PRECURSOR DESCRIPTION AND DATA

NSIC Accession Number: 138830

Date: March 31, 1978

Title: Reactor Cooldown Rate Exceeds Limit Following Reactor Trip at Rancho Seco

The failure sequence was:

1. With the reactor at 70% power, an operator dropped a light bulb into an open backlighted push button assembly while replacing a burned out light.
2. The dropped bulb created a short-to-ground in the Y portion of the Non-Nuclear Instrumentation (NNI-Y), which resulted in actuation of current limiting and undervoltage protection circuitry and consequently interrupted AC power to all NNI-Y DC power supplies.
3. Approximately 2/3 of all NNI signals were affected by the power loss, resulting in erroneous signals in both the control room and the Integrated Control System (ICS).
4. The ICS reduced feedwater flow to zero in response to faulty signals and reactor trip occurred on high pressure. An auxiliary feed pump started on the loss of feedwater flow, however the auxiliary feedwater valves remained closed due to incorrect steam generator level indication. (During the nine minute period following trip, both steam generators went dry.)

cont.

Corrective action:

1. An analysis of the effect of the transient on plant components was performed by B & W. As a result of this analysis, B & W recommended the plant be allowed to return to power, subject to increased surveillance and maneuvering limits for the first startup.
2. The steam lines were checked for damage.
3. An RCS leak test was performed.
4. A casualty procedure concerning restoration of NNI power was written, and a procedure for operator action in the event NNI was unavailable was to be prepared.

Design purpose of failed system or component:

The NNI provides control and instrumentation signals for numerous reactor plant parameters.

Unavailability of system per WASH 1400:* Not considered

Unavailability of component per WASH 1400:* --

*Unavailabilities are in units of per demand D^{-1}. Failure rates are in units of per hour HR^{-1}.

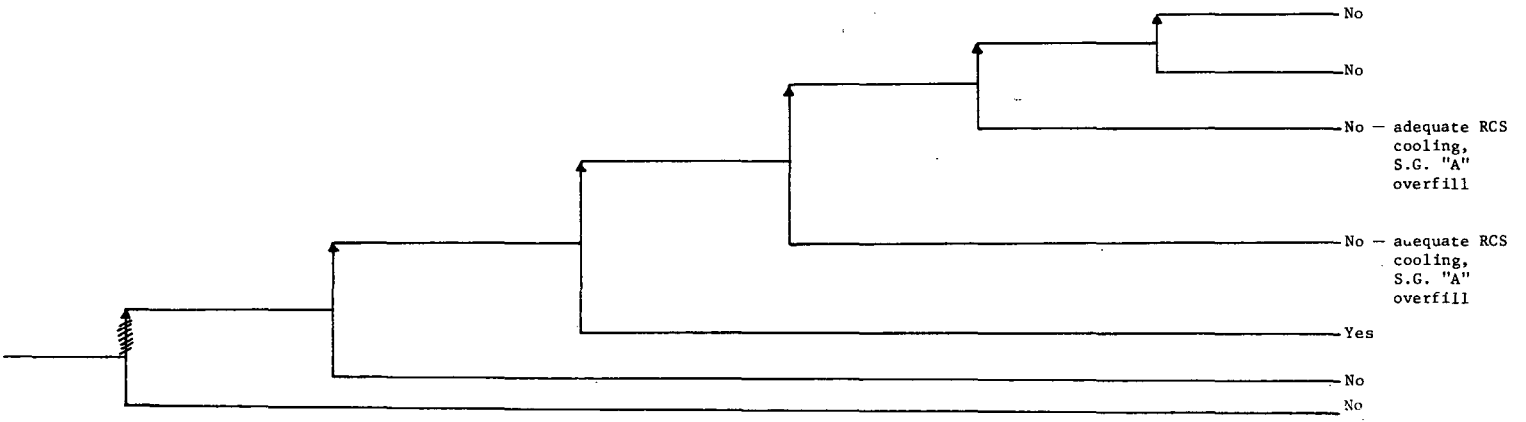
failure sequence, continued

5. The startup level indication for the "A" steam generator eventually (9 minutes after trip) drifted below the low level setpoint and the ICS opened the auxiliary feedwater control valve, admitting water to steam generator "A".

6. The injection of auxiliary feedwater to the "A" steam generator produced a drop in RCS pressure to below the SFAS low pressure trip setpoint (1600 psig), and resulted in the opening of both auxiliary feedwater bypass valves and the filling of both steam generators with water.

7. Due to the unavailability of reliable instrumentation, auxiliary feedwater injection was continued until NNI-Y power was restored (70 minutes after trip). RCS pressure was controlled using available pressurizer level and pressure instrumentation and throttling HPI flow. At the time NNI-Y power was restored, the steam generators had been filled; water had entered the main steam lines, and the RCS had cooled down to 285°F (300°F/hr cooldown rate).

Reactor at 70% power	Momentary short circuit results in trip of NNI-Y power supplies - 2/3 of all NNI control and instrumentation signals affected	ICS reduces feedwater flow to zero and starts auxiliary feedwater pump, flow to steam generator inhibited (all due to affected instrumentation), resulting in steam generator boiling dry. (reactor trip on high RCS pressure)	Startup level indication for "A" steam generator eventually drifts below low level setpoint - auxiliary feedwater flow initiated to "A" steam generator	Injection of auxiliary feedwater to "A" steam generator results in RCS cooldown - pressure drop below SFAS low pressure setpoint (1600 psig)	SFAS initiation provides AFW flow to second steam generator, high pressure injection to RCS	Due to lack of instrumentation, operators continue AFW injection until NNI-Y power is returned (70 minutes) and control RCS pressure and level by throttling HPI flow-steam generators filled, water in steam lines, RCS cooldown at 300°F/hr	Potential Severe Core Damage



NSIC 138830 — Actual Occurrence for Reactor Cooldown Rate Exceeds Limit Following Reactor Trip at Rancho Seco

Loss of Main Feedwater *	Reactor Trip	Auxiliary Feedwater and Secondary Heat Removal	PORV Demanded	PORV or PORV Isolation Valve Closure	High Pressure Injection	Long Term Core Cooling	Potential Severe Core Damage	Sequence No.
							No	1
							No	2
							Yes	3
		(CD) **					Yes	4
							No	5
							No	6
							Yes	7
				***			Yes	8
							No	9
							No	10
							Yes	11
		(CF)					Yes	12
							Yes	13

NSIC 138830 — Sequence of Interest for Reactor Cooldown Rate Exceeds Limit Following Reactor Trip at Rancho Seco

* due to NNI-Y power supply trip

** success requires instrument drift in correct direction or operator decision to open AFW control valves when instrumentation indicates steam generators contain water

*** not part of mitigation procedure (pre-TMI-2)

CATEGORIZATION OF ACCIDENT SEQUENCE PRECURSORS

NSIC ACCESSION NUMBER: 138830

DATE OF LER: March 31, 1978

DATE OF EVENT: March 20, 1978

SYSTEM INVOLVED: Non Nuclear Instrumentation

COMPONENT INVOLVED: Power Supplies

CAUSE: Power supply trip due to momentary short, human error

SEQUENCE OF INTEREST: Loss of Main Feedwater

ACTUAL OCCURRENCE: Failure of NNI and consequent steam generator dryout and overfill, RCS overcooling.

REACTOR NAME: Rancho Seco

DOCKET NUMBER: 50-312

REACTOR TYPE: PWR

DESIGN ELECTRICAL RATING: 918 MWe

REACTOR AGE: 3.5 yr

VENDOR: B & W

ARCHITECT-ENGINEERS: Bechtel

OPERATORS: Sacramento Municipal Utility District

LOCATION: 25 mi SE of Sacramento, California

DURATION: N/A

PLANT OPERATING CONDITION: 70% power

SAFETY FEATURE TYPE OF FAILURE: (a) inadequate performance; (b) failed to start; (c) made inoperable; (d) _____

DISCOVERY METHOD: operational event

COMMENT: