

U. S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-346/85021(DRP)

Docket No. 50-346

License No. NPF-3

Licensee: Toledo Edison Company
Edison Plaza
300 Madison Avenue
Toledo, OH 43652

Facility Name: Davis-Besse Nuclear Power Station, Unit 1

Inspection At: Oak Harbor, OH

Inspection Conducted: June 9 through June 23, 1985

Inspectors: W. G. Rogers

D. C. Kosloff

N. C. Choules

P. R. Wohld

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I. N. Jackiw, Chief
Reactor Projects Section 2B

7-30-85
Date

Inspection Summary

Inspection on June 9 - June 23, 1985 (Report No. 50-346/85021(DRP))

Areas Inspected: Special inspection to observe and review the licensee's performance and corrective actions as a result of the loss of feedwater event on June 9, 1985. The inspection involved a total of 454 inspector-hours onsite by five NRC inspectors including 171 inspector-hours onsite during off-shifts.

Results: No items of noncompliance or deviations were identified.

DETAILS

1. Persons Contacted

a. Licensee

- *T. Murray, Nuclear Mission Assistant Vice President, Acting Nuclear Mission Head
- *B. Beyer, Nuclear Projects Director
- S. Quennoz, Plant Manager
- J. Ligenfelter, Technical Superintendent
- W. O'Conner, Operations Superintendent
- L. Simon, Operations Supervisor
- *S. Wideman, Nuclear Licensing Specialist

The inspectors also interviewed other licensee employees, including members of the technical, operations, maintenance, I&C, licensing, engineering and health physics staffs.

b. NRC Region III Site Team

- *W. Shafer, Branch Chief, DRP
- I. Jackiw, Section Chief, DRP
- N. Choules, Regional Inspector
- *P. Wohld, Regional Inspector

*Denotes those present at the exit meeting on June 22, 1985.

2. Initial NRC Response to June 9, 1985 Event

At 0135 in the morning on June 9, 1985, the licensee experienced a reactor/turbine trip, total loss of feedwater for 10 to 15 minutes. At 0226 an Unusual Event was declared by the Shift Supervisor.

Approximately an hour after the initiating event, the resident inspectors were notified of the situation by the licensee. The inspectors proceeded to the site after notifying Region III management. By the time the inspectors arrived at the site, the licensee had restored feedwater flow to the steam generators using the auxiliary feedwater pumps and the startup feedwater pump. The inspectors witnessed the trip recovery actions until the Unusual Event was terminated. Following the trip, the inspectors conducted an initial review of the computer readouts of the transient in the Technical Support Center. During the afternoon of June 9, 1985, the inspectors met with regional supervision and provided a plant status including all known information related to the transient.

3. The NRC Fact Finding Team

On June 10, 1985, the Executive Director of Operations appointed a Fact Finding Team (FFT) to investigate the transient plant response and the licensee's response to the event, and to assure that all root causes

of the event were identified. The FFT arrived at the facility on June 11, 1985, and commenced performing the duties stated above. A full report of the event will be made by the FFT.

4. Confirmatory Action Letter

On June 10, 1985 a Confirmatory Action Letter (CAL) was issued by Region III delineating action to be taken by the licensee prior to the unit returning to power operations. A copy of the CAL is attached to this report. The major elements of the CAL are presented below:

- a. Stop any work in progress or planned on equipment that malfunctioned during the transient until the FFT concurred with the corrective actions.
- b. Review the actuation of the main steam isolation valves.
- c. Review the actuation of the auxiliary feedwater system.
- d. Review the main feedwater system operation.
- e. Perform an analysis of the effects this event had on the steam generators.
- f. Perform testing of the main and auxiliary feedwater pumps to assure proper operation.

5. Licensee Maintenance Effort

To implement item a. of the CAL stated above, a "freeze list" was drawn up listing the equipment which failed or was suspected of malfunctioning during the event. Specific guidelines were established for troubleshooting this equipment. The major elements of these guidelines were:

- a. Evaluate all data and history concerning the equipment in question.
- b. Develop hypotheses for the primary and alternate root causes of the problem.
- c. Develop plans for testing the hypotheses through checks, troubleshooting, inspections, etc.
- d. Have the NRC review completed plans prior to implementation.
- e. Perform corrective actions after the root cause has been determined.

On June 17, 1985, the inspector observed a briefing of maintenance personnel on the guidelines to be followed when performing maintenance on the "freeze list" equipment. The guidelines were provided to all maintenance personnel. The briefing appeared to be adequate to inform maintenance personnel of what was expected during these maintenance activities.

On June 17, 1985, the inspector also observed a briefing of quality control (QC) inspectors on the "freeze list" guidelines. The briefing appeared to be adequate to informing the QC inspectors of their duties during these maintenance activities. The QC inspectors were informed that 100% coverage would be provided during maintenance activities.

