NRC FORM 366 (7-77)

UPDATE REPORT - PREVIOUS REPORT DATED 7/ /80

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT

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

0 1 | A L B R F 3 (2) | 0 0 - 0 0 0 0 0 - 0 0 (3) | 4 1 1 1 1 (4) | | | (5)

LICENSEE CODE 9–14; LICENSE NUMBER 15–25; LICENSE TYPE 26–30; CAT 57–58

CON'T 0 1 | REPORT SOURCE L (6) | 0 5 0 0 0 2 9 6 (7) | 0 6 2 8 8 0 (8) | 0 7 2 8 8 0 (9)

DOCKET NUMBER 61–68; EVENT DATE 69–74; REPORT DATE 75–80

EVENT DESCRIPTION AND PROBABLE CONSEQUENCES (10)

0 2 During a routine shutdown for maintenance, when reactor was manually scrammed, 76
0 3 of 185 control rods failed to fully insert. Following two additional manual scrams and
0 4 a reset in preparation for a third manual scram (during which an automatic scram
0 5 occurred) the rods were fully inserted into the core. See Technical Specification
0 6 3.3.A.1. The unit was placed in cold shutdown. There was no danger to the health and
0 7 safety of the public. No previous occurrences.
0 8

	SYSTEM CODE (11)	CAUSE CODE (12)	CAUSE SUBCODE (13)	COMPONENT CODE (14)	COMP. SUBCODE (15)	VALVE SUBCODE (16)
0 9	R B	X	Z	C O N R O D	Z	Z

(17) LER/RO REPORT NUMBER	EVENT YEAR		SEQUENTIAL REPORT NO.		OCCURRENCE CODE	REPORT TYPE		REVISION NO.
	8 0	—	0 2 4	/	0 1	T	—	1

ACTION TAKEN (18)	FUTURE ACTION (19)	EFFECT ON PLANT (20)	SHUTDOWN METHOD (21)	HOURS (22)	ATTACHMENT SUBMITTED (23)	NPRD-4 FORM SUB. (24)	PRIME COMP. SUPPLIER (25)	COMPONENT MANUFACTURER (26)
X	X	A	B	0 2 6 4	Y	Y	N	G 0 8 0

CAUSE DESCRIPTION AND CORRECTIVE ACTIONS (27)

1 0 The event cause description and the corrective actions taken are
1 1 given in the attachment. The control rod system was supplied by the
1 2 General Electric Company.
1 3
1 4

	FACILITY STATUS (28)	% POWER (29)	OTHER STATUS (30)	METHOD OF DISCOVERY (31)	DISCOVERY DESCRIPTION (32)
1 5	D	0 3 7	NA	A	Operator Observation

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

PERSONNEL EXPOSURES

	NUMBER (37)	TYPE (38)	DESCRIPTION (39)
1 7	0 0 0	Z	NA

PERSONNEL INJURIES

	NUMBER (40)	DESCRIPTION (41)
1 8	0 0 0	NA

LOSS OF OR DAMAGE TO FACILITY

	TYPE (42)	DESCRIPTION (43)
1 9	Z	NA

8008040 /67

PUBLICITY

	ISSUED (44)	DESCRIPTION (45)	NRC USE ONLY
2 0	Y	Press release	

NAME OF PREPARER ______________________ PHONE: ______________________

Tennessee Valley Authority
Browns Ferry Nuclear Plant

Form BF-17
BF 15.2
1/10/79

LER SUPPLEMENTAL INFORMATION

BFRO-50- 296 / 8024 Technical Specification Involved 3.3.A.1

Reported Under Technical Specification 6.7.2.A.5

Date of Occurrence 6-28-80 Time of Occurrence 0130 Unit 3

Identification and Description of Occurrence: During a routine shutdown for maintenance when reactor was manually scrammed, 76 of 185 control rods failed to fully insert. Following two additional manual scrams and a reset in preparation for a third manual scram (during which an automatic scram occurred) the rods were fully inserted into the core. See Technical Specification 3.3.A.1. The unit was placed in cold shutdown. There was no danger to the health and safety of the public.

Conditions Prior to Occurrence:

Unit 1 - 95% steady state power

Unit 2 - 95% steady state power

Unit 3 - 400 MWe

Action specified in the Technical Specification Surveillance Requirements met due to inoperable equipment. Describe.

Unit was placed in cold shutdown.

Apparent Cause of Occurrence:
See the attached.

Analysis of Occurrence:

There was no danger to the health or safety of the public, no release of activity, or damage to the plant or equipment, and no significant resulting chain of events.

Corrective Action:
1. Items addressed in Sections VII thru X of attached portion of TVA safety evaluation have been accomplished.
2. Positive vent installed on east side header vent.
3. Implemented NRC IE Bulletin 80-17 testing
4. Further investigation of possible modifications will be done.

Failure Data:
None

*Retention: Period - Lifetime; Responsibility - Administrative Supervisor

*Revision: [signature]

I. EVENT DESCRIPTION

On June 28, 1980, power was reduced to 390 MWe on Browns Ferry unit 3 by decreasing the recirculation flow and inserting 10 power rods in preparation for a scheduled shutdown for feedwater system maintenance. At 0130 hours, the operator initiated a manual scram to complete the shutdown operation.

All control rod drives (CRD) received a scram signal as observed by the operations personnel and the shift technical advisor. All the west bank rods (92) scrammed full-in except rod 30-23, which settled at position "02." However, on the east bank, 75 rods out of the 88 withdrawn failed to fully insert and came to rest at various notch positions, from positions 46 to 02 (average insertion 10 notches).* The core power was substantially reduced from 36 to less than or equal to 2-percent by the partial insertion and level control was maintained normally by the feedwater control system.

Following a drain of the scram discharge volume for periods of 93 and 53 seconds, respectively, the operator manually scrammed the reactor two additional times with rod insertion occurring both times. The scram discharge volume was then allowed to drain a third time for 160 seconds. Upon removal of the scram discharge level bypass, the reactor auto-scrammed on high drain volume. The remaining withdrawn control rods were then observed to insert at normal speed. A sequence of events is shown below in Table 1. The total time elapsed between the initial scram and final insertion of the control rods was 14 minutes.

TABLE 1
Sequence of Events

Time		Event
0	seconds	#1 scram (manual)
271	"	#1 scram reset
364	"	#2 scram (manual)
423	"	#2 scram reset
476	"	#3 scram (manual)
682	"	#3 scram reset
842	"	#4 scram (auto) - all rods at "00"

At this point, the operators continued the normal shutdown operation.

*One rod notch is equivalent to two numerical positions.

II. CORE ANALYSIS

The first manual scram was initiated from 36% power and 40% recirculation flow. The shift technical advisor initiated a process computer scan of the local power range monitors (LPRM's) after completion of the scram. While it was not determined whether the core was critical, an estimate based on LPRM readings determined that power level in the vicinity of the partially scrammed rods was less than or equal to 2%. The heat flux at this power level is very low and there is no possibility of fuel damage or violation of fuel safety limits. Off-gas data and reactor coolant samples have been analyzed and are within their expected ranges.

III. POST INCIDENT INSPECTION

Following the event on June 28, 1980, TVA conducted various inspections and reviews as summarized:

1. Hydraulic Control Units - Immediately after the event, operations and a maintenance engineer independently verified the valve lineup to be normal on the east bank hydraulic control units (HCU's). Accumulator recharge was verified in the control room. General Electric engineers subsequently also verified the HCU's lineup.

2. The scram instrument discharge header vents and drain valves were operated as expected. Also, one of the vent valves was pulled and a 1.35 CFM vacuum pump was connected on the drainage side. A vacuum of 8 inches of mercury was pulled for a short period which dropped sharply to 2 inches. With the test set-up and test equipment used, a reading of 2 inches is considered equivalent to zero vacuum. The reason for this temporary 8-inch mercury vacuum was not determined.

3. The scram discharge instrument volume level switches were calibrated. The low-level (3 gallon) and rod block (25 gallon) switches did not operate during the first calibration fill. Some residue was flushed from the instrument taps and these two switches then operated satisfactorily. Recorded data and operator observation did indicate that these two switches worked at least during part of the incident. The 4 high-level scram (50 gallon) switches were tested with no problems.

