PRECURSOR DESCRIPTION AND DATA

NSIC Accession Number: 160846

Date: March 20, 1980

Title: Loss of 24 Volt dc Nonnuclear Instrument Power Supply at Crystal River 3

The failure sequence was:

1. With the reactor at 100% power, the 24 V dc nonnuclear instrumentation "X" power supply was lost due to a failed voltage buffer card.
2. Because of this, the integrated control system received erroneous signals and demanded (1) a reactor power increase, (2) a feedwater runback, and (3) the opening of the power-operated relief valve.
3. The open PORV did not prevent reactor coolant pressure from reaching the over-pressure trip set point, which initiated a reactor trip.
4. The loss of power caused the PORV to stay open. Primary coolant was discharged into the reactor coolant drain tank and then into the reactor containment building (43,000 gal) after the drain tank rupture disk opened. RCS pressure dropped resulting in high pressure injection being automatically actuated at 3 min (HPI continued for 84 min).
5. At 4 min the operator tripped the reactor coolant pumps as required by the HPI initiation.
6. The "A" once through steam generator effectively boiled dry at approximately 8 min.
7. The operator shut the block valve which stopped the loss of reactor coolant through the PORV at 2 to 5 min.
8. The operator initiated emergency feedwater at approximately 9 min.
9. The RCS pressure increased due to continued HPI at 1100 gpm, and a code safety valve opened at 10 min.
10. Power was restored to the nonnuclear instrumentation about 21 min into the transient.
11. At 29 min the operator throttled the HPI flow to about 250 gpm.
12. Until about 2 h after the incident began, the safety valve periodically released coolant at 2300 psi to the containment. About 40,000 gal of coolant was dumped into the reactor building.
13. At about 5 h 7 min into the transient, decay-heat closed-cycle cooling pump DCP-1A failed, rendering the "A" decay-heat closed-cycle cooling loop inoperable. The failure was due to failure of the pump motor coupling.
14. The plant was stabilized and maintained in hot standby on natural circulation until forced RCS flow was initiated about 6 h 16 min

into the transient. The plant was subsequently taken to cold shutdown.

15. Throughout the event, core coverage was maintained; no fuel damage occurred, and the RCS remained within code allowable limits.

Corrective action:

The plant was shut down for resolution of the problem and implementation of corrective actions. These actions included:

- Complete testing and inspection of the nonnuclear instrumentation system for similar failures.
- Installation of new redundant channels for indication of twenty-three key plant parameters to provide more reliable information to the operator.
- Comprehensive operator training in response actions for NNI and ICS failures.
- Installation of positive position indication on the power operated relief valve and the two code safety valves.
- Modification of the NNI power supply to provide more reliable power.
- Evaluation of NNI power supply reliability in response to IE Bulletin 79-27 (Loss of Non-Class 1E Instrumentation and Control Power System Bus During Operation).
- Modification of the control circuitry for the PORV and pressurizer spray valves so that the valves will not open in the event of loss of NNI power.

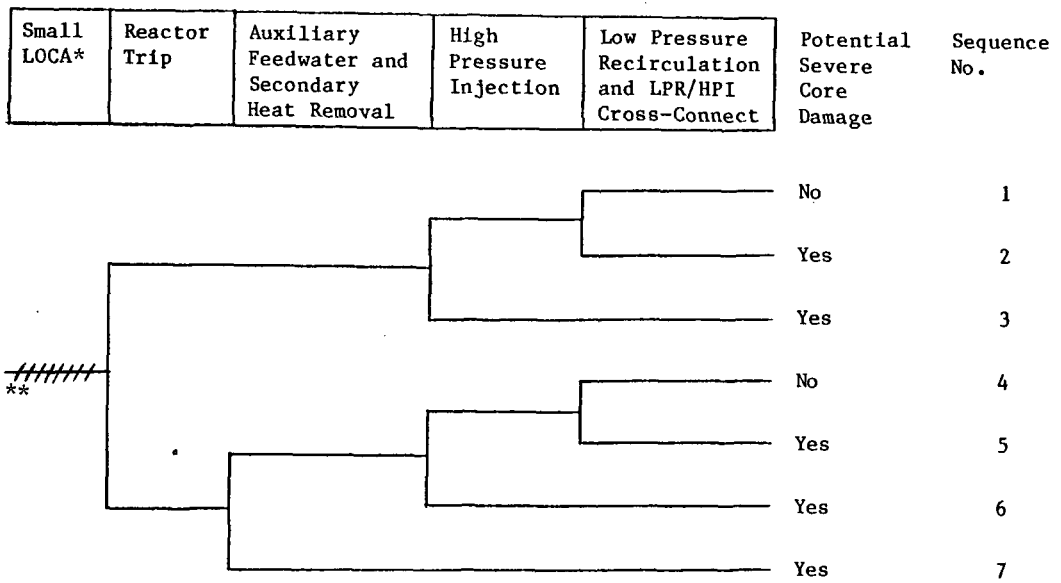
The NRC initiated an extensive review program regarding the effect of the Crystal River event.

Design purpose of failed system or component:

The nonnuclear process instrumentation provides the required input signals of process variables for the reactor protection, regulating, and auxiliary systems. It performs the required process control functions in response to those systems and provides instrumentation for startup, operation, and shutdown of the reactor system under normal and emergency conditions. Inputs to the reactor protective system by the nonnuclear instrumentation are reactor outlet temperature, coolant flow, and pressure. Inputs provided to the integrated control system are reactor outlet temperature, inlet differential temperature, coolant flow, feedwater temperature, feedwater flow, steam generator level, steam generator outlet pressure, and turbine header pressure.

Reactor at power and loss of NNI train X power supply due to failed voltage buffer cord	Consequent erroneous signals to ICS resulting in increased power demand, feedwater runback, and opened PORV	Reactor trip due to high RCS pressure	Safety injection initiated due to decreasing RCS pressure	Operator closes block valve and isolates open PORV	Operator manually initiates emergency feedwater	Power restored to NNI train X	HPI throttled to minimize discharge of containment	Decay heat closed cycle cooling pumps DCP-1A unavailable due to failed motor coupling	Shutdown delayed while pump DCP-1A is repaired	Potential Severe Core Damage
										No
										No - single decay heat loop available
										No
										No
										No
										Possible - if HPI throttled to point that subcooling is lost
										No
										No
									(PORV closure)	Possible - if HPI throttled to point that subcooling is lost
										No
									(PORV closure)	Possible - if HPI throttled to point that subcooling is lost
										No
										No
										Yes
ATWS										Yes

NSIC 160846 - Actual Occurrence for Loss of 24-V Nonnuclear Instrument Power Supply at Crystal River 3



NSIC 160846 - Sequence of Interest for Loss of 24-V dc Nonnuclear Instrumentation Power Supply at Crystal River 3

*due to loss of NNI-X power supply

**continued small LOCA requires operator error in not closing PORV block valve

CATEGORIZATION OF ACCIDENT SEQUENCE PRECURSORS

NSIC ACCESSION NUMBER: 160846

LER NO.: 80-010 Rev. 1

DATE OF LER: March 20, 1980

DATE OF EVENT: February 26, 1980

SYSTEM INVOLVED: Nonnuclear instrumentation

COMPONENT INVOLVED: 24 V dc power supply

CAUSE: A combination of misaligned connector pins on printed circuit boards and a technician working on saturation meter circuit utilizing these boards resulted in loss of the power

SEQUENCE OF INTEREST: Loss of NNI-X power supply

ACTUAL OCCURRENCE: Failure of nonnuclear instrumentation power supply, reactor trip, turbine trip, and engineered safeguards actuation

REACTOR NAME: Crystal River Unit 3

DOCKET NUMBER: 50-302

REACTOR TYPE: PWR

DESIGN ELECTRICAL RATING: 825 MWe

REACTOR AGE: 3.1 years

VENDOR: Babcock & Wilcox

ARCHITECT-ENGINEERS: Gilbert Associates

OPERATORS: Florida Power Corporation

LOCATION: 7 miles NW of Crystal River, Florida

DURATION: N/A

PLANT OPERATING CONDITION: 100% power

TYPE OF FAILURE: Inadequate performance; made inoperable

DISCOVERY METHOD: Operational event

COMMENT: