UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30323

Report No.: 50-302/91-25

Licensee: Florida Power Corporation
3201 34th Street, South
St. Petersburg, FL 33733

Docket No.: 50-302 License No.: DPR-72

Facility Name: Crystal River 3

Inspection Conducted: December 8 - 23, 1991

Inspector: _____ 1/6/92
J. P. Holmes-Ray, Senior Resident Inspector Date Signed

Inspector: _____ 1/6/92
D. Mellen, Reactor Engineer, Region II Date Signed

Inspector: _____ 1/6/92
P. Burnett, Reactor Engineer Region II Date Signed

Inspector: _____ 1/6/92
R. Freudenberger, Resident Inspector Date Signed

Accompanying Personnel: F. Talbot, NRC Region II Intern

Approved by: _____ 1/6/92
K. Landis, Section Chief Date Signed
Division of Reactor Projects

SUMMARY

Scope:

This unannounced, reactive inspection was conducted by the resident inspectors and accompanying regional personnel to review the details of the reactor trip and Engineered Safety System actuation that occurred at Crystal River Unit 3 on December 8, 1991. This transient was initiated by a failure of the pressurizer spray valve. The inspection included a review of the transient description, sequence of events, licensed operator performance, procedure adequacy and implementation, Emergency Plan implementation and reporting, pressurizer spray valve failure analysis, previous reactor trips, and licensee initial corrective actions.

Results:

Four apparent violations discussed in this inspection report were deemed of sufficient significance to warrant consideration for escalated enforcement.

Within the areas inspected, the following apparent violations were identified:

50-302/91-25-02, Failure to maintain Engineered Safety Feature Actuation System operability, paragraph 4;

50-302/91-25-03, Failure to implement procedures for correcting abnormal plant operating conditions, paragraph 5;

50-302/91-25-04, Failure to report a high pressure injection actuation in a timely manner and to declare and report the related Unusual Event in a timely manner, paragraph 6; and

50-302/91-25-05, Failure to implement effective corrective actions for a defective pressurizer spray valve, paragraph 7.

One unresolved item (URI) was identified:

50-302/91-25-01, Accuracy of annunciator alarm status printer, paragraph 3.

REPORT DETAILS

1. Persons Contacted

Licensee Employees

* J. Alberdi, Manager, Nuclear Plant Operations
* G. Boldt, Vice President Nuclear Production
P. Breedlove, Nuclear Records Management Supervisor
R. Fuller, Senior Nuclear Licensing Engineer
B. Hickle, Director, Quality Programs
D. Porter, Nuclear Operations Superintendent (Acting)
P. McKee, Director, Nuclear Plant Operations
W. Neuman, Supervisor, Inservice Inspection
V. Roppel, Manager, Nuclear Plant Maintenance
* W. Rossfeld, Manager, Nuclear Compliance
E. Welch, Manager, Nuclear Electrical/Instrumentation and Control Engineering Services
R. Widell, Director, Nuclear Operations Site Support
M. Williams, Nuclear Regulatory Specialist
* K. Wilson, Manager, Nuclear Licensing

Other licensee employees contacted included office, operations, engineering, maintenance, chemistry/radiation, and corporate personnel.

NRC Resident Inspector and Accompanying Personnel

* K. Landis, Chief, Section RP2B, RII
* P. Holmes-Ray, Senior Resident Inspector
R. Freudenberger, Resident Inspector
L. Mellen, Reactor Engineer, RII
P. Burnett, Reactor Engineer, RII
F. Talbot, NRC Intern, RII

*Attended exit interview

2. Transient Description

The transient description and sequence of events were verified by the inspectors by using information from the Annunciator Events Recorder, Recall System, Control Room Logs, and Operator Interviews. Based on information gathered to develop the sequence of events, the inspectors conducted a review to assess licensed operator performance and procedure adequacy and implementation during the reactor coolant system pressure transient.

This transient began on December 8, 1991, at 2:50 a.m., with the plant at approximately ten percent reactor power. The operators were gradually increasing reactor power in preparation for phasing the unit to the grid. In accordance with operating procedure OP-203, "Plant Startup," the

operators initiated a transfer of the auxiliary steam supply from Units 1 and 2 to Unit 3 supplying its own auxiliary steam from main steam. During the transfer, the turbine building operator reported a large steam flow to the deaerator feed tank. The control room operators anticipated a decrease in reactor coolant system temperature as a result of increased steam flow from the steam generators to the deaerator feed tank. The steam flow to the deaerator feed tank was isolated and control rods were withdrawn to increase reactor power and maintain reactor coolant system temperature.

This power increase was sufficient to increase reactor coolant system pressure to the point that the pressurizer spray valve (RCV-14) received an open signal. Main control board position indication continued to indicate RCV-14 was closed. However, based on the reactor coolant system pressure response, the valve had partially opened. A second power increase was made which also resulted in an increase in reactor coolant system pressure sufficient to send an open signal to the pressurizer spray valve. Again, based on reactor coolant system pressure response, the pressurizer spray valve had opened further, with main control board indication that the valve was closed. Reactor coolant system pressure dropped rapidly for a short period of time, then continued to decrease at a slower rate, apparently due to partial closure of the pressurizer spray valve and/or actuation of the pressurizer heaters. As reactor coolant system pressure continued to decrease, two more power increases were made by the operators. Reactor power was now approximately fifteen percent of full power.

Reactor coolant system pressure approached the reactor protection system reactor trip setpoint of 1800 psig approximately fifteen minutes after reactor coolant system depressurization began. The reactor automatically tripped on low RCS pressure at 3:09 a.m. As a result of the reactor trip, reactor coolant system pressure decreased rapidly to approximately 1650 psig, then continued to decrease at a rate similar to that before the trip. Shortly after the reactor trip, control panel alarms actuated to indicate that the reactor coolant system pressure had decreased to 1640 psig. Approximately one minute after these alarms, the nuclear operator bypassed both trains of the automatic actuation of high pressure injection.

The above alarms and bypass switches are further described as follows. During a controlled plant depressurization and cooldown, the alarms at 1640 psig alert the operators that the automatic actuation of the ESFAS for high pressure injection is not bypassed. This is intended to prevent inadvertent actuation of high pressure injection during controlled plant shutdowns. During an event, these alarms alert the operators of an impending automatic actuation of high pressure injection. The ESFAS logic associated with low (1500 psig) RCS pressure is comprised of two trains with three channels each. Each train requires a two-out-of-three logic to actuate. The channels in both the "A" and the "B" trains are designated "RC1," "RC2," and "RC3." Since the bypass switches were installed to allow bypass of individual channels, a total of six switches, three per

train, labelled "HPI RC1," "HPI RC2," and HPI RC3" were placed in the bypass position by the nuclear operator. This bypassed the automatic actuation of high pressure injection on low (1500 psig) RCS pressure. The ESFAS for automatic actuation of high pressure injection in response to low-low (500 psig) RCS pressure and high (4 psig) reactor building pressure remained available. The ESFAS high pressure injection actuation includes: high pressure injection, partial containment isolation, emergency feedwater initiation and control, and start of the emergency diesel generators.

Approximately six minutes after the ESFAS high pressure injection actuation signals were bypassed, sufficient actuation logic bistables tripped, as indicated by main control panel alarms, to actuate the system had it not been bypassed. Twelve seconds later, operators took the "A" train of the high pressure injection actuation logic out of bypass. The "A" train of HPI immediately actuated. Four seconds after that, operators took the "B" train of the high pressure injection actuation logic out of bypass and the "B" train of HPI immediately actuated. Engineered safety equipment started and operated properly. As a result of operator actions, ESFAS HPI was disabled for just over six minutes. Actuation of the "A" train engineered safety equipment was delayed by twelve seconds and "B" train by sixteen seconds from the time they were called upon to actuate.

Following the high pressure injection actuation, full high pressure injection occurred for approximately one minute. The operators then took actions to throttle, then stop, high pressure injection, secure the emergency diesel generators, and secure emergency feedwater. Reactor coolant system pressure had increased and was above the high pressure injection actuation setpoint. The reactor coolant system pressure increase was sufficient to result in the automatic reset of the high pressure injection actuation bypass.

With high pressure injection secured, reactor coolant system pressure again began to decrease. At 3:35 a.m. one of the high pressure injection bistables tripped on low RCS pressure. Ten seconds later, both trains of high pressure injection actuation were bypassed by the operators to prevent a second start of the emergency diesel generators, emergency feedwater, and containment isolation. Approximately ten minutes later, one of the high pressure injection valves was opened to increase flow to the reactor coolant system from the make-up pumps. After reactor coolant system pressure had increased to about 1700 psig, the high pressure injection valve was closed. Pressurizer level indication was off scale high, but based on the reactor coolant system pressure response, the pressurizer did not go solid. At 3:54 a.m. the pressurizer spray block valve (RCV-13) was closed. Reactor coolant system pressure control was regained and normal make-up and let-down were established shortly thereafter. An Unusual Event was declared at 4:55 a.m. based on the valid actuation of the high pressure injection portion of the emergency core cooling systems. The Unusual Event was terminated at 5:06 a.m.

3. Sequence of Events

The inspectors verified the following detailed sequence of events by using information from the Annunciator Events Recorder, Recall System, Control Room Logs, and Operator Interviews.

Time	Event
00:50:00	Reactor critical
02:07:00	Plant in Mode 1 operation
02:40	Approx. time of steam flow to deaerator tank
02:48:00	First reactor power increase
02:49:17	Pressurizer spray valve partially opened
02:51:00	Second reactor power increase
02:51:39	Pressurizer spray valve open
02:53:25	RC Pressure Low alarm (<2055 psig in RCS)
02:54:59	Third reactor power increase
03:00:29	Fourth reactor power increase - reactor power 15%
03:08:39	RPS Channel "A" Trip - Low RCS Pressure
03:09:17	RPS Channel "D" Trip - Low RCS Pressure
03:09:17	Reactor Trip
03:09:17	Turbine Trip - from Reactor Trip
03:09:58	Low Pressurizer Level alarm (<200" in Pressurizer)
03:11:36	ES Actuation "B" Not Bypassed alarm (<1640 psig in RCS)
03:11:37	ES Actuation "A" Not Bypassed alarm (<1640 psig in RCS)
03:12:49	ES "A" HPI bypassed by operator
03:12:49	ES "B" HPI bypassed by operator
03:18:50	HPI Ch #1 1500 PSI Bistable Tripped (WR RCS Press - 1553)
03:19:04	HPI Ch #2 1500 PSI Bistable Tripped (WR RCS Press - 1574)
03:19:14	RC Pressure Low Low Alarm (<1600 psig in RCS)
03:19:16	+ES Actuation "A" HPI (Operator came out of Bypass)
03:19:20	+ES Actuation "B" HPI (Operator came out of Bypass)
03:19:56	ES Actuation "A" HPI Bypassed to balance HPI flows
03:19:58	ES Actuation "B" HPI Bypassed to balance HPI flows
03:20:37	EFIC Reset & EFW Pumps secured
03:21:44	High Pressure Injection secured
03:24:25	HPI Ch #2 1500 PSI Bistable reset by operator
03:24:29	HPI Ch #1 1500 PSI Bistable reset by operator
03:27:42	Operator resets "A" & "B" HPI
03:27:42	ES Actuation "B" Not Bypassed Alarm (<1640 psig in RCS)
03:27:43	ES Actuation "A" Not Bypassed Alarm (<1640 psig in RCS)
03:35:18	HPI Ch #1 1500 PSI Bistable Tripped (WR RCS Press - 1551)
03:35:28	ES "A" HPI bypassed by operator
03:35:28	ES "B" HPI bypassed by operator
03:35:29	HPI Ch #2 1500 PSI Bistable Tripped

03:35:43	Wide Range RC Pressure Low Low (<1600 psig)
03:37:46	HPI Ch #3 1500 PSI Bistable Tripped
03:42:56	Makeup Valve (MUV - 24) opened by operators
03:45:07	Pressurizer Level Hi-Hi Alarm (>275 inches in pressurizer)
03:48:41	HPI Ch #3 1500 PSI Bistable Reset by operator
03:50:57	HPI Ch #2 1500 PSI Bistable Reset by operator
03:51:13	HPI Ch #1 1500 PSI Bistable Reset by operator
03:53:46	MUV - 24 closed (RCS pressure increasing)
03:54	RCV - 13 closed (spray block valve)
04:55	Unusual Event Declared
05:06	Terminated Unusual Event
05:15	Notified State of Florida of Unusual Event
05:32	Notified NRC of Unusual Event and high pressure injection

