTHER STATUS ㉚	METHOD OF DISCOVERY	DISCOVERY DESCRIPTION ㉜
1 5	X ㉘	030 ㉙	Mode 1	A ㉛	Control Room Alarm

	ACTIVITY RELEASED	CONTENT OF RELEASE	AMOUNT OF ACTIVITY ㉟	LOCATION OF RELEASE ㊱
1 6	Z ㉝	Z ㉞	NA	NA

PERSONNEL EXPOSURES

	NUMBER	TYPE	DESCRIPTION ㊴
1 7	000 ㊲	Z ㊳	NA

PERSONNEL INJURIES

	NUMBER	DESCRIPTION ㊶
1 8	000 ㊵	NA

8312160147 831201
PDR ADOCK 05000370
S PDR

LOSS OF OR DAMAGE TO FACILITY

	TYPE	DESCRIPTION ㊸
1 9	Z ㊷	NA

PUBLICITY

	ISSUED	DESCRIPTION ㊺	NRC USE ONLY
2 0	N ㊹	NA	

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December 31, 1983

Mr. James P. O'Reilly, Regional Administrator
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street NW, Suite 2900
Atlanta, Georgia

Subject: McGuire Nuclear Station Unit 2
Docket No. 50-370
LER/RO-370/83-62

Dear Mr. O'Reilly:

Please find attached Reportable Occurrence Report RO-370/83-62. This report concerns T.S. 3.1.1.4, "The Reactor Coolant System Lowest Operating Loop Temperature (T_{avg}) Shall Be Greater Than Or Equal To 551°F". This incident was considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

H.B. Tucker /BS

Hal B. Tucker

PBN:jfw
Attachment

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

Records Center
Institute of Nuclear Power Operations
1100 Circle 75 Parkway, Suite 1500
Atlanta, Georgia 30339

Mr. W. T. Orders
NRC Resident Inspector
McGuire Nuclear Station

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DUKE POWER COMPANY
MCGUIRE NUCLEAR STATION
REPORTABLE OCCURRENCE REPORT NO. 370/83-62

REPORT DATE: December 1, 1983

FACILITY: McGuire Unit 2, Cornelius, NC

IDENTIFICATION: Unit 2 Reactor Coolant System T_{AVE} <551°F During Power Reduction

DESCRIPTION: During rapid power reduction on October 15, 1983 the reactor coolant (NC) system average temperature (T_{AVE}) decreased below the minimum temperature for criticality allowed by Technical Specification 3.1.1.4. The specified minimum of 551°F for any NC system loop, while operating in Modes 1 or 2 with K eff $\geq$ 1.0, was exceeded for approximately four minutes with reactor power ~30.4%. The minimum T_{AVE} was again exceeded (low of 537.6°F) for approximately thirteen minutes with reactor power decreasing from ~11% to ~3%.

This incident is attributed to Administrative Deficiency. The incident occurred because the Control Operator excessively borated the NC system during rapid power reduction by boration. However, no training or guidelines were available to assist the Operator in his necessarily rapid assessment of the correct boration time. Also, the existing station policy did not permit, in this instance, power reduction by control rod insertion.

EVALUATION: During power reductions effected by control rod insertion, axial power distribution changes from that which exists during continuous operation at a given power level. Axial variations in power are measured by changes in the axial flux difference (AFD), which is limited by Technical Specification 3.2.1 to a target band. Deviation from this target band for more than 60 minutes during the previous 24 hours results in a 50% maximum power limit imposed by the Specification action statement. Station policy was to avoid all penalty time to ensure that AFD remained within an analyzed range and to ensure that a power limitation would not be imposed. The proper method of power reduction (as mandated by the policy) was to increase boron concentration in the NC system. Boron addition decreases reactor power without the undesirable AFD effects which arise from control rod insertion.

Control Operators receive no simulator training in rapid power reductions by boration. Power reductions on the simulator are accomplished through rod insertion with rod control in AUTO. AFD penalty time is not a consideration for simulator operation because of training time constraints and further, because the operator aid computer (OAC) program which monitors AFD does not exist on the simulator.

Operators have gained some experience through earlier rapid power reductions, but the effects of boron addition change as remaining core life decreases. Also, the effects differ between McGuire's two operating units. Generally, though, the full effects of boron addition are not manifested for 15 to 30 minutes after boration is terminated. This means that reactor power will continue to decrease (due to boron effects alone) after the boron addition is complete. In conjunction with this effect, total core xenon concentration begins to increase (due to the power reduction) and reactor power is driven even lower. An additional observation is that boron effects occur with peaks at 2 different times. It is thought that this occurs because boron is not uniformly mixed in the NC system.

