



UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION V

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Enclosure 1

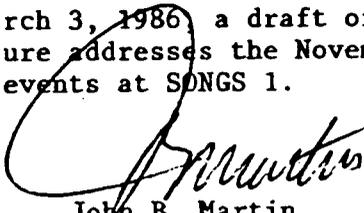
MAR 13 1986

MEMORANDUM FOR: C. J. Heltemes, Jr., Director
Office for Analysis and Evaluation of
Operational Data

FROM: John B. Martin, Regional Administrator

SUBJECT: ABNORMAL OCCURRENCE REPORT TO CONGRESS FOR
SAN ONOFRE NUCLEAR GENERATING STATION (SONGS)
UNIT 1 NOVEMBER 21, 1985 EVENT

In accordance with a phone conversation between J. L. Crews of my staff and P. E. Bobe of your office on March 3, 1986, a draft of an Abnormal Occurrence Report is enclosed. The enclosure addresses the November 21, 1985 subject, loss of power and water hammer events at SONGS 1.


John B. Martin
Regional Administrator

Enclosure:
As stated

cc:

J. L. Crews
✓ P. E. Bobe

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Loss of Power and Water Hammer Event

The following information pertaining to this event is also being reported concurrently in the Federal Register. Appendix A (see the second general criterion) of this report notes that a major degradation of essential safety-related equipment can be considered an abnormal occurrence.

Date and Place - On November 21, 1985, San Onofre Nuclear Generating Station (SONGS), Unit 1, experienced a partial loss of inplant ac electrical power while the plant was operating at 60 percent power. Following a manual reactor trip, the plant lost all inplant ac power for 4 minutes and experienced a severe incidence of water hammer in the feedwater system which caused a leak, damaged plant equipment, and challenged the integrity of the plant's heat sink. SONGS Unit 1 utilizes a Westinghouse - designed pressurized water reactor. The plant is operated by Southern California Edison Company (the licensee) and is located south of San Clemente, California.

The event involved several equipment malfunctions and extensive operator actions, including operator actions outside the control room.

Nature and Probable Consequences

At 4:51 a.m., on November 21, 1985, the plant was operating at 60 percent power, when a ground fault was detected by protective relays associated with a transformer which was supplying power to one of two safety-related 4160V electrical buses. The resulting isolation of the transformer caused the safety-related bus to de-energize, which tripped all feedwater and condensate pumps on the east side of the plant. The pumps on the west side of the plant were unaffected since their power was supplied from another bus. The continued operation of the west feedwater and condensate pumps, in combination with the failure of the east feedwater pump discharge check valve to close, resulted in over-pressurization and rupture of an east side flash evaporator low-pressure heater unit. The operators, as required by emergency procedures dealing with electrical systems, tripped the reactor and turbine-generator. As a result, the plant experienced its first complete loss of steam generator feedwater and inplant electrical power since it began operation.

The subsequent 4-minute loss of inplant electric power started the emergency diesel generators (which by design did not load), de-energized all safety-related pumps and motors, significantly reduced the number of control room instrument indications available for operators to diagnose plant conditions, produced spurious indications of safety injection system actuation, and caused the NRC Emergency Notification System (ENS) phone on the operator's desk to ring spuriously. Restoration of inplant electric power was delayed by an unexpected response of an automatic sequence that should have established conditions for delayed remote-manual access to offsite power still available in the switchyard.

The loss of steam generator feedwater was the direct result of the loss of power to the two main feedwater and one auxiliary feedwater pump motors, and the designed 3-minute startup delay of the steam-powered auxiliary feedwater pump. The loss of the feedwater pumps, in combination with the failure of four additional feedwater check valves to close, allowed the loss of inventory from all three steam generators and the partial voiding of the long horizontal runs of feedwater piping within the containment building. The subsequent automatic start of feedwater injection by the steam-powered auxiliary feedwater pump did not result in the recovery of steam generator level because the backflow of steam and water to the leak in the evaporator carried the auxiliary feedwater with it. Later, operators isolated the feedwater lines from the steam generators, as required by procedure, unknowingly initiating the process of refilling the feedwater lines in the containment building. Before all feedwater lines were refilled, a severe water hammer occurred that bent and cracked one feedwater pipe in the containment building, damaged its associated pipe supports and snubbers, broke a feedwater control valve actuator yoke, and stretched the studs, lifted the bonnet, and deformed the gasket on from a 4-inch feedwater check valve. The damaged check valve developed a significant steam-water leak, the second leak in the event.

The second leak, in combination with an earlier inadvertent re-establishment of steam generator blowdown, caused all three steam generator water levels to drop below indicating levels. Steam from all three steam generators fed the leak, because of the absence of individual main steam isolation valves.

Despite these problems, operators later succeeded in recovering level indication in the two steam generators not directly associated with the feedwater piping leak. With the reestablishment of steam generator levels, the operators safely brought the plant to a stable cold shutdown condition, without a significant release of radioactivity to the environment (the pre-existing primary to secondary leak was not exacerbated) and without significant additional damage to plant equipment.

Cause or Causes - As described in more detail above, the most significant aspect of the event involved the failure of five safety-related check valves in the feedwater system whose failure occurred in less than a year, without detection, and jeopardized the integrity of safety systems.

Actions Taken to Prevent Recurrence

Licensee - The licensee has undertaken an extensive study (including testing programs) of the multiple failures associated with the event to determine root causes and to take effective corrective actions to minimize recurrence. While some tentative conclusions have been made, they may be modified as the ongoing studies continue.

The licensee is keeping the NRC aware of the results of their studies and testing program.

The licensee has provided a program plan (Ref. 2) to determining the root causes of the equipment malfunctions and the appropriate corrective actions. Other issues (e.g., operational management, procedural deficiencies; equipment design, testing, maintenance deficiencies; etc.) are also under review by the licensee.

In response to an February 19, 1986 NRC meetings (Reference 3), the licensee submitted a detailed lists of actions (Reference 5) to address numerous areas of concern. The licensee plans to brief the Commission on March 18 and provide a comprehensive report of their analyses on March 28, 1986.

NRC - Upon being notified of the event, the NRC Resident Inspectors for the plant arrived shortly thereafter. They observed licensee actions to assure the plant remained in a stable condition and began an initial investigation of the circumstances associated with the event.

On November 21, 1985, the Regional Administrator of the NRC Region V Office forwarded a Confirmatory Action Letter to the licensee (Ref. 5) indicating, among other things, that the licensee would not perform any additional work on equipment that malfunctioned during the event until the NRC investigation could review the licensee's proposed actions. The letter also stipulated that the plant was not to be restarted until authorized by the NRC Region V Regional Administrator or his designee.

On November 22, 1986, the responsibility for the incident investigation was assigned to a special NRC Incident Investigation Team by the NRC Executive Director for Operations at the request of the Region V Regional Administrator, in conformance with a NRC staff-proposed Incident Investigation Program. The Team, composed of six technical experts, was to (1) fact-find as to what happened; (2) identify the probable cause as to why it happened; and (3) make appropriate findings and conclusions to form the basis for possible follow-on actions. The Team began their investigation at the plant site on November 23, 1985. The equipment which malfunctioned was quarantined.

The Team collected and evaluated information to determine the sequence of operator, plant, and equipment responses during the event and the causes of equipment malfunctions. The sequence of these responses was determined primarily by interviewing personnel who were at the plant during the event and by reviewing plant data for the period immediately preceding and during the event. The Team also toured the plant to examine the equipment which malfunctioned, the equipment that was key to mitigating the transient, and the control room instrumentation and controls. The Team also interviewed plant management personnel and NRC Region V personnel who arrived at the site soon after the plant was stabilized about their knowledge of the plant response and operator actions. By correlating plant records with personnel statements on their actions and observations, the Team was able to compile a picture of the event.

The results of the Team's investigation are contained in NUREG-1190 (Ref. 1). Problems identified included issues specific to SONGS and several possible generic issues. In addition, the Team has concluded that the most significant aspect of the event was that five safety-related feedwater system check valves degraded to the point of inoperability during a period of less than a year, without detection, and that their failure jeopardized the integrity of safety-related feedwater piping.

The root causes of the check valve failures have not been determined and are still under review by SCE and independently by the NRC. Potential contributors to this problem include inadequate maintenance, inadequate inservice testing, inadequate design, and inadequate consideration of the effects of reduced power operations. Maintenance records for these valves were either missing or lacked specificity on what was done. Inservice testing records for these valves were inconsistent; the testing procedure was not rigorous; the test acceptance criteria were subjective; the testing frequency was open-ended; and, the tests did not assure detection of the failures found. Finally, reduced power operations at Unit 1 are now routine because of steam generator tube plugging and sleeving, and the reduced feedwater flow may have increased the susceptibility of check valve components to hydraulic-induced vibration.

The NRC continues to be involved in the resolution of this event and related matters. The event provides an opportunity for the NRC to learn from experience and to feed back the pertinent lessons into NRC and licensee activities. The Executive Director for Operations has directed NRC program managers to conduct an in-depth and searching reappraisal of the effectiveness of their programs in light of the lessons of the SONGS Unit 1 event with the view of making the NRC programs more effective. An NRC action plan has been developed through a cooperative effort of the Offices of Nuclear Reactor Regulation, Inspection and Enforcement, and Region V.

This plan resulted in three basic types of actions that the staff is undertaking:

- * Evaluation of licensee corrective actions and evaluations that are required for restart in accordance with the NRC established, action list. Most notably, assessment of the licensee's review of plant material condition and readiness for operation.
- * Evaluation of generic implications of the SONGS Unit 1 event through a sampling of industry experience and technical evaluations of root causes, e.g., check valve design implementation.
- * Evaluation of NRC requirements and positions in light of existing implementation practices, root causes found from the event, and samples of industry practices.

These actions outline a program that evaluates the SONGS Unit 1 restart program, and assures that generic aspects are considered.

Future reports will be made as appropriate.