4. Scram History Review - The scram histories for Browns Ferry units 1, 2, and 3 were reviewed for rod insertion or any other irregularities. Out of 320 scrams, several instances of single rods latching at "02" were noted, but cannot be related to the subject event. One recent occurrence on Browns Ferry unit 1 was examined in which the group 2 and 3 scram solenoids were deenergized and reset before completion of the scram stroke. This action resulted in halting a number of rods before full insert position was reached. A true scram signal was not, however, present in this case, and the event is unrelated.

5. Control Rod Drive History - A history of recent rod drive performance was examined for possible relationship to the unit 3 occurrence. No problems were noted that could contribute to the event.

Maintenance Review - A preliminary review was made of recent maintenance and modification activities on Browns Ferry unit 3 CRD system. There is no evidence that these activities could have contributed to the problem of June 28, 1980. Review of maintenance and modification activities is continuing.

IV. EVALUATION OF POSSIBLE CRD SYSTEM MALFUNCTIONS

A. Electrical/Control Failure

1. Failure to Process Scram Signal - Following the first manual scram, the unit operator and shift technical advisor verified that the blue scram indicator light for each control rod was illuminated. This light is activated by spring-mounted position switches (direct indication) on the scram inlet and scram outlet valves. Both valves for each control rod must be in the open position to activate the indicator light for the individual control rod. Illumination of all lights confirms that each scram inlet and outlet valve responded to the manual scram signal. Rod position data showed that each rod that was not fully inserted moved inward following each scram.

Response times required for the scram actuators to fully deenergize were verified to be well within the allowable time by performance of SMI 150, "Scram Solenoid Response Time." Electrical independence of each rod scram group was verified by performance of SEMI 19, "Scram Pilot Valve Electrical Independence Test."

2. Interference from Reactor Manual Control System - The RMCS controls and programs electrical power to valves in the CRD hydraulic system for normal control rod in and out movement. The system is configured for single rod operation. Postulated gross failure of the reactor manual control system and initiation of multiple control rod drive withdrawal signals will not prevent rod insertion during scram since the insert forces are 3.3 times greater than the withdrawal forces under these conditions.

B. Release of Nitrogen to the Scram Discharge

If nitrogen were present, it would act no differently than the air in the discharge volume and is, therefore, of no consequence.

C. Isolation Valves Closed on Multiple HCU's

Incorrect valve lineup would prevent rod insertion during scram. Following the event, each hydraulic control unit was checked and correct valve lineup was verified.

D. Multiple CRD Seal Failure

During scram, multiple CRD seal failure may result in excessive flow to the scram discharge headers. The scram discharge headers are sized to accommodate this most unlikely occurrence. Control rod drive stall flows will be checked to verify seal integrity on the east bank as a part of the planned functional rod tests prior to startup.

E. Multiple Scram Outlet Valve Leakage

Leakage from the scram outlet valves would flow to the scram discharge headers. If the flow rate into the header was to exceed the flow rate out of the header, the available scram discharge volume would be reduced. Insufficient discharge volume would restrict or prevent control rod insertion during scram. The leakage from the outlet valve would cause reactor water to flow through the CRD and increase the temperature of the drive. CRD temperature charts were reviewed following the event; drive temperatures were normal.

F. Failure of the East Side Vent

Valve failure, vent line blockage, or other vent system problems could have prevented complete drainage of the east side header following the last scram. If so, sufficient volume may not have been available to accept the scram discharge water; control rod insertion would be restricted during scram. Inspections and tests following the event could not prove or disprove possible valve malfunction or line blockage. However, line blockage may have been cleared by the pressure increase (1000 psi) in the SDV header following scrams.

G. Blockage in the Drain Line from the East Side Header to Scram Discharge Instrument Tank

As discussed above, failure to drain the header would restrict rod insertion during scram. Inspections and test following the event could not detect drain line blockage. However, any blockage present may have been cleared by the pressure increase (1000 psi) in the drain following scrams.

H. Failure of Drain Valve

Failure of the SDIV tank to drain would be detected by installed level switches.

V. EVENT SEQUENCY ANALYSIS

Evaluation of the event recorder and process computer output lends evidence to the initial presence of excessive water in the east bank scram discharge headers prior to the manual scram.