+ ES HPI actuated immediately following reset of ES Bypass

While reviewing this sequence of events, the inspectors noted that on both occasions that the high pressure injection actuation signal was bypassed, the annunciator alarm printer indicated that the "A" and "B" trains were bypassed within 0.025 seconds. The location of the bypass switches and operator actions based on the operator interviews caused the inspectors to question the accuracy of these alarm points. A review of the operation of the annunciator system did not identify a cause for this apparent anomaly. Surveillance Procedure SP-130, "Engineered Safeguards Monthly Functional Test," verifies the proper operation of these annunciator alarms on a monthly basis. This minor discrepancy had minimal impact on the ability to analyze the transient. No other discrepancies with the annunciator alarm status were identified. The licensee is investigating the cause of this apparent discrepancy. The inspector will review the results of the licensee's evaluation, Unresolved Item 50-302/91-25-01, Accuracy of annunciator alarm status printer.

4. Licensed Operator Performance

The inspectors interviewed licensee personnel and determined that some licensed operator actions immediately preceding and during the transient aggravated the situation and were considered inappropriate.

As described above, during the initial phase of the transient, the operators believed a reactor coolant system cooldown was in progress. Four reactor power increases were made. Two of these power increases were accomplished while the reactor coolant system was depressurizing and after an RC Pressure Low alarm was received. While the RCS was depressurizing, and prior to the reactor trip, the RCS Tavg remained constant at normal operating temperature. The rod withdrawal to increase power after the RCS Pressure Low alarm, and while the cause of the RCS depressurization was not understood, is considered a nonconservative action.

Further into the depressurization transient, at approximately 1700 psig in the reactor coolant system, the ES "A" and "B" Not Bypassed annunciators alarmed. The operators observing the pressure decrease noticed that at approximately 1600 psig there was an abatement in the rate of depressurization. They concluded that the depressurization was under control and an actuation of ESFAS was not desired. (Subsequent review indicated that this abatement was probably the result of partial closure of the pressurizer spray valve and/or the pressurizer heaters). The high pressure injection actuation signal was placed in bypass. The action to bypass the high pressure injection actuation signal was apparently taken independently by the reactor operator. A procedure which directed or authorized this action did not exist. The shift supervisor stated that he noticed the reactor operator's actions and directed him to return the channels to normal. The ESFAS high pressure injection actuation channels were bypassed for slightly over six minutes based on the annunciator alarm printer. Interviews with on-shift operators revealed that they thought the time in bypass was much shorter than six minutes. After the transient, performance of SP-130 revealed no discrepancies in the alarm printer. The licensee accepted the alarm printer indication as being accurate. While both channels of the high pressure injection actuation signal were bypassed, logic bistables sufficient to actuate the system tripped as indicated by main control panel alarms. The high pressure injection systems actuated immediately as they were returned to the normal condition. The plant remained in operational mode 3 or higher during the transient. As the result of inappropriate operator action, the high pressure injection actuation signal was bypassed for a total of just over six minutes with the plant in an operational mode in which Technical Specification 3.3.2.1 required it to be operable. While the high pressure injection actuation was bypassed, a valid demand signal was present for twelve seconds on train "A" and for sixteen seconds on train "B." This appears to be a violation of Technical Specification 3.3.2.1, example (a) of apparent violation 50-302/91-25-02, Failure to maintain Engineered Safety Feature Actuation System operability.

Following the high pressure injection actuation, full high pressure injection occurred for approximately one minute. The operators took actions to throttle, then stop high pressure injection, secure the emergency diesel generators, and secure emergency feedwater. Reactor coolant system pressure was now above the high pressure injection actuation setpoint. With high pressure injection secured, reactor coolant system pressure again began to decrease. At 3:35 a.m. one of the high pressure injection bistables tripped. Ten seconds later, both trains of high pressure injection actuation were bypassed by the operators to prevent a second start of the emergency diesel generators, emergency feedwater, and partial containment isolation. This action was taken at the direction of shift management and authorized by the acting Operations Superintendent, who was in the control room. The inspectors considered bypassing the automatic actuation of ESFAS high pressure injection this time to also be inappropriate since the cause for the uncontrolled depressurization had not been identified. Had the depressurization been the result of reactor coolant system inventory escaping through an

unidentified path, this action could have placed the facility in an unanalyzed condition. This appears to be a second example of a violation of Technical Specification 3.3.2.1, example (b) of apparent violation 50-302/91-25-02.

5. Procedure Adequacy and Implementation

The inspectors conducted a review of procedures utilized by the licensee during the reactor coolant pressure transient to assess the adequacy of the procedures and their implementation.

In the initial stages of the reactor coolant system depressurization, the reactor coolant system pressure low (RCS PRESS LOW) annunciator alarmed, indicating RCS pressure less than 2055 psig. The operators verified that the alarm was valid based on indicated reactor coolant system pressure. The Annunciator Response Procedure AR-502, "ICS J Annunciator Response," was not referenced by the operators as a means to aid in diagnosing the plant condition. Inspector review of AR-502, "ICS J Annunciator Response," concluded that the procedure contained minimal information regarding operator actions in response to a valid alarm condition. Prior to the reactor coolant system pressure transient, the licensee had initiated actions to improve the quality of the Annunciator Response Procedures.

The operators implemented AP-580, "Reactor Trip," and AP-380, "Engineered Safeguards Actuation," and referred to AP-450, "Emergency Feedwater Actuation," as entry conditions warranted during the reactor coolant system pressure transient. The inspectors noted a discrepancy in the implementation of AP-380, "Engineered Safeguards Actuation."

AP-380 entry conditions required operators to enter the procedure. The entry conditions include: RCS pressure less than 1500 psig, manual ESFAS actuation, and reactor building pressure greater than 4 psig. AP 380 follow-up action step 3.14 isolates possible sources of low reactor coolant system pressure. Included as one of the detailed actions of that step was direction to "Close RCV-13, PZR spray block valve." The inspectors concluded that had this procedure been implemented in a stepwise fashion, and all applicable actions been taken, the pressurizer spray block valve would have been isolated significantly earlier in the transient. This appears to be an example of failure to implement procedures and appears to be a violation of Technical Specification 6.8.1, apparent violation 50-302/91-25-03, Failure to implement procedures for correcting abnormal plant operating conditions.

Administrative Instructions delineating the implementation of Annunciator Response, Abnormal, Emergency, and Verification Procedures contained in AI-400E, "Performance and Transmittal of Procedures," and AI-500, "Conduct of Operations," were reviewed. The Administrative Instructions state that Annunciator Response, Abnormal, Emergency, and Verification Procedures "provide guidance for mitigating the effects of unusual events or returning the plant to normal operation." The instructions indicate that

when entry conditions for Abnormal and Emergency Procedures exist, all immediate actions are to be performed. Follow-up actions may be omitted and the Abnormal or Emergency Procedure may be exited based on operator judgement, with Shift Supervisor concurrence. These Administrative Instructions appeared to contribute to the failure to appropriately implement the portions of AP-380, "Engineered Safeguards Actuation," mentioned above, in that they were vague.

Also, minimal guidance was included in the Administrative Instructions as to when operators were expected to reference Annunciator Response Procedures.

6. Emergency Plan Implementation and Reporting

The inspectors performed a review of the Radiological Emergency Response Plan and the reporting requirements of 10 CFR 50.72 as implemented by the licensee during the reactor coolant system pressure transient.

The reactor trip which occurred at 3:09 a.m. was reportable as a four hour report in accordance with 10 CFR 50.72 (b) (2). The actuation of high pressure injection at 3:19 a.m. was reportable in accordance with 10 CFR 50.72 (b) (1) Non-Emergency Events - One hour reports. 10 CFR 50.72 (b) (1) requires that the licensee shall notify the NRC as soon as practical and in all cases within one hour of the occurrence of any event that results or should have resulted in Emergency Core Cooling System discharge into the reactor coolant system as a result of a valid signal.

The high pressure injection actuation due to a valid low reactor coolant system pressure is a condition which is classified as an Unusual Event in accordance with the Radiological Emergency Response Plan, Table 8.1. During the transient, initiation of high pressure injection was recognized as requiring a one hour report, however it was not recognized as a condition requiring classification as an Unusual Event. After plant conditions were stabilized, an Unusual Event was declared at 4:55 a.m. The Unusual Event was terminated at 5:06 a.m. State of Florida authorities were notified of the Unusual Event at 5:15 a.m., twenty minutes after the event was declared, and a total of one hour and fifty-six minutes after the event occurred. The NRC was notified of the Unusual Event and the actuation of high pressure injection at 5:32 a.m., two hours and thirteen minutes after the event occurred.

The Florida Power Corporation Radiological Emergency Response Plan was developed using the guidance of NUREG-0654/FEMA-REP-1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness Support of Nuclear Power Plants." Section 13.1 of the FPC Radiological Emergency Response Plan, "Range of Assessment Activities," discusses the duties of the Emergency Coordinator (Shift Supervisor). Relative to his duties regarding the classification of events, it states that "The initial classification of an emergency is used as the first indicator of the level of assessment activity required" and "...the Emergency Coordinator shall assure that those assessment activities

required to identify fully the nature of the emergency are completed quickly in order to determine the possibility of an escalation in the severity of the situation."

NUREG-0654, in a discussion of the bases for the Emergency Action Levels, identifies that the rationale for the Notification of Unusual Event and Alert classes was to provide early and prompt notification of minor events which could lead to more serious consequences given further failures or which may be indicative of more serious conditions which were not yet fully realized. NUREG-0654 further states that "prompt" notification of offsite authorities is intended to indicate within about fifteen minutes for the Notification of Unusual Event class, as measured from the time the operators recognize that events have occurred which make the declaration of an emergency class appropriate.

Ninety-six minutes elapsed from the ti[illegible] conditions existed which required classification as an Unusual Event and the Unusual Event declaration. The NRC does not consider ninety-six minutes as an acceptable time for the term "completed quickly" used in the FPC Radiological Emergency Response Plan. Two hours and thirteen minutes elapsed from the time the high pressure injection actuation occurred and NRC notification. This appears to be a violation of the Florida Power Corporation Radiological Emergency Response Plan and 10 CFR 50.72, apparent violation 50-302/91-25-04, Failure to report a high pressure injection actuation in a timely manner and to declare and report the related Unusual Event in a timely manner.

7. Pressurizer Spray Valve Failure Analysis

The inspectors reviewed the licensee's root cause evaluation of these failures. The initiating cause of the reactor coolant system pressure transient was the failure of the pressurizer spray valve in mid position. The concurrent failure of the position indication on the main control panel indicating the valve was closed complicated diagnosis and termination of the transient.

The pressurizer spray valve is a 2 1/2" globe valve with a Limitorque (SMB-000) motor operator. As part of the valve design to prevent stem rotation, a keyway was cut into the stem and a key retainer was mounted in the valve yoke.

Following the reactor coolant system pressure transient, the as found condition of the valve and the operator was carefully evaluated and documented by the licensee. This evaluation identified that the key associated with the stem anti-rotation device was missing, and the lower packing ring was severely damaged. Based on this information, the licensee's preliminary failure analysis concluded that the pressurizer spray valve failed in the partially open position due to a damaged ring of valve packing wedging between the valve stem and the carbon spacer inside the stuffing box. It was believed that the rotating/sliding action of the valve stem, along with the [illegible]cking ring's orientation to the stuffing box

leakoff connection and carbon spacer, could have caused the damage. The replacement packing for the valve was redesigned.

Further, the missing valve stem anti-rotation device was allowing the valve stem to rotate during operation of the valve. This caused the stem's physical position to be different from that indicated by the limit switch. Failure to install this device appeared to be the source of past position indication failures associated with the valve and was a contributing cause to the packing ring failure. Inspector review of the as found conditions determined that the licensee's postulated failure mode was credible.

Prior to plant restart, the valve was refurbished and repacked, the stem anti-rotation device was reinstalled, a refurbished motor operator was installed, and motor-operated valve and control circuitry testing was performed. The motor operated valve and control circuitry testing was reviewed by the inspector. The testing was thorough and no significant deficiencies were identified.

The licensee also reviewed the maintenance history associated with the pressurizer spray valve. Repetitive similar failures of the valve were identified and had been documented in NCOR 90-122. These previous failures included:

DATE	FAILURE
12/8/91	Failed indication, valve failed in mid position,
7/91	Failed indication, valve apparently continued to operate satisfactorily,
6/90	Failed indication, valve failed in mid position.

Although the repetitive nature of these similar failures was identified by the licensee, root cause determination and actions to preclude repetition of the malfunction were not effective. This is an apparent violation of 10 CFR 50, Appendix B, Criteria XVI, Corrective Action, apparent violation 50-302/91-25-05, Failure to implement effective corrective actions for a defective pressurizer spray valve.

The licensee's Quality Programs Department plans to perform a special evaluation of the effectiveness of the implementation of programs currently in place to identify and correct repetitive equipment failures.

8. Review of Previous Reactor Trips

The inspectors conducted a review of two previous reactor trips since startup from the mid-cycle refueling outage which ended in November 1991. This review was limited to potential common contributing causes of the reactor trips and the reactor coolant pressure transient reviewed in detail by this inspection. A detailed review of each of the previous

reactor trips was conducted by the Resident Inspectors and documented in NRC Inspection Report 50-302/91-24. A summary of these reactor trips is included here for completeness.

On November 25, 1991, at 5:16 p.m., the unit was synchronized with the grid when the output breaker was closed. At about 5:20 p.m., with reactor power at approximately twenty percent of full power, a reactor trip occurred when the operating main feedwater pump tripped. The cause of the main feedwater pump trip was a spurious low Deaerating Feed Tank level signal. The spurious signal was the result of a failure of the level indicator gaskets. This depressurized the level legs and created an indicated low DFT level when actual level was high. The high level was caused by the failure of the DFT dump valve to operate. Upon investigation of the failure of the dump valve, its breaker was found tripped. The breaker was reset and functioned properly. The Senior Resident Inspector was in the control room at the time of the trip and he observed operations response. The operators responded to this event in a prompt, proper, and professional manner.

On December 3, 1991, CR-3 was being shutdown from 100% reactor power to investigate the location of the reactor vessel refueling canal seal plate. At 50%, power was stabilized to adjust the RPS Nuclear Overpower Trip Setpoint down to 64.5% in accordance with TS action required when QPT limits are exceeded. Power Range detector NI-8 had failed low. In the pre-job meeting, prior to adjusting the trip setpoint, the effect of NI-8 failure on the ICS and RPS was discussed. The I&C technician, in accordance with SP-113, "Power Range Nuclear Instrumentation Calibration" placed "A" channel of RPS to "bypass" then placed the Power Range Test Module in "Test/operate". This caused an immediate downward feedwater transient. A reactor trip occurred about one minute later from high reactor coolant system pressure. The cause of this event was a misunderstanding by the plant staff of the processing of power range nuclear instrumentation signals to the ICS and the effects of channel test switches. The response of the plant was correct for the switch positions that occurred.

A major contributor to this reactor trip was inadequate and inaccurate operator training. If the ICS feedwater control and reactor control had been placed in "Hand" (Manual) prior to placing the Power Range Test Module to "Test/operate," no transient would have occurred. SP-113 had no step to accomplish placing ICS feedwater control to "Hand." On December 5, 1991, a change was incorporated into SP-113 to place ICS Feedwater Demand in "Hand" if any Power Range Channel is not operable.

The inspectors did not identify any significant root cause commonality between the three transients.

9. Licensee Initial Corrective Actions

The inspectors evaluated the licensee's reactor trip review, analysis, and initial corrective actions for the three reactor trips and verified the

implementation of the corrective actions on a sampling basis. As a result of the reactor coolant pressure transient, the licensee initiated various corrective actions. The Senior Vice President, Nuclear Operations placed an administrative hold on plant startup and established a Startup Review Panel to evaluate the three reactor trips since completion of the mid-cycle maintenance outage. Each of the reactor trips was also evaluated for corrective action by Administrative Instruction AI-704, "Reactor Trip Review and Analysis." The licensee also requested an independent evaluation of the reactor coolant pressure transient be performed by the B&W Nuclear Services, Transient Analysis Group.