On October 15, 1983, control room operators received alarm indication that steam generator (S/G) feedwater isolation valve, 2CF-35, was not fully open. Investigation found the valve to be not fully open and slowly drifting closed. (See RO-370/83-63 for an account of the valve repair.) It was decided to decrease power to 30% power which would have allowed feeding the S/Gs through the upper nozzles, thus bypassing 2CF-35 (which isolates the lower nozzle) and permitting repair.

Boric acid to charging pumps control valve 2NV-265B was opened, admitting ~34 gpm of high concentration boric acid (7000-7700 ppm) to the NC system. The Control Operator felt that by terminating boration with reactor power at 45%, he would be able to stabilize power at ~30%, allowing 15% for the delayed reactivity effects he had seen earlier. Had time allowed, the Operator could have calculated the appropriate boron addition (compensated for xenon buildup) and converted to the required boration time. The power defect curve in the control room Data Book contains the necessary data, but the computation is fairly time consuming, and the Operator was forced to act quickly due to the precarious status of 2CF-35.

All major plant parameters remained within tolerance as thermal power was reduced to 45%. Boration was terminated, reactor power continued to decrease as expected, and electric power reduction continued at 20 MW per minute. Approximately 44 minutes into the event, 12 minutes after cessation of boron addition, low T_{AVE} alarms were received in the control room. (The Control Operator had observed the T_{AVE} decrease and had begun to withdraw control rods as a countermeasure.) In response, 2NV-252A, Makeup Water Supply to Boric Acid Blender control valve, was opened to begin dilution of the NC system. About 1 minute after the low T_{AVE} alarms were sounded, T_{AVE} for all loops decreased below 551°F. Electric power reduction was then increased to 50 MW per minute to reduce heat removal from the NC system. T_{AVE} recovered to $\geq$551°F for all NC loops approximately 48 minutes into the event.

Reactor power stabilization would have required a decrease in boron concentration of ~1 ppm per minute to counter the increasing xenon worth rate. Charging rate at the time was at its maximum (120 gpm) and boron concentration was being decreased at about 1 ppm per minute. Xenon worth rate, however, continued to increase to a maximum of ~12.76 pcm 71 minutes into the transient. Also, the second peak in boron addition effects occurred at this time (~19 minutes after boration was stopped).

After 51 minutes, T_{AVE} again started to decrease and T_{AVE} for all NC loops was <551°F approximately 60 minutes into the transient. Generator output reduction was continued in an effort to recover T_{AVE}. At 68 minutes, about the time of the lowest T_{AVE} (537.6°F), the generator controls were placed in manual and output was reduced from 62 MW to 0 in two minutes. The generator breakers were then opened, and control rod insertion for reactor shutdown was begun two minutes afterwards. T_{AVE} for all NC loops was $\geq$551°F at 73 minutes. Reactor power was reduced to zero at 79 minutes.

CORRECTIVE ACTION: During both periods while any of the NC loops' T_{AVE} was less than 551°F, the Control Operator was diluting the NC system boron concentration, withdrawing control rods, and decreasing generator output.

Operating Procedure "Boron Concentration Control" has been revised to address borating through 2NV-265B. Enclosure 4.8 has been added to the procedure and procedure steps require that the power defect curve (in the control room Data Book) be consulted for a determination of how much boron to add for a given power reduction. Further, the Control Operator is required to close 2NV-265B if he cannot continuously monitor boron addition to the NC system.

The station policy has been amended to make AFD penalty time a secondary consideration in emergency situations. The approved method of rapid power reduction is now by insertion of control rods. This policy change was communicated to the Shift Supervisors at a meeting on October 28. The change was subsequently explained to the Control Operators.

SAFETY ANALYSIS: Analysis indicates that the moderator temperature coefficient remained negative throughout the transient. The lease negative MTC coincided with the occurrence of the minimum T_{AVE} and is estimated to have been -2.0 PCM/°F. Despite wide swings in PZR pressure (attributable to the characteristics of the proportional/integral PZR control system), the NC system remained in a subcooled state with a steam space and water level in the PZR. The minimum NC system temperature of 537.6°F was much greater than the vessel RT_{NDT} temperature.

The control room operators were cognizant of, and responding to all major plant parameters and were ready to insert rods or take other extraordinary measures had any development warranted such action. The health and safety of the public were unaffected by this incident.