PRECURSOR DESCRIPTION AND DATA

NSIC Accession Number: 116212

Date: August 3, 1976

Title: Inadvertant Load Shedding on Safety-Related Buses at Millstone 2

The failure sequence was:
1. On July 5, 1976, Millstone 2 was decreasing load to repair a leaking feedwater heater when a reactor trip occurred due to a steam generator transient. The station loads had already been transferred to an offsite source. As a result of the trip and the fact that the transmission network was very lightly loaded and lightly supplied at the time, the 345 KV grid voltage dropped to 335 KV (its normal voltage is approximately 360 KV) and remained there for over one hour.
2. Following the trip, certain non-safety related 480 V equipment did not start due to blown control power fuses in the equipment motor control centers. It was concluded that the fuses blew because of the low line voltage, perhaps compounded by inherent cable voltage drops to the individual motor control centers.
3. The utility concluded that under similar low voltage conditions 480 V safety-related equipment might not operate and tests were made to determine the minimum voltage (410 V) at which equipment operability could be assured. cont.

Corrective action:
1. The undervoltage trip logic was modified (1) to prevent additional load shedding once the diesels have started, and (2) to provide dual undervoltage trip setpoints which would allow for short-term grid transients.
2. The transformer taps were changed to optimize in-plant voltage.

Design purpose of failed system or component:
The emergency power system provides power to safety-related equipment in the event of a loss of offsite power.

Unavailability of system per WASH 1400:* emergency power: $1 \times 10^{-2}/D$

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

4. To prevent such a low-voltage occurrence, the ESFAS undervoltage relays were raised to assure the plant would be separated from the grid before grid voltage fell to a point at which equipment operability could not be assured.

5. On July 16, 1976, with the plant at 100% power, a 1500 HP circulating water pump was started. The current inrush from the pump start resulted in a voltage drop on the safety-related bus to below the revised undervoltage trip point.

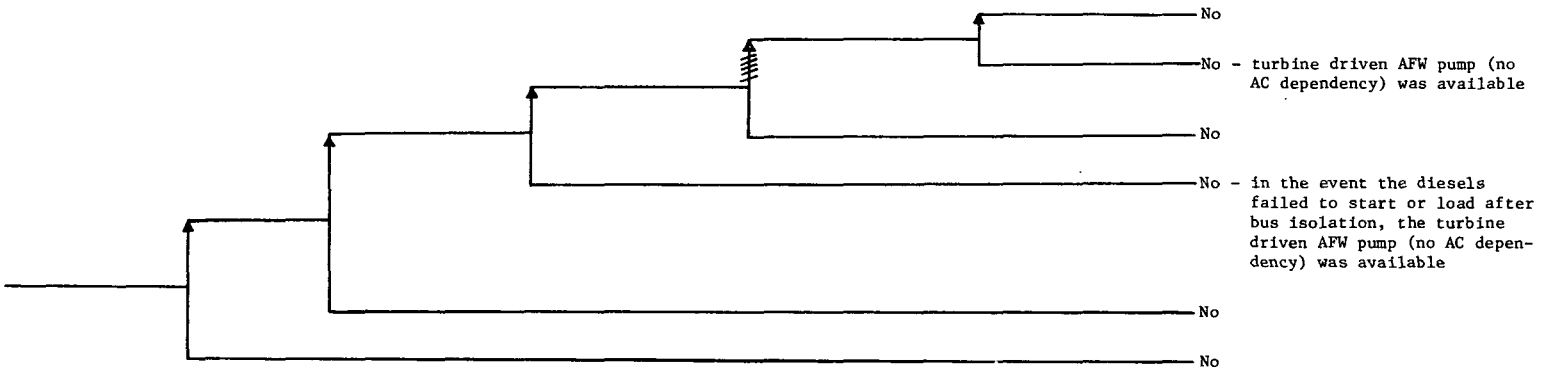
6. The ESAS sensed the undervoltage condition, isolated the safety-related buses from the plant electrical system, tripped the reactor, shed bus loads, started the diesel generators, and connected them to the safety-related buses.

7. When the service water and reactor building closed cooling water pumps were sequenced on to the safety-related buses, the inrush current for each component caused the bus voltage to drop below the new undervoltage setpoint for each component and these loads tripped off the buses.

8. At the completion of the load sequence the emergency buses were energized but the main loads were unconnected due to the additional load shed signals.