The AI-704 corrective action plans included appropriate corrective actions to resolve event specific concerns regarding plant equipment malfunctions, procedure improvements, and training deficiencies. The implementation of these corrective actions was generally good, with the exception of operating procedure improvements as a result of the reactor coolant system pressure transient. Guidance to aid in diagnosing and terminating a decreasing reactor coolant pressure transient was included in Operating Procedures OP-203, "Plant Startup," and OP-204, "Power Operations." The inspector considered the OP procedure revision to be too event specific, and inappropriately focused on normal Operating Procedures verses Annunciator Response Procedures and/or Abnormal Operating Procedures. The licensee indicated that these procedure revisions were temporary, pending implementation of broader procedure improvements including an improvement of the Annunciator Response Procedures which was initiated prior to events evaluated in this report.

The purpose of the Startup Review Panel was to review the events that had occurred at Crystal River, Unit 3 since initial criticality after the mid-cycle maintenance outage. The results of this evaluation and planned corrective actions were discussed with the NRC in a meeting held in the NRC Headquarters Offices on December 13, 1991. Corrective Actions prior to plant startup included additional training of licensed operators on the causes of the three events and a simulator exercise which demonstrated the trips and practiced faulted turbine startups. One session of this training was observed by the inspectors. This use of the simulator was considered a positive initiative.

The preliminary results of the Transient Analysis Program did not differ significantly from the results of the licensee's evaluations. The Transient Analysis Group made one recommendation that the licensee had not yet initiated. The licensee adopted the recommendation, which was to perform a human factors based evaluation of the transient.

10. Exit Interview

The inspection scope and findings were summarized on December 23, 1991, with those persons indicated in paragraph 1. The inspectors described the areas inspected and discussed the inspection results in detail. Dissenting comments were not received from the licensee. Proprietary

information is not contained in this report. The inspectors also attended interviews conducted by personnel from the NRC's Office for Analysis and Evaluation of Operational Data, who conducted an independent human factors review of this event.

Item Number	Status	Description and Reference
50-302/91-25-01	open	URI - Accuracy of annunciator alarm status printer, paragraph 3.
50-302/91-25-02	open	VIO - Failure to maintain Engineered Safety Feature Actuation System operability, paragraph 4.
50-302/91-25-03	open	VIO - Failure to implement procedures for correcting abnormal plant operating conditions, paragraph 5.
50-302/91-25-04	open	VIO - Failure to report a high pressure injection actuation in a timely manner and to declare and report the related Unusual Event in a timely manner, paragraph 6.
50-302/91-25-05	open	VIO - Failure to implement effective corrective actions for a defective pressurizer spray valve, paragraph 7.

11. Acronyms and Abbreviations

AFW - Auxiliary Feedwater System
a.m. - ante meridiem
AP - Administrative Procedure
ASS - Assistant Shift Supervisor
B&W - Babcock & Wilcox
CFR - Code of Federal Regulations
DFT - Deaerating Feed Tank
ECCS - Emergency Core Cooling System(s)
EFIC - Emergency Feedwater Initiation Control System
EFP - Emergency Feedwater Pump
EFW - Emergency Feedwater
ES - Engineered Safeguard (this term is used interchangeably with ESF)
ESF - Engineered Safety Feature
ESFAS - Engineered Safety Feature Actuation System
FPC - Florida Power Corp.
HPI - High Pressure Injection
ICS - Integrated Control System
MUP - Make-Up Pump
NRC - Nuclear Regulatory Commission
OP - Operating Procedure
p.m. - post meridiem

PSI - Pounds per Square Inch
psig - pounds per square inch gauge
QPT - Quadrant Power Tilt
RC - Reactor Coolant (System)
RCP - Reactor Coolant Pump
RCS - Reactor Coolant System
RO - Reactor Operator
RPS - Reactor Protection System
SP - Surveillance Procedure
SW - Nuclear Services Closed Cycle Cooling System
TS - Technical Specification
URI - Unresolved Item
VIO - Violation
WR - Work Request