The most obvious observation is the successful insertion of the west bank rods, while most of the east bank rods had difficulty. Also, the time to actuate the scram discharge instrument volume (SDIV) high-level switches was about 19 seconds. The fill time for the 10 preceding scrams on unit 3 fell between 42 seconds and 54 seconds. Therefore, the 19-second fill time was most irregular and infers a considerable volume of water was already present.

There is also an approximate correlation between the drain times between the second, third, and fourth scrams, and the total notches inserted on each scram. The drain times are tabulated below:

Scram	Between Scrams	Scrams	Total Notches Inserted
1-2	93 sec.	#2	478
2-3	53 sec.	#3	201
3-4	160 sec.	#4*	400

As a first approximation, it is estimated that one second of drainage time will provide enough discharge volume to allow 4.6 notches of rod insertion. Time between the third and fourth scrams (160 seconds) would, in theory, allow 736 notches to be inserted. Since only 400 rod notches were left out after the third scram, it is predicted that the fourth scram would be successful in inserting the remaining rods.

VI. SUMMARY OF FINDINGS

Based on the event description, the discussion of possible system malfunctions, and the event sequency analysis, failure of all rods to fully insert during scram is attributed to a reduction in scram discharge volume due to retention of water in the east side header.

VII. PHYSICAL INSPECTIONS

The 2-inch scram discharge volume drain line was checked for blockage from where it ties into the 6-inch east scram discharge header up to the scram discharge volume instrument tank. Six cuts were made in the piping and each section of piping was rodded out with a metal tape. No obstructions were located. In addition, a section of piping was flushed with demineralized water. No flow restrictions were identified and only a very fine silt-like residue was observed at the discharge.

*All rods scram to "00."

The scram vent volume was inspected by making cuts where each vent line ties into each scram header. The common vent line on the reactor building drain side of the vent isolation valve was also cut. Each vent line was flushed; no restrictions were observed at the discharge of the flush line. A 1.35 CFM vacuum pump was hooked to the common vent line; after 15 minutes of pumping, a vacuum could not be established.

The 6-inch scram discharge header was inspected using fiberoptics at the 2-inch drain line penetration and at each of the vent line penetrations. A fine residue was observed in the header. The header was then flushed and reinspected. No foreign objects were observed.

The scram discharge volume (SDV) tank was visually inspected by inserting a boroscope through the vent penetration. No foreign matter other than a fine residue was observed. The drain line from the tank was inspected and found to be free of foreign objects.

The 2-inch SDV drain line was checked for slope from the scram discharge volume to the scram discharge volume tank. The drain line showed a downward slope from the scram discharge volume to the SDVT over the full length of the line except for a 1-5/8 inch rise on the expansion loop in the steam vault. This has been evaluated by the General Electric Company and judged to have no adverse consequences. The overall drop from the drain line tie-in to the discharge volume to the SDVT is approximately 1 foot 7 inches. Also, each 6-inch header was inspected and determined to have an adequate slope for drainage.

The air lines from the air dryer to the CRD system on the unit 3 east header were traced out with no abnormalities identified.

The unit 3 reactor building equipment drain sump was visually inspected. It contained a typical buildup of corrosion products and sludge on the bottom of the sump. No objects were found which would block a 2-inch drain line.

VIII. SUMMARY OF DRAIN AND VENT TESTS

A series of tests was conducted to determine the drainage characteristics of the scram discharge volume. These tests consisted of filling the discharge instrument tank and headers with demineralized water, then measuring drain times and flow rates for various combinations of drain and vent valve positions. Preliminary analysis of the test results supports the following conclusions and observations:

1. Accurate measurement of the water level within a discharge header is possible using ultrasonic equipment.

2. A closed vent will impede the drainage of the affected header. The time to totally drain the header would be several hours (assuming that no makeup source is available). In this case, if the instrument volume drain valve is open, the level switches provide no assurance that the discharge headers are drained.

3. The equipment drain header was monitored during the tests. No indications of negative pressure were observed. Also, the vent valves were removed and an attempt was made to pull a vacuum on the east and west side vent piping, with no success. All observations indicated that the vent header system was working properly.

4. The measured drain time of the entire system was about 30 minutes. The west side volume drained in 9½ minutes. Measured east header flow rates, following drainage of the west header, varied from 13 gpm to 6 gpm as the header volume emptied. The instrument volume can pass approximately 44 gpm when full. Accordingly, it is estimated that a standing volume of water could be established in the east side header if the inleakage is greater than 6 gpm. This rate of flow would not be detected by the scram discharge instrument volume level switches if the drain valve were open. Available data indicates that multiple scram discharge valves would have to be leaking to achieve inleakage rates of this order. This condition would be annunciated by marked temperature increase in the affected rods.

IX. CONTROL ROD TESTS

The following additional tests were completed.

1. Friction and stall flow tests east bank rods that failed to insert. This test was performed prior to startup to:

    a. verify normal insert/withdraw operation of the CRD's
    b. prove no binding of the drives either external or internal exits
    c. verify integrity of the drive seals

2. Full scram from position "00." This test was performed prior to startup to provide further assurance of the proper operation of the reactor protection system and operation of the vent header system.

3. Selected Rod Scrams - Prior to startup, individual scrams will be performed on 10 rods from the east side. The rods to be scrammed and documented in Attachment 1* and were chosen to include five rods which partially inserted and five rods which inserted fully during the June 28, 1980, incident. Accumulator pressure will be reduced for this test to protect the rod drives.

4. East Bank Rod Scrams - After the reactor is brought to rated pressure and temperature, all the rods on the east bank which failed to insert initially during the June 28, 1980, event, will be individually scram-timed to verify compliance with technical specifications speeds.

*Letter from A. L. Vest, General Electric Company, to H. L. Abercrombie, Plant Superintendent, BFNP, dated July 4, 1980.

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5. Manual Scram from Power - The reactor will be manually scrammed at minimum recirculation speed. Since the rod density at this power level has approximately half of the rods withdrawn, this will be a representative test of overall scram system operability. All testing required by IE 80-17 was completed prior to restart.

X. VERIFICATION OF SYSTEM OPERABILITY

In addition to the inspections and tests performed to verify system operability and ensure adequate drainage of the scram volume headers, TVA will promptly incorporate the following measures:

1. Monitor the scram discharge headers daily.

2. Increase the test frequency of the scram discharge volume level switches to once per month.

3. Develop procedures to verify that the scram discharge volume is free of residual water following each scram and before startup.

4. Visually inspect each hydraulic control unit daily to ensure that the manual valves are in their normal position.

5. Verify daily the normal position indication of SDV vent valves and drain valves.

6. Additional requirements of IE 80-17 will be implemented in accordance with that document.

Attachment 1 364 L-20

7-4-80

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GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY . . . . . . 832 GEORGIA AVENUE
CHATTANOOGA, TENNESSEE 37402, Phone (615) 894-2550

INSTALLATION AND SERVICE ENGINEERING DEPARTMENT

G-EP-0-118

July 4, 1980

cc: J. R. Calhoun
S. F. Dillworth
L. W. Mills

Mr. H. L. Abercrombie
Browns Ferry Nuclear Plant
P. O. Box 2000
Decatur, AL 35602

Dear Mr. Abercrombie:

General Electric has reviewed the proposed scram testing at Browns Ferry 3 and believes all safety requirements can be satisfied provided:

1. The testing of the control drives (function and stall flow) are satisfactorily completed.

2. Ten (10) control rods are scram tested prior to achieving criticality. These are control rods:

22-03	34-07
18-55	06-35
26-51	14-35
06-47	34-39
10-43	26-55

3. All systems required by the technical specifications to be operable prior to startup are operable.

4. Both the RWM and the RSCS are operable during the approach to criticality.

5. Specific attention should be paid to expected performance of the control rods during rod maneuvering.

It is General Electric's opinion that all safety analysis are acceptable for the proposed test during heatup if conducted in manner described by TVA.

With respect to the control rod drop accident, it is General Electric's opinion that the consequences are within acceptable limits even if the control rods fail to scram. The limiting condition is a rod drop from cold critical. For this event, the constrains of the RSCS and RWM will limit the accident reactivity insertion and the Doppler defect will terminate the power increase. The event will be terminated by an increase in the moderator temperature cold condition can be reached by manual insertion of the control rods or initiation of the SLCS.

Very truly yours,

D W Diefenderfer for

A. L. Yest
Service Supervisor - Nuclear

ALY:DWD:mav