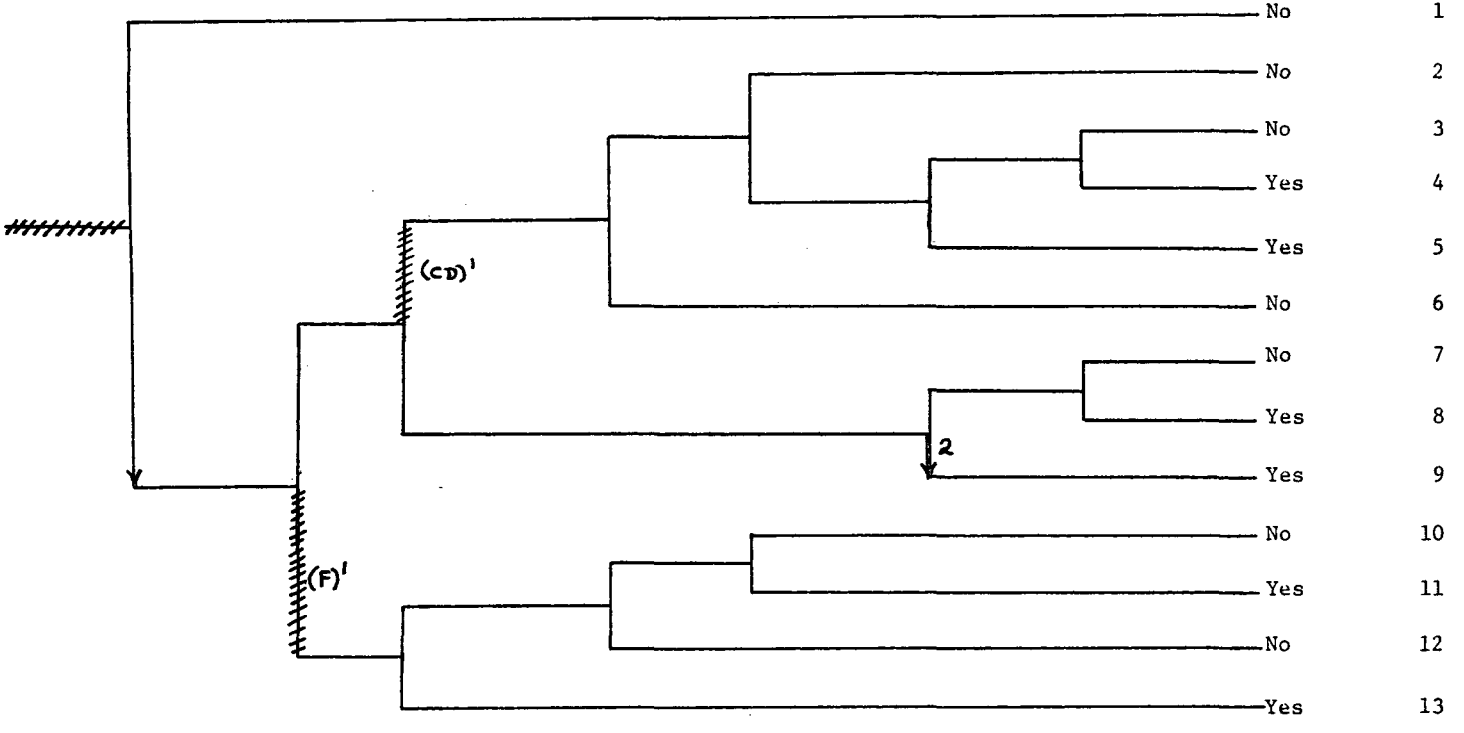
9. The undervoltage bistables were immediately reset to their previous setpoints and the reserve station transformer connected to the safety-related buses. The service water and reactor building closed cooling water pumps were started satisfactorily five minutes after their previous trip.

Reactor at 100% power and under-voltage trip set-points reset to assure adequate voltage to safety-related components in the evnet of degraded grid voltage	Operator starts circulating water pump	Pump current in-rush results in voltage drop on safety-related bus below revised undervoltage trip point	Safety-related buses isolate, reactor trip, bus load shed, diesel generators start and connect to safety-related buses	Service water and reactor building closed cooling water pumps trip on undervoltage during sequencing due to current in-rush dropping bus voltage below revised undervoltage trip setpoints	Operator resets undervoltage trip setpoints and successfully loads service water and reactor building closed cooling water pumps	Potential Severe Core Damage



NSIC 116212 — Actual Occurrence for Inadvertent Load Shedding on Safety-Related Buses at Millstone 2

Loss of Offsite Power	Turbine Generator Runs Back and Assumes House Loads	Emergency Power	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
								No	3
								Yes	4
								Yes	5
								No	6
								No	7
								Yes	8
								Yes	9
								No	10
								Yes	11
								No	12
								Yes	13



NSIC 116212 — Sequence of Interest for Inadvertent Load Shedding on Safety-Related Buses at Millstone 2

[1]Success requies immediate operator action to reset undervoltage trip setpoints and reload safety-related loads.

[2]Operating procedures did not provide for use of HPI for core cooling

CATEGORIZATION OF ACCIDENT SEQUENCE PRECURSORS

NSIC ACCESSION NUMBER: 116212

DATE OF LER: August 3, 1976

DATE OF EVENT: July 20, 1976

SYSTEM INVOLVED: emergency power

COMPONENT INVOLVED: undervoltage trip setpoints

CAUSE: Undervoltage trip setpoints incorrectly set, human error

SEQUENCE OF INTEREST: loss of offsite power

ACTUAL OCCURRENCE: apparent loss of offsite power and failure of major safety related components to load.

REACTOR NAME: Millstone 2

DOCKET NUMBER: 50-336

REACTOR TYPE: PWR

DESIGN ELECTRICAL RATING: 870 MWe

REACTOR AGE: .8 yr

VENDOR: Combustion Engineering

ARCHITECT-ENGINEERS: Bechtel

OPERATORS: Northeast Nuclear Energy Company

LOCATION: 5 miles SW of New London, Conn.

DURATION: N/A

PLANT OPERATING CONDITION: 100% power

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

DISCOVERY METHOD: operational event

COMMENT: