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): CRYSTAL RIVER UNIT 3

DOCKET NUMBER (2): 0 5 0 0 0 3 0 2

PAGE (3): 1 OF 7

TITLE (4): ELECTRICAL FAULT IN 230 KV TRANSMISSION SYSTEM

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)
									N/A	0 5 0 0 0
0 2	2 8	8 4	8 4	0 0 3	0 0	0 3	2 9	8 4	N/A	0 5 0 0 0

OPERATING MODE (9): 1

POWER LEVEL (10): 0 7 4

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)	[X]	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)	[ ]	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: W. K. Brandhauer

TELEPHONE NUMBER: AREA CODE 9 0 4 | 7 9 5 - 6 4 8 6

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
B	F K	L A R	G 0 8 0	N					
X	F K	2 1	G 0 8 0	N					

SUPPLEMENTAL REPORT EXPECTED (14)

[ ] YES (If yes, complete EXPECTED SUBMISSION DATE) [X] NO

EXPECTED SUBMISSION DATE (15): MONTH | DAY | YEAR

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

On February 28, 1984, Crystal River Unit 3 (CR-3) was operating at about 74% reactor power and 650 MWe with four reactor coolant pumps running. The 'B' emergency diesel generator was synchronized to the grid for periodic test.

At approximately 1039 a fault occurred in the 230 KV electrical system external to CR-3 eventually resulting in brief loss of power to Unit 3 startup transformer. The power loss resulted in a reactor shutdown due to loss of power to the control rod drive mechanisms.

The 'B' emergency diesel generator output breaker was locked out after tripping on generator field overcurrent. The 'A' diesel generator picked up the 'A' ES bus loads. Reactor cooling was accomplished by emergency feedwater supplied to the steam generators.

The plant electrical line-up was a major factor in this event and it is to be re-examined. Training will be conducted to assure proper control of pressurizer level during plant transients.

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BACKGROUND

On February 28, 1984, Crystal River Unit 3 was operating at about 74% reactor power and 650 MWe(1) with four RC pumps (AB, P) operating. The "B" diesel generator (EK, DG) was synchronized to the grid for periodic testing. Power was limited by repair of waterbox "A" (KE, COND).

The turbine driven emergency feedwater pump (BA, P) was also undergoing performance of a surveillance procedure. The "B" emergency diesel was undergoing surveillance testing and was synchronized to the power distribution grid via the 4160v ES bus 3B (EK, BU) and the Unit 3 startup transformer (FK, XFMR).

The 4160v unit busses 3A and 3B (EA, BU) were powered from the Unit 3 startup transformer. The reactor coolant pumps (6900V Reactor Aux Bus (EA, BU)) were powered from Unit 3 auxiliary transformer (EA, XFMR). The powering of the 4160/480 busses from the startup transformer and the 6900 volt busses from the auxiliary busses is the lineup selected, based on operating experience, to be the most reliable line-up to avoid the loss of MFW pumps (SJ, P) following a reactor trip.

IDENTIFICATION OF EVENT

At approximately 1039, a ground fault occurred in the 230 KV electrical system external to CR-3. The fault was subsequently determined to be caused by the failure of a lightening arrestor (FK, LAR) on one of the CR-1 step-up transformers (FK, XFMR). The automatic fault isolation capability of the electrical transmission system functioned to isolate the fault. A 230 KV protective relay malfunction (FK, 21) and subsequent external electrical transmission system instability resulted in a momentary loss of the 230 KV supply (4 to 5 seconds) to the CR-3 startup transformer. The loss of power resulted in a reactor (AB, RCT) shutdown most likely caused by the loss of power to the Control Rod Drive Mechanisms (AA, MO). This report also identifies other possible causes for the reactor trip.

The fault caused a degraded voltage condition in the supply to Unit 3 startup transformer resulting in degraded voltage conditions on the 4160v busses in the plant. The autostart circuit of the "A" emergency diesel generator (EDG) started "A" EDG. The "B" EDG was already running and synchronized to the ES 4160v bus "3B" for testing. During this degraded voltage condition the "B" EDG tried to maintain voltage on the 230 KV external transmission system. This resulted in the diesel output breaker tripping apparently on field overcurrent. Approximately 50 seconds later, the 230 KV substation was totally de-energized causing a momentary loss of power to all loads fed by the Unit 3 startup transformer.

The momentary loss of power to the startup transformer dropped power to the 4160v busses (3A, 3B, ESA, ESB) and the 480 busses (Reactor Aux. 3A and 3B, Turbine Aux. 3A and 3B and Heating Aux Bus 3 (EC, BU)). The battery backed 120 VAC busses (ED, BU) functioned during the transient and were not lost. The major loads lost as a result of the power loss were:

NOTE: (1) Abreviations listed on Attachment 1.

a) Control Rod Drive Power Supply
b) Reactor Coolant Pumps (momentarily)
c) Main Feedwater Pumps and Booster Pumps

The main feedwater pumps were most probably lost due to a loss of the lube oil pump (SL, P) and the resulting drop in the main feedwater turbine control oil pressure (JK). The loss is supported by past experience when the lube oil pumps were normally powered from the auxiliary tranformer and during most reactor trips the MFW pumps were lost because the automatic bus transfer to the startup transformer was too long (30 to 40 cycles). The loss of control oil pressure signals the main turbine (TA, TRB) to trip and the RPS (JC) to trip the reactor.

ANALYSIS OF EVENT

Adequate RCS subcooling margin was maintained after the reactor trip. Minimum RCS pressure was approximately 1752 psig at a corresponding hot leg temperature of 551 degrees F. Cold leg temperature rose to approximately 552 degrees F.

Make-up initially was through the normal path but as pressurizer level (AB, PZR) decreased rapidly, the HPI path was added by opening a high pressure injection (BG, V) valve. Pressurizer level decreased to approximately 32 inches due to a slight EFW over cooling. Make-up and single nozzle HPI flow were continued to restore pressurizer level. A makeup tank (CB, TK) low level alarm occurred and the Borated Water Storage Tank (BP, TK) supply to the make-up pumps (CB, P) was opened. Make-up tank level dropped to approximately 36 inches. Letdown was restarted and make-up tank level was restored. Pressurizer level also began to recover.

Power to the RCPs was lost for approximately 4 to 5 seconds. RC flow coasted down but power was restored before the pump breakers could open because of an 8 second breaker undervoltage time delay. The 6900v Reactor Aux. Busses had been powered from the unit auxiliary transformer but shifted to the startup transformer when power was restored approximately 4 seconds later. The RCPs resumed normal speed and RC flow was restored.

Emergency Feedwater (EFW) initiated shortly after the trip and controlled OTSG (AB, HX) levels without any unusual problems. A slight overcooling (well within expected ranges) was evidenced by the pressurizer level decrease.

Problems were encountered restoring the main feedwater pumps to operation. Upon loss of Unit 3, auxiliary steam was lined up to use Unit 1 and 2 auxiliary steam to supply the MFP turbine. However, since these units had also tripped their auxiliary steam was not available. Auxiliary steam was lined up to Unit 3 and MFP "B" was put back in operation. MFP "A" was blowing steam from a gland bleed port and was not put back into operation until repaired.

Emergency diesel "A" start circuits had sensed degraded bus voltage (4160 and 480v busses) before the trip and EDG "A" was running at the time of the trip. When power was lost to the 4160 and 480v ES "A" busses, the EDG"A" breaker closed in approximately 3 seconds and restored power to the ES"A" busses. Main steam safety valves (SB, RV) lifted once and reseated to control OTSG steam pressure. Power to the 4160 and 480v ES"B" busses was restored manually approximately 2 minutes later from the Units 1 and 2 4160v feed. Restoration of 230 KV to the Unit 3 startup transformer restored power to the 4160v Unit busses 3A and 3B and the 480v Aux. busses.

The 4160v ES busses 3A and 3B were transferred back to the Unit 3 startup transformer after approximately 30 and 60 minutes, respectively.

Reactivity was controlled by the control rods dropping into the core. Post trip reactivity shutdown margin noted in the operator log is -3.77% Delta K/K.

The most likely cause for the control rods dropping into the core is the loss of power to the control rod drive system. The loss of power caused the control rod drive mechanism stator field to decay and disengage the lead screw allowing the rods to fall into the core by gravity.

The other possible causes for the control rods dropping into the core are:

a. Reactor Trip on loss of MFW pumps
b. Reactor Trip on turbine trip
c. Reactor Trip on Reactor Coolant Pump Power Monitors action
d. Control rod drive source interrupt device

The thermal conditions of the plant during the transient were as expected for the conditions surrounding the trip. Decay heat was removed by the emergency feedwater system as the main feed pumps were tripped due to low control oil pressure. Examination of Tc values showed a good trip response as this value never dropped below 547 degrees F and never exceeded 573 degrees F for either loop, before stabilizing within the post trip window. Delta Tc was less than 1 degree F during the trip and reached a maximum value of 4 degrees F 5 minutes after the transient. The pressure/temperature information indicates that the recovery from the trip was normal with the temperature within the post trip window of 542 degrees F to 548 degrees F. Less post trip over feed of the steam generators occurred than has been seen in the recent past. This may be explained by the fact that in this case EFW was being controlled through the startup valves to maintain the low level limit, while in past cases main feed water was operating.

A situation arose which warrants further mention. An RCS flow reduction of apparently 37% was seen after the trip. This is because for a period of between 1 to 5 seconds the RCP's did not have any power. However, because of an 8 second 6900 volt undervoltage trip delay the pump breakers never tripped, and when power was restored the RCP's returned RCS flow back to normal. It is important to note that had the 230 KV service not been restored heat transfer from the core to the system generators would have been dependent on natural circulation.

No significant radioactive releases occurred and no 10 CFR limits were exceeded as a result of this event.

Safety equipment (ES bus "A", Diesel Gen. and EFP-1) availability was good. Two pieces of equipment were inoperable during the plant recovery process, while other safety equipment operated per design. The two pieces of equipment were the steam driven emergency feed pump which was taken out of service while surveillance procedures were being performed and the third piece of equipment was the B diesel generator which tripped due to trying to support the degraded grid.

The motor driven emergency feedwater pump performed as designed and adequately provided for the removal of decay heat.

ASSESSMENT CONCLUSIONS

1. The most likely cause of the reactor shutdown was a loss of power to the control rod drive system.

2. The power loss to the control rods resulted from a 4160v bus lineup through the Unit 3 startup transformer to the 230 KV yard and a subsequent 230 KV fault. Operator action to restore power to the busses appears to have been deliberate and unrushed. Although power was available to power the 4160v ES busses from the Unit 3 startup transformer, ES bus 3B was left tied to the Unit 1 and 2 feed. The feeds to ES busses "A" and "B" from the startup transformer were subsequently closed approximately 30 and 60 minutes, respectively, after the trip.

3. The "B" EDG output breaker tripped due to field overcurrent of the EDG while experiencing a degraded voltage condition on the 4160v ES "B" bus. A degraded bus/electrical fault in an electrical distribution system caused the "B" diesel generator output breaker to trip open because the diesel was synchronized to the distribution system for test. This set of circumstances needs to be reviewed considering the monthly diesel test requirements.

   Diesel breaker operation is not adequately stressed in training to ensure understanding of the proper trip and reclose sequence.

   Electrical power lineup could be reconfigured to provide to the plant better protection from electrical distribution grid disturbances.

4. The primary system response was normal for this event except for the momentary drop in forced RC flow.

5. The secondary system response was normal for this event with decay heat removal by the steam generators supplied with emergency feedwater.

6. Control of makeup tank level and pressurizer level was not adequate. With both normal makeup and HPI using the make-up tank as a source and with letdown stopped, the make-up tank level decreased at a steady rate to approximately 36" while pressurizer level decreased to approximately 31 inches. When pressurizer level decreased to less than 50 inches, makeup suction should have been shifted to the BWST and a second MU pump started as specified in the Reactor Protection System Actuation (AP-580) procedure. These actions were not appropriately taken.

   After the make-up tank low level alarm, the operators opened the BWST suction and subsequently restored the make-up tank and pressurizer levels.

7. The applicable plant procedures in this event were Reactor Protection System Actuation, Turbine Auto Stop Actuation, Emergency Feedwater Actuation, and Emergency Diesel Generator Actuation. Operator interviews and event review shows that the procedures were adequate to handle this event.

CORRECTIVE ACTIONS

1. Problems with main feed pump oil pumps will be investigated with the intent to eliminate the loss of these pumps as has been experienced when the 4160v unit bus "rapid" transfers to the Unit 3 start-up transformer from the Unit 3 aux. transformer.

2. Provide on shift discussions of this event with all operating crews. Emphasis needs to be placed on compliance with AP-580 as to assuring the BWST is provided as a make-up source and a second make-up pump is started if pressurizer level is less than 50 inches. Maintaining awareness of emergency measures taken (opening high pressure injection valve) should also be discussed.

3. Evaluate either (a) not performing EDG tests during periods in which thunderstorm activity is in the immediate area or (b) after synchronizing the EDG to the grid, using "house loads" to obtain the tech spec required 1500 KW and separating from the grid for an independent run of the EDG.

4. The failed lightening arrestor was replaced.

5. The 230 KV protective relays which misoperated have been tested and no apparent problems were found. The relays are presently out of service pending completion of an engineering investigation.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	PAGE (3)
CRYSTAL RIVER UNIT 3	0 5 0 0 0 3 0 2	8 4	— 0 0 3	— 0 0	0 7 OF 0 7

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

ATTACHMENT 1

ABBREVIATIONS

APSR	Axial Power Shaping Rod
BWST	Borated Water Storage Tank
EDG	Emergency Diesel Generator
EFP	Emergency Feedwater Pump
EFW	Emergency Feedwater
ES	Engineered Safeguards
HPI	High Pressure Injection
MFP	Main Feedwater Pump
MFW	Main Feedwater
MW_e	Megawatts Electric
OTSG	Once Through Steam Generator
RC	Reactor Coolant
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
RPS	Reactor Protection System
Tc	Reactor Coolant System Cold Leg Temperature

Florida Power
CORPORATION

March 29, 1984
3F0384-20

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

Subject: Crystal River Unit 3
Docket No. 50-302
Operating License No. DPR-72
Licensee Event Report No. 84-003-00

Dear Sir:

Enclosed is Licensee Event Report No. 84-003-00 which is submitted in accordance with 10 CFR 50.73.

Should there be any questions, please contact this office.

Sincerely,

G. R. Westafer

G. R. Westafer
Manager, Nuclear Operations
Licensing and Fuel Management

AEF/feb

Enclosure

cc: Mr. James P. O'Reilly
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