Florida Power
CORPORATION
Crystal River Unit 3
Docket No. 50-302

May 12, 1994
3F0594-11

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

Subject: Licensee Event Report (LER) 93-008-01

Dear Sir:

Attached is Licensee Event Report (LER) 93-008-01 which is submitted in accordance with 10 CFR 50.73.

This supplement provides additional information which was previously unavailable.

Sincerely,

Gary Boldt

G. L. Boldt
Vice President
Nuclear Production

GLB/JAF:rp

Attachment

xc: Regional Administrator, Region II
Project Manager, NRR
Senior Resident Inspector

IE22

NRC FORM 366 (5-92)

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMB NO. 3150-0104

EXPIRES 5/31/95

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HOURS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON DC 20503.

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
CRYSTAL RIVER UNIT 3 (CR-3)	0 5 0 0 0 3 0 2	1 OF 0 7

TITLE (4)

Due to a Lack of Engineering Review, Motor Operated Valves With Brakes Could Fail to Perform Their Safety Function Under Degraded Voltage Conditions

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 7	0 6	9 3	9 3	— 0 0 8	— 0 1	0 5	1 2	9 4	N/A	0 5 0 0 0

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (CHECK ONE OR MORE OF THE FOLLOWING) (11)							
POWER LEVEL (10)	1 0 0		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)		50.73(a)(2)(i)		50.73(a)(2)(viii)(A)		
			20.405(a)(1)(iv)	X	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
K. R. Wilson, Nuclear Licensing Manager	9 0 4 5 6 3 - 4 5 4 9

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

CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	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 July 6, 1993, Crystal River Unit 3 (CR-3) was in Mode 1 (POWER OPERATION) at 100% Rated Thermal Power producing 859 Megawatts. A High Pressure Injection suction valve was determined to be inoperable. A concern had been raised for the operability of safety related Limitorque motor operated valves (MOV) with an electrical motor brake option installed. A 1991 calculation showed that under degraded voltage conditions, valve motors will have sufficient voltage to accelerate their load, however motor brakes, which require higher voltages, may not receive sufficient voltage to release the brake. The valve therefore may not be capable of performing its safety function. This is a condition outside the design basis. The cause was a lack of engineering review for the motor brake voltage requirements. On April 11, 1994, a periodic revision to the 1991 calculation identified an additional 4 valves which may not function under degraded grid voltage coincident with accident conditions. The 1994 revision was more conservative than the original calculation and contained information unavailable in 1991. Some of the corrective actions included locking valves in place, brake removal, further analysis to assure performance of valve safety functions, and a plant modification to eliminate a valve safety function.

EVENT DESCRIPTION:

On June 6, 1993, Crystal River Unit 3 (CR-3) was in Mode 1 (POWER OPERATION) at 100% Rated Thermal Power producing 863 Megawatts. During the process of reviewing the draft dedication and seismic qualification plan for a spare motor and brake assembly for main feedwater crosstie valve FWV-28 [SJ,ISV] a Limitorque motor operated valve (MOV), a discrepancy was identified between the acceptance criteria for the electrical brake minimum operating voltage versus the valve motor minimum voltage acceptance criteria. A review was conducted to determine the design requirements for the brakes and to identify other safety related MOVs with similar brakes. Six other safety related valves were found with this condition.

On June 28, 1993, a concern was then identified for the operability of these valves. A calculation performed in 1991 showed that under degraded voltage conditions, valve motors will have sufficient voltage to accelerate their load. However, the motor brakes did not receive degraded voltage operation review. The brake function is to protect the valve from excessive mechanical thrust by stopping motor and valve inertia after power cut off. The brake coil [CL] is connected in parallel to the motor. The braking action is released with the energizing of the brake coil. Upon power cut off, the coil is deenergized and the brake clamps onto the valve motor shaft. The motor brake has a more restrictive operating range of 460 Volts Alternating Current (VAC) +/- 10 percent than analyzed for the valve operator. This more restrictive motor brake operating voltage range results in the possibility the MOVs may be exposed to voltages within design operating ranges but lower than required to operate the brake coil. With insufficient voltage to release the brake coil, the valves could be unable to perform their safety function.

Limitorque Maintenance Update 92-2, Section 7 "Significance of Motor Brakes on Actuator Motors" indicates that the brake does not substantially minimize the inertial overshoot of the valve drive train for this type of valve. The vendor confirmed this type of valve will function properly without brakes.

On July 6, 1993, CR3 was in Mode 1 at 100 percent Rated Thermal Power producing 859 Megawatts. At 1700 on that day, MUV-58 [BQ,ISV], the normally closed High Pressure Injection (HPI) [BQ] suction valve from the Borated Water Storage Tank (BWST) [BP,TK], was declared inoperable and the Action Statement for Technical Specification (TS) Limiting Condition for Operation (LCO) 3.5.2, ECCS Subsystems - T_{avg} > 280°F, was entered. The TS was exited on July 7, 1993 at 0405 upon removal of the stationary and rotating discs for MUV-58 which permanently de-coupled the motor from the brake assembly. The electrical power connections to the brake were also removed. This modification was performed on MUV-73 [BQ,ISV], the normally open BWST suction valve, as well.

On April 11, 1994, CR-3 was in MODE 5 (COLD SHUTDOWN), with reactor coolant system temperature at approximately 115 degrees Fahrenheit. The plant was engaged in a refueling outage. Engineering personnel were performing periodic revision of calculations. Revision 1 to the previously completed motor starting calculation, which would include MOVs not considered in the previous revision, was in progress. The original calculation (Revision 0 of CALC E-91-0018) which only addressed block loaded motors, including MOVs, was being modified in a conservative direction by applying a series of factors not available during performance of the original calculation. Block loading is the sequential connection of groups of devices to a bus. These factors included the following:

A. Motor overload resistance;
B. A higher impedance of Engineered Safeguards (ES) bus [EA,BU] B 4160/480 transformer [EA,XFMR];
C. More accurate, but limiting, motor starting power factor;
D. More accurate vendor supplied actual cable impedance;
E. Motor torque correction factors based on Limitorque 10CFR21 report;
F. Locked rotor heating; and
G. A higher Second Level Undervoltage Relays (SLURs) [27] setpoint, which offset some of the negative impact of the above stated factors.

Since Revision 0 of the motor starting calculations did not model FWV-28 (see Attachment - Simplified Main Feedwater Flow Diagram), an estimate of voltage available at the motor terminals was made by comparison with a similar valve addressed in Revision 0 of the calculations. The estimate of 345 VAC was adequate to assure proper operation of FWV-28, including brakes. Presently unverified motor starting calculations now model FWV-28 utilizing the Revision 1 criteria. These calculations indicate that only 307 VAC would be available at the motor terminals during accident conditions coincident with degraded grid voltage. Although the 307 VAC at the motor terminals still allows the valve operator to exceed minimum required thrust values, the MOV brake release requires 345 VAC. The inability of the MOV brake to release would prevent the motor from operating and performing its intended safety function of closing on main feedwater isolation.

Revision 1 of this motor starting calculation (presently unverified) also indicates that three other MOVs would not have sufficient voltage at their motor terminals to develop minimum required thrust during accident conditions coincident with degraded grid voltage conditions.

Main feedwater suction isolation valves FWV-14 and FWV-15 [SJ,ISV] will not receive adequate voltage under accident conditions coincident with degraded grid voltage during its opening stroke. However, the closing stroke is critical to safety by isolating main feedwater suction, and the motor does have sufficient reduced voltage capability during its closing stroke. Therefore FWV-14 and FWV-15 do not present any safety concern.

FWV-30 does not have sufficient voltage capability at its motor terminals at the beginning of the closure stroke, under accident conditions coincident with degraded grid voltage, to equal or exceed minimum required thrust requirements. However, sufficient voltage is present to initiate MOV movement. As startup load surges reduce, ES bus voltage increases and sufficient voltage for full thrust is present at the end of the closing stroke. Therefore FWV-30 does not present any safety concern.

These calculations established a condition outside the design basis and are reported in accordance with 10 CFR 50.73(a)(2)(ii)(B).

CAUSE:

The cause of the 1993 condition was a lack of engineering review of the motor brake voltage requirements. Although the motor brake symbols appear on relevant drawings, the voltage requirements for the motor brakes were not determined when degraded voltage calculations were originally performed. In CR3's configuration, the brake is wired in parallel with two phases of the three phase 460 VAC power feed to the valve operator electric motor. As such, the brake was considered part of the motor and did not receive a separate review.

The current (1994) condition was identified when new previously unavailable analytical data was incorporated into Revision 1 of the motor starting calculations.

EVENT EVALUATION:

In the 1993 report seven safety related valves were identified with motor brakes installed. Four of the valves are maintained locked in their safety function position during plant operation and are thus not a concern. One valve with a motor brake manufactured by Sterns was tested and is operable with voltages above 75 percent (345 VAC). The remaining two valves (MUV-58 and MUV-73) have motor brakes manufactured by Dings Dynamic Group.

The event of concern involves a postulated low voltage condition in the 230 kV switchyard at the low end of the SLUR setpoint coupled with an Engineered Safeguards (ES) actuation and subsequent block loading. With switchyard voltage at the low end of the SLUR setpoint and with accident loads applied via block loading, MUV-73 and MUV-58 receive 377.1 VAC and 381.2 VAC, respectively, during BLOCK 1 loading.

The vendor for these motor brakes has indicated that the brake coil could fail at a +/- 10 percent voltage differential. This places the lower limit for motor brake voltage at 414 VAC. If voltage remains above the SLUR setpoint, the Emergency

Diesel Generator (EDG) [EK,DG] will not connect to the bus and restore adequate voltage. As long as voltages remain below 414 VAC, insufficient voltage to release the brake coil could exist and the valves might be unable to perform their safety function.

These valves provide HPI suction to the Makeup Pumps (MUP) [BQ,P] from the BWST during accident conditions and are required to open on an HPI signal. Normal plant configuration is for one of these valves to be open and the other closed. Upon an HPI signal with voltages above the SLUR setpoint, the MOVs with motor brakes will be block loaded to the degraded bus. Assuming the closed valve fails to open, the operating MUP will not be realigned to the BWST and will rapidly draw down the Makeup Tank (MUT) [CB,TK]. Damage to that MUP will occur if suction pressure is lost. At that point, and under an assumed simultaneous single active failure of the other ES selected MUP to start, HPI would be unavailable until operator action can be taken to align and start the third MUP. The event could also be mitigated by operator action to supply the ES buses with power from the EDGs.

The inability of the FWV-28 brake to release will prevent the motor from operating and performing its intended safety function. The safety function of FWV-28 is to provide feedwater system isolation in conjunction with the feedwater block valves during events which result in significant depressurization of one or both Once Through Steam Generators (OTSG) [SG]. Upon reaching 600 psig pressure in an affected OTSG the main feedwater isolation circuitry sends an isolation signal to that train's feedwater pump, suction valve, block valves, and crosstie valve FWV-28. Assuming that only one feedwater pump is in operation, and that the running pump is on the opposite train as the affected OTSG, the main feedwater isolation circuitry will send a suction valve and block valve closure signal to the train associated with the affected OTSG, a trip signal to the non-running pump and a closure signal to FWV-28. A modification to the main feedwater isolation logic circuitry will, when appropriate conditions are met, provide an isolation signal to both feedwater trains, and a trip signal to both main feedwater pumps. This action will eliminate the need to assign a safety function to FWV-28.

The Revision 1 motor start calculations indicate that FWV-14 and FWV-15 will not receive adequate voltage under accident conditions coincident with degraded grid voltage on their opening stroke. The inability of FWV-14 and FWV-15 to open under accident conditions has no safety significance since the safety function of these valves is to close and provide main feedwater suction isolation. Engineering analysis via these calculations has indicated that on their closing stroke the motors have sufficient reduced voltage capability to operate satisfactorily.

The unverified 1994 Revision 1 calculations indicate that FWV-30 does not have sufficient voltage capability at its motor terminals under accident conditions coincident with degraded grid voltage to overcome minimum required thrust requirements at the instant actuation voltage is applied to the motor terminals. This degraded voltage is the result of other loads applied to the ES bus

simultaneously with the FWV-30 actuation. The 1994 Revision 1 calculations indicate that, at the instant the closure actuation voltage is received at the FWV-30 motor terminals, sufficient voltage for full thrust at valve closure and seating is not present, however sufficient voltage is present to initiate MOV movement. As startup load surges reduce, ES bus voltage increases and sufficient voltage for full thrust is present at the end of the closing stroke. Therefore the performance of FWV-30 does not present any safety concern.

CORRECTIVE ACTIONS:

MUV-58 and MUV-73 have had their motor brakes removed. Applicable drawings have been revised to more accurately reflect the motor brake option. The lack of a separate engineering review for these valve operator subcomponents is considered an isolated event due to the manner in which they were wired as part of the motor. Engineering personnel have been advised of this occurrence to increase the awareness for vendor supplied subcomponents when performing operability reviews or preparing design packages. A modification to the main feeedwater isolation logic will be installed during Refuel 9, which will eliminate the need for assigning the safety function of main feedwater crosstie valve FWV-28. Additionally, the calculations (E-91-0018 Revision 1) will be verified prior to the end of July 1994.

PREVIOUS SIMILAR EVENTS:

There have been three previous Licensee Event Reports (LER) generated due to potentially inadequate voltage to safety related components, two of which included degraded grid voltage concerns (LER 92-007, LER 92-010 and LER 92-020).

ATTACHMENT:

SIMPLIFIED MAIN FEEDWATER FLOW DIAGRAM