INFORMATION REQUESTED FROM IE, THE REGIONS, NRR
AND NMSS, AS APPROPRIATE, FOR EACH CALENDAR QUARTER

AEOD should be provided with a listing and assessment of only the items below which appear reportable either as potential AOs, "Other Events of Interest," or "Other Events Considered for AO Reporting." The assessment (in summary form) should include the significance of the items and the reasons for reporting.

A. IE, or Regional Offices, as appropriate

1. Events reported in accordance with the Immediate Notification requirements.
2. Identification of a generic safety concern raised by the of an incident or incidents which prompted notification of other possibly affected licensees, i.e., Bulletins or Information Notices.

Cognizant Regional Offices

1. Incidents classified by the licensees as Alerts, Site Area Emergencies, or General Emergencies.
2. Significant enforcement actions, i.e., Severity I and II items; civil penalties, orders to cease and desist, license suspension, license modifications, or revocations, or show cause orders.
3. Actions to require shutdown of a facility for safeguards considerations.

B. NRR

1. License suspensions.
2. Orders covering license modifications for safety reasons.
3. Identification of those generic safety concerns approved by the Director, NRR.

C. NMSS, or Regional Offices, as appropriate

1. License suspensions.
2. Orders or license amendments in response to significant safety-related, security or safeguards incidents.
3. Identification of a generic safety concern raised by the of an incident or incidents.
4. Changes to safeguards features because of MUF and LEMUF incidents reportable under 10 CFR 70.

ITEMS FOR FOURTH QUARTER CY 1985
AO REPORT AND COMMISSION PAPER
(Presently in Staff and Commission Review Process)

I. AOs

- 85-19 Inoperable Main Steam Isolation Valves (Brunswick Unit 2).
- 85-20 Management Deficiencies at Fermi Nuclear Power Station (Fermi Unit 2).
- 85-21 Diagnostic Medical Misadministration (Letterman Army Medical Center, Presidio of San Francisco, California).
- 85-22 Therapeutic Medical Misadministration (Queen's Medical Center, Honolulu, Hawaii).
- 85-23 Diagnostic Medical Misadministration (Hospital Universitario, San Juan, Puerto Rico).

II. Appendix B (Updates)

- 79-3 Nuclear Accident at Three Mile Island - Further information is provided and the item remains open.
- 83-3 Failure of Automatic Reactor Trip System - This previously closed item is reopened to describe several recent problems with Westinghouse and General Electric type reactor trip breakers. The item is then reclosed.
- 83-6 Uncontrolled Leakage of Reactor Coolant Outside Primary Containment - This previously closed item is reopened to report a similar type event at Dresden Unit 3. The item is then reclosed.
- 84-2 Through Wall Crack in Vent Header Inside BWR Containment Torus - This previously closed item involving Hatch Unit 2 is reopened to report a similar type event at Hatch Unit 1. This item is then reclosed.
- 84-19 Buildup of Uranium in a Ventilation System (Nuclear Fuel Services, Erwin, Tennessee) - This previously closed item is reopened to report a similar type event at Hatch Unit 1. The item is then reclosed.
- 85-7 Loss of Main and Auxiliary Feedwater Systems (Davis-Besse) - Further information is provided and the item remains open.
- 85-8 Diagnostic Medical Misadministration (Hospital of St. Raphael, New Haven, Connecticut) - Further information is provided and the item is closed out.

- 85-9 Diagnostic Medical Misadministration (Mercy Hospital, Pittsburgh, Pennsylvania) - Further information is provided and the item is closed out.
- 85-15 Therapeutic Medical Misadministration (University Health Center of Pittsburgh's Joint Radiation Oncology Center, Magee-Women's Hospital site, Pittsburgh, Pennsylvania) - This previously closed item is reopened to report updating information. The item is then reclosed.
- 85-16 Therapeutic Medical Misadministration (Hershey Medical Center, Hershey, Pennsylvania) - This previously closed item is reopened to report updating information. The item is then reclosed.

III. Appendix C ("Other Events of Interest")

1. Systems Interaction Event (Hatch Unit 1).
2. Suspension of License of a Medical Research Institute (Institute for Medical Research of Bennington; Bennington, Vermont).
3. HPCI Turbine Exhaust Multiple Check Valve Failures (Shoreham Unit 1).

IV. Enclosure 3 (To the Commission paper which forwards the report to the Commission for approval).

No items were proposed.

INFORMATION NEEDED FOR VARIOUS TYPES OF REFERENCES

For any material supplied by the staff for inclusion in either the draft quarterly report, or Enclosure 3 to the Commission paper, it is requested that complete references (including copies, unless you have previously provided copies) be given to AEOD. This includes:

- (a) For NUREG documents: The NUREG number, the complete title, date published, availability from GPO Sales Program and/or NTIS.
- (b) Letters to licensees (license modifications, civil penalties, inspection reports, notices of violations, etc.): The name of the sender (and office), the name of the recipient (both the name of the licensee and the recipient at the licensee), date of letter, docket number and availability (generally, for inspection and copying for a fee at the NRC Public Document Room).
- (c) Letters from licensees to the NRC: Similar to (b) above.