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

March 15, 1996
3F0396-13

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

Subject: Licensee Event Report (LER) 96-007-00

Dear Sir:

Please find the enclosed Licensee Event Report (LER) 96-007-00. This report is submitted by Florida Power Corporation in accordance with 10 CFR 50.73. A supplement to this report is expected to be provided by April 11, 1996.

Sincerely,

Ron Davis FOR B. J. Hickle

B. J. Hickle, Director
Nuclear Plant Operations

TWC:ff

Attachment

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

IE22

NRC FORM 366 (5-92)

U.S. NUCLEAR REGULATORY COMMISSION

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 9

TITLE (4): HPI Line Break With Loss of Battery Could Result in Operator Reliance on Instrumentation Inadequate for Accident Mitigation

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	1 4	9 6	9 6	0 0 7	0 0	0 3	1 5	9 6	N/A	0 5 0 0 0

OPERATING MODE (9): 1

POWER LEVEL (10): 1 0 0

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)	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)
T.W. Catchpole, Sr. Nuclear Licensing Engineer	3 5 2 5 6 3 - 4 6 0 1

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
X YES (If yes, complete EXPECTED SUBMISSION DATE)	NO		0 4	1 1	9 6

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

On February 14, 1996, Florida Power Corporation's Crystal River Unit 3 was operating in MODE 1 (POWER OPERATION) at 100% power. Discrepancies had been identified between two FSAR tables which address single failures for Small Break Loss of Coolant Accidents (SBLOCA) associated with the High Pressure Injection (HPI) system. On February 15, 1996 a Problem Report was generated and a conservative one hour notification was made to NRC to report a suspected design basis issue. An operability evaluation on February 16, 1996, led to a determination that CR-3 may be in an unanalyzed condition in that a loss of battery in a SBLOCA scenario would leave the operator with only wide range indicators in two of the four HPI injection lines to measure flows that may be lower than the effective range of these instruments. As a result, it was determined that technical specifications for instrumentation requirements associated with the HPI system could not be fully met and a controlled plant shutdown was commenced at 1655 hours. A single root cause has not been finalized. Corrective actions identified include replacement of instrumentation and reanalysis of HPI Pinch Break failure scenarios with additional guidance to be provided to operators. A final root cause and additional actions will be provided in a supplement to this LER.

EVENT DESCRIPTION

On February 14, 1996, Florida Power Corporation's (FPC) Crystal River Unit 3 (CR-3) was operating in MODE 1 (POWER OPERATION) at 100% power, generating 883 megawatts (MW). A member of the Emergency Operating Procedure (EOP) Enhancement Team generated a Precursor Card to identify inconsistencies discovered between two Final Safety Analysis Report (FSAR) tables which contain single failure analyses for two Small Break Loss of Coolant Accidents. One single failure analysis is for a small break at the Reactor Coolant Pump [AB,P] discharge (Reactor Coolant System Cold Leg) which initiates the High Pressure Injection (HPI) System [BQ]. The other analysis is for a HPI Injection Line SBLOCA where a break is postulated in one of the four injection lines between the last check valve in the line and the Reactor Coolant System (RCS) cold leg. Various size HPI line breaks have been analyzed from a small "pinch" break to a full guillotine break of the injection line. The inconsistencies concern the portion of the failure analyses involving a component failure of a battery [EJ,BTRY] (DC) which also results in a loss of an Emergency Diesel Generator [EK,DG]. Specifically, in the HPI Line Break scenario, the table indicates the failure will result in loss of power to 2 HPI injection valves [BQ,FCV], one train of flow instrumentation [BQ,FI] and one HPI pump [BQ,P]; whereas the RCS Cold Leg SBLOCA indicates loss of power to 2 HPI injection valves and loss of one HPI pump with no discussion of the loss of flow instrumentation. Neither table clearly recognizes the fact that Engineered Safeguards (ES) signals will be lost to its respective side HPI valves in the described failure scenario.

The Nuclear Shift Manager (NSM) reviewed the above Precursor Card and determined the need for a Problem Report (PR) which was initiated on February 15, 1996 and presented to the Shift Supervisor on Duty (SSOD) at 2130 hours. The SSOD determined the condition represented a suspected design basis inadequacy in that the FSAR failed to address all equipment lost and the mitigation strategy for a LOCA coincident with a Loss of Offsite Power (LOOP) and the loss of a battery. The SSOD determined the HPI system remained operable but conservatively made a 1-Hour notification to the Nuclear Regulatory Commission (NRC) using the Emergency Event Notification system. The notification was made in accordance with 10CFR50.72(b)(1)(ii)(B) as a suspected design basis issue and Event Number 29982 was assigned. The SSOD then directed the formation of an Operability Concern Resolution (OCR) team to evaluate system operability in accordance with Compliance Procedure CP-150 "Identifying and Processing Operability Concerns".

The OCR team assembled at approximately 0730 hours on February 16, 1996 and initially focused on the DC failure issue and its effect of the failure on HPI flow instrumentation. This instrumentation is needed to balance HPI flow through the 4 injection lines during a HPI line break SBLOCA. This is to assure adequate HPI flow to the core [RCT,AC]. Due to the configuration of HPI flow transmitters (one wide range transmitter and one narrow range transmitter installed for each

injection line powered alternately by "A" and "B" train DC), the loss of DC power to one train would result in loss of narrow range instruments for two of the four lines and wide range instruments for the other two lines. The narrow range instruments have a range of 0-200 gallons per minute (gpm) and the wide range instruments have a range of 0-500 gpm. The OCR team was aware that the accuracy of the wide range instrumentation was determined in 1989 to be inadequate (see Licensee Event Report 89-037-00) at low flows and that use of these instruments below 200 gpm could lead an operator to an inadequately balanced HPI flow condition. The 1989 event resulted in a plant shutdown and installation of the narrow range instruments. Also in 1989, analyses established that the HPI line pinch break could lead to variations in the flow rates in each HPI line.

A Plant Review Committee (PRC) meeting was convened at approximately 1300 hours. The OCR team had obtained a copy of a calculation, document I89-0038 "HPI Flow Indication Error Analysis" when requested by the PRC to provide an explanation of the problem. I89-0038 discusses several failure modes that can be imposed by a SBLOCA in a cold leg or an HPI line break up to the first check valve from the RCS (guillotine or pinch break) and contains statements not to use the wide range flow indicators below 190 gpm. The 190 gpm value was established shortly after the 1989 event to provide operators with a meter scale overlap reading. During the PRC meeting, the discussion of worst case instrument errors applied to the available wide range and narrow range indicators for the three intact HPI lines yielded flows less than the required 270 gpm specified in the SBLOCA analysis. Based on the information available, PRC concluded the instrumentation available to the operators in the above failure scenario could not be relied on below 190 gpm and recommended a plant shutdown.

At approximately 1600 hours on February 16, 1996 the SSOD was informed of the PRC recommendation and determined Improved Technical Specification (ITS) requirements for HPI flow could not be met. The specific ITS Limiting Conditions for Operation (LCO) which could not be met were LCO 3.3.17 for Post-Accident Monitoring (PAM) instrumentation which requires 2 OPERABLE flow instruments (narrow range and wide range) for each of 2 loops for each of 4 HPI system injection lines, and LCO 3.5.2 which requires restoration of 1 of the 2 inoperable Emergency Core Cooling System (ECCS) trains to OPERABLE. Since the instrumentation common to both trains was inoperable, the SSOD entered ITS LCO Required Action 3.0.3 at 1630 hours, which requires the plant to be in at least MODE 3 (HOT STANDBY) within 7 hours. NRC was notified at 1630 hours in accordance with 10CFR50.72(b)(ii)(A) of CR-3 being in an unanalyzed condition and Event Number 29987 was assigned. A controlled plant shutdown began at 1655 hours.

This report is being submitted in accordance with 10CFR50.73(a)(2)(i)(A) and 10CFR50.73(a)(2)(ii)(B) to report the completion of a plant shutdown required by technical specifications and a condition outside CR-3's design basis, respectively.

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

EVENT EVALUATION

HPI injection valves [BQ,FCV] are automatically opened on an Engineered Safeguards (ES) actuation. This control scheme also allows the operator to take the valve(s) to manual and remotely open the valves. Since analyses provide for operator action within 20 minutes, sufficient time exists to open the valves whose ES signal may be lost during the scenarios involving a loss of one or more vital busses.

Each HPI line and the normal makeup [CB] (MU) line is equipped with a flow element [BQ,NZL] as shown on the attached Figure. Each injection line has a narrow range and wide range instrument string. The narrow range instrument string was installed in 1989 as a result of LER 89-037 and is Class 1E consisting of differential pressure transmitters [BQ,PDT], voltage buffers [BQ,BUF], and flow indicators [BQ,FI]. The wide range instrument string was upgraded to Class 1E in 1992. HPI flow is classified as a Regulatory Guide 1.97 Type A Variable. Both narrow range and wide range flow indicators are classified a Category 1 Post-Accident Monitoring instrumentation.

To ensure adequate HPI flow in the event of a break in one of the four HPI injection lines, instruments are needed to balance flow among the four lines or to isolate HPI flow in the broken line. In order to remain bounded by the SBLOCA analysis, flow rates of 270 gpm (assumed) to the core in the first 20 minutes of an HPI line break and 306 gpm after 20 minutes for RCS pressure below 1200 pounds per square inch gauge (psig) must be met. Balancing HPI flows involves equalizing flow in each injection line while maximizing total flow. Operators are instructed only when it is clear that one line demonstrates a much greater flow (indicative of failure) should flow be reduced in an injection line as a means of balancing. This is accomplished by throttling the injection valves [BQ, INV]. The intent of balancing HPI flow is to maximize the flow which actually gets to the core. If an HPI line break exists, the broken line may exhibit a much higher flow rate than in each of the unbroken lines. If the flow in the broken line is throttled, then more flow will go through each of the other lines to the RCS and less HPI water will be lost out of the broken line. Current rules for loss of subcooling margin instruct the operator to isolate the high HPI line and balance the other 3 lines if 1 narrow range HPI line flow indicates off scale high and is verified using the wide range indication.

Additional secondary functions of the HPI flow instruments include:

1. Determining if the injection valves have opened during an HPI actuation.

2. Informing operators of potential pump runout conditions.

3. Informing operators of the need to align a recirculation flow path for pump protection at low flows.

4. Diagnosing other SBLOCA accidents. For example, they may be used along with other indications, to estimate the total leakage flow rate or to determine the location of a LOCA.

A Probabilistic Safety Assessment (PSA) evaluation was performed of the likelihood of a HPI line break (3.2E-07/year) occurring between the check valve and the reactor vessel, followed by a concurrent LOOP (3.5E-02/year) and battery failure (3.5E-02/year). Assuming HPI would be needed for approximately 24 hours following the LOCA the probability of a LOOP during a 24-hour window was determined to be 8.77E-05 which translated to a frequency of occurrence for this scenario of 9.63E-15. This scenario is below the cutoff for inclusion in CR-3's Core Damage Frequency (CDF) and well below the cutoff of 1E-07/year for Integrated Plant Evaluation (IPE) reportability.

Although the PSA evaluation concludes the probability of the subject failure is remote, this event indicates the additional flow instrumentation provided to operators after the 1989 event described in LER 89-037, was of marginally acceptable design.

CAUSE

No single root cause has been identified for this event pending the outcome of a formal root cause evaluation discussed in the "corrective actions" section. However, several contributing factors appear to be evident based on the reviews conducted to date.

Although LER 89-037 specifies the 0-500 gpm instrumentation will not be used below 200 gpm, it was noted that Calculation I89-0038 provides a "special case" where their use is acceptable below 200 gpm in a loss of battery scenario. Subsequent to the decision to shutdown, after an opportunity to review Calculation I89-0038 in detail, it was noted the conclusion for the special case was based on an interpolation of data regarding minimum required flows obtained from a 1989 Babcock & Wilcox calculation titled "HPI Flow Requirements for HPI Balancing". This case was added to I89-0038 in May, 1990; however, LER 89-037 was not identified as an input considered for the addition and therefore, no reconciliation of the conflicting positions was made. The calculation also does not address the difficulty operators may have reading and interpreting the flow indicators and may not be conservative. The assumptions used in the calculation are currently being studied further.

A review of operator training lesson plans regarding balancing of HPI flow revealed the operator is instructed, consistent with the EOP guidance, to monitor and balance HPI flow through the injection lines. Variations in flow rates are not discussed in detail although a simulator exercise for flow balancing indicates there is no rule on how close HPI flows must be maintained for proper

balance. Instructor notes indicate balancing should maintain HPI flows as close as possible without requiring constant adjustment. Simulator scenarios for evaluating operator actions in response to an HPI line break do not include a loss of battery as a single failure concurrent with a LOOP and LOCA. One scenario addresses a narrow range indicator failed high, in which case the operator is expected to verify flow via the wide range instrument for the affected line. The flow in this case is within the effective range of the wide range instrumentation.

Regarding the two single failure tables in the FSAR, it was noted that each was introduced at different times. The table addressing the HPI Injection Line SBLOCA was added in 1991 subsequent to installation of the narrow range flow instrumentation; whereas, the RCS Cold Leg SBLOCA table had been in the FSAR since 1979. No comparison of the tables appears to have been performed at the time by the contributing organization.

IMMEDIATE CORRECTIVE ACTION

The SSOD determined the LCO 3.3.17 LCO 3.5.2 could not be met and entered LCO 3.0.3. A controlled plant shutdown was started which began Refueling Outage 10R on February 16, 1996, two weeks earlier than originally scheduled.

ADDITIONAL CORRECTIVE ACTION

1. To resolve concerns regarding questionable accuracy of the wide range HPI flow instrumentation at lower flows, a modification package will be prepared for their replacement with instrumentation having appropriate accuracy. The installation of replacement instrumentation will occur prior to startup from the current refueling outage.

2. FSAR single failure tables 6-14 and 6-19 will be revised as part of the above modification package to correct inconsistencies and issued within six months of the completion of Refuel 10R.

3. Calculation I89-0038 will be revised prior to startup from the current refueling outage to incorporate necessary changes in failure analyses based on installed instrumentation.

4. Flow requirements during various SBLOCA scenarios will be finalized by Framatome Technologies (formerly B&W Nuclear Technologies) prior to startup from the current refueling outage. The scenarios will include variations in HPI flow.

5. A practice simulator demonstration will be developed to incorporate variations in HPI injection line flows for operator simulator training. Operators will complete this training during the first requalification training cycle following Refuel 10R.

6. Based on the modification to install new instrumentation and a finalization of flow requirements per item 4, above, revised HPI balancing and isolation criteria will be issued prior to startup from the current refueling outage. This will be in the form of an interim change to the appropriate Emergency Operating Procedure (EOP).

ACTION TO PREVENT RECURRENCE

A root cause evaluation has been initiated to address human performance during and after the 1989 event described in LER 89-037 and immediately preceding the determination of the need for plant shutdown for this event. This effort is expected to be completed prior to startup from the current refueling outage, after which additional corrective actions may be identified. A supplement to this LER will be provided at that time.

PREVIOUS SIMILAR EVENTS

LER 89-037 resulted in a plant shutdown on October 26, 1989 after it was determined that available HPI flow instrumentation was not sufficiently accurate and operator action to balance HPI flows may result in inadequate flow to the core. Several recent LER's have been issued to discuss instrument errors and their relationship to HPI flow. These include LER 95-26 for a November, 1995 event involving instrumentation for RCP seal injection flow which is required to be considered for total HPI flow but did not meet R.G. 1.97 requirements and LER 96-006 for a January, 1996 event which addressed new methodologies for instrument error that could cause a challenge to established HPI pump runout values.

ATTACHMENT

Attachment 1 -Abbreviations, Definitions and Acronyms
Figure 1 - Makeup and Purification/HPI System (simplified)

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

ATTACHMENT 1 - ABBREVIATIONS, DEFINITIONS AND ACRONYMS

Category 1	These R.G. 1.97 measurements are key variables with the most stringent requirements.
CR-3	Crystal River Unit 3
ECCS	Emergency Core Cooling Systems
EOP	Emergency Operating Procedure
FPC	Florida Power Corporation
HPI	High Pressure Injection
MODE ONE	POWER OPERATION (Greater Than 5 Percent Rated Thermal Power)
MU	Makeup and Purification System
Precursor	The Precursor system is an easy-to-initiate mechanism designed to promote the identification and correction of concerns, incidents or conditions that may adversely affect the operation of CR-3.
Problem Report	Documents a condition or event which warrants evaluation, root cause analysis, or corrective actions beyond what it would receive if documented and processed by other methods.
R.G. 1.97	"Instrumentation for Nuclear Power Plants to Assess Plant and Environs Conditions During and Following and Accident"
SBLOCA	Small Break Loss-of-Coolant Accident
Type A	Those plant specific variables described in R.G. 1.97 that provide primary information needed to permit the control room operator to take the specified manually controlled actions for which no automatic control is provided and that are required for safety systems to accomplish their safety function for design basis accident events.

NOTES: ITS defined terms appear capitalized in LER text {e.g. MODE ONE}
Defined terms/acronyms/abbreviations appear in parentheses when first used {e.g. Reactor Building (RB) }.
EIIS codes appear in square brackets {e.g. Makeup Tank [CB,TK] }

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MAKE-UP & PURIFICATION / HPI SYSTEM

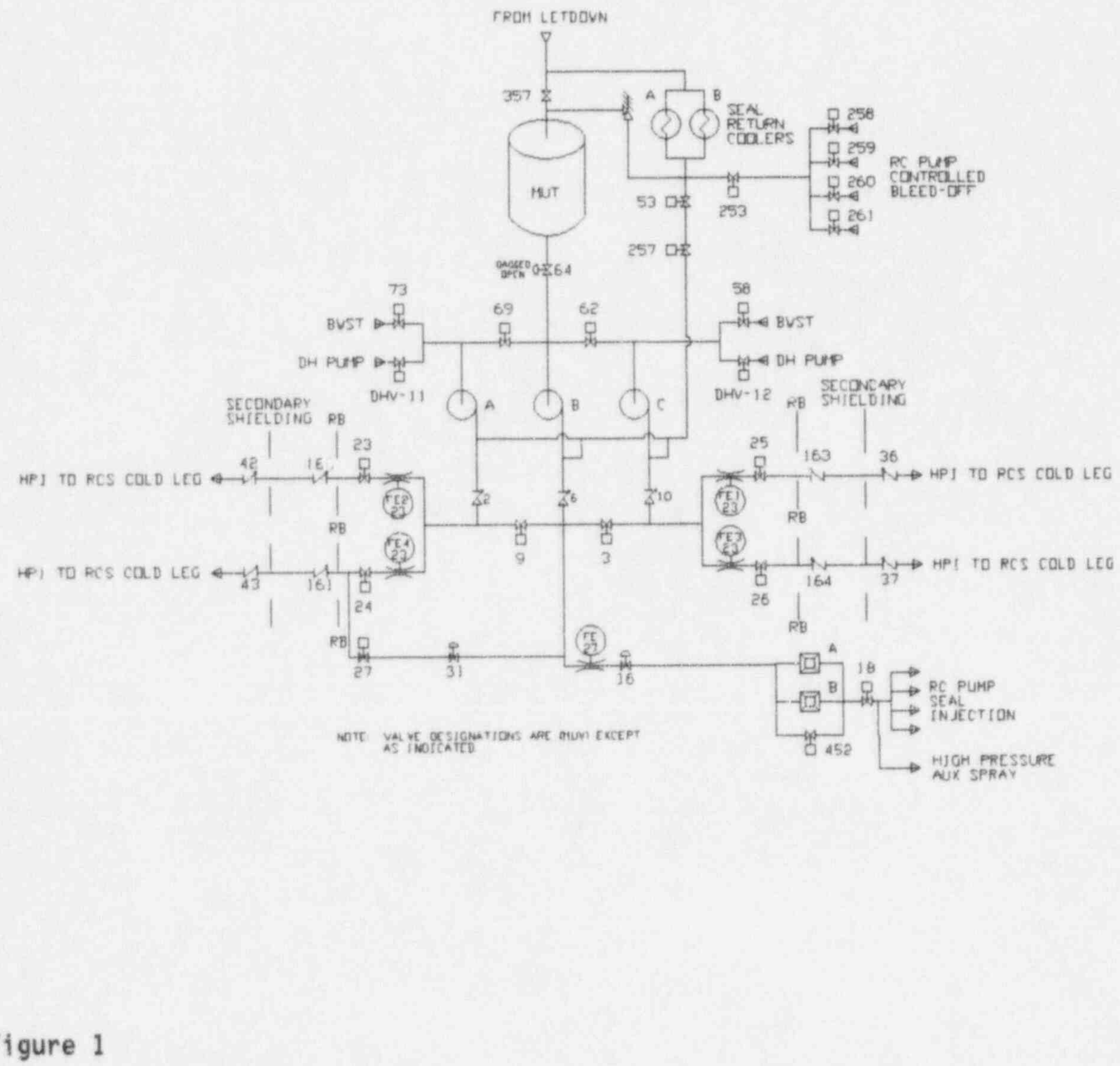

Figure 1