The licensee developed "Action Plans" to troubleshoot the equipment on the "freeze list". The following equipment was listed on the freeze list:

- a. MFP's Turbine and Controls
- b. SFRCS and Associated Instrument Channels
- c. Aux Feed Pump Turbines and Controls
- d. MSIV's Including Controls-Actuating Circuits, Pneumatic Supplies
- e. S/U Feed Valve SP-7A - and Controls
- f. Source Range Instrument Channels
- g. Turbine Bypass Valve (TBV) SP-13A2 - Any other components for which there is found an indication of water hammer damage

Traps and drains associated #2 TBV header; MS 2575, MS 737, MS 739, ST 3, ST 3A
- h. PORV and Controls and Actuation System
- i. Main Steam Safety Valves and Atmospheric Vent Valves
- j. AF 599 and AF 608 Valves, Actuators and Controls
- k. MS 106 and Controls
- l. SW Valve and Controls on AFW Alternate Supply

6. Inspection of Action Plans

Auxiliary Feedwater Valves AF599 and AF608

Normally open, Limitorque motor-operated auxiliary feedwater (AFW) gate valves AF-599 and AF-608 mechanically failed to reopen on a signal from the main control room after they were inadvertently closed during the June 19 event. While other failures also occurred in the AFW system, the failure of these two valves was itself enough to prevent AFW from reaching either steam generator. On manually attempting to open the valves, limited exercising of the valve handwheels appears to have caused relaxation of the motor-operator torque switch spring packs. This action reset the torque switches, allowing existing control signals to operate, and causing the valves to open fully on their motor-operators.

The licensee contracted a consultant, MOVATS, Incorporated, and developed a testing and troubleshooting plan to identify the cause of the valve failure during the event. This work commenced on June 18, 1985, subsequent to NRC concurrence with the plan and with the valve in its "as failed" mechanical condition. The inspectors observed visual inspection, testing, and troubleshooting of the valves by the licensee and its contractor. The techniques used were beyond those normally available or used by the licensee, involving the measurement of valve stem thrust loads, motor-operator currents, and limit switch actuation during valve operation. A load cell was used to determine actual valve stem thrust loads at the open and closed torque switch settings. The results of this activity, combined with indications of valve operations during the event, led to the conclusion that the torque switch bypass limit switch in each valve's control circuit was not set to remain closed long enough to provide the necessary bypass function on valve opening with differential pressure conditions across the valve. During the event, the valves appear to have experienced a high differential pressure after closing, causing the torque switch to be open after the bypass switch opening, and thereby stopping valve motion. Apparently, the torque switch was set high enough that it did not open when the valve was exercised during post maintenance or surveillance testing. Hence, the bypass limit switch setting error revealed itself only during the event when high differential pressure conditions across the valve caused higher torque.

Specific items identified during the inspection were:

- (1) The spring pack shoulder on valve AF-599 was installed backwards and was screwed on too tightly, compressing the spring pack assembly. Although this apparently did not contribute to the valve failure, it is an indication of poor maintenance quality.
- (2) The torque switch bypass limit switch on valve AF-599 was set to open at approximately nine handwheel turns in the open direction from fully turned in the closed direction, not at nine turns from the beginning of stem travel as required by Maintenance Procedure MP 1410.32.2, "Removal and Repair of Limitorque Valve Controls." The error in setting the switch appears due, partly, to the procedure which is susceptible to misinterpretation.
- (3) The same switch for valve AF-608 was also improperly set at eight turns from the beginning of stem travel instead of nine.

- (4) Because AF-608 was set only slightly off, the switch setting recommended in the procedure (five percent of stem travel) appears unacceptable. The licensee has proposed changing this standard to ten percent for all Limitorque motor-operated gate valves. (Testing subsequent to the inspection period, using high differential pressure conditions, indicates that ten percent may still not be enough.)
- (5) Torque switch imbalance on both AF-599 and AF-608 caused the actual torque required to open the torque switch on valve closing to be somewhat greater than expected and somewhat less than expected on valve opening. Even though the imbalance could have contributed to valve failure, it was not the primary cause. Valve AF-599 had the largest imbalance, with torque switch settings expected to allow 15,000 pounds stem thrust on opening and 8,000 pounds thrust on closing. Actual values determined by test were approximately 13,900 pounds opening and 10,300 closing. Valve stem thrust loads were well below these values during mid travel.
- (6) Quality Control hold points and verification requirements are not included in the approved maintenance procedure but are developed when a maintenance work order is written. Maintenance records for AF-599 include a quality control check sheet marked "NA" for verification of the limit switch settings. No other test or verification appears required that would reveal improperly set torque switch bypass limit switches.
- (7) Valves AF-599 and AF-608 were improperly identified as passive in the licensee's program for inservice testing of pumps and valves under Section XI of the American Society of Mechanical Engineers' Boiler and Pressure Vessel Code. The licensee has been testing these valves during refueling outages, however, with no indication of a problem because the test was done without a differential pressure across the valve. Testing quarterly, per Code requirements, would not necessarily have revealed the valve deficiencies.
- (8) Valve AF-599 failed to open during another event on March 3, 1984. Corrective action and subsequent retesting in response to that failure was not adequate to reveal the valve problems that existed then as well as during the June 9, 1985 event.
- (9) A higher torque switch setting would have prevented the failure to open event by allowing the valves to open under differential pressure conditions without opening the torque switch.

While the above items are potential items of noncompliance, because of the number of equipment failures that occurred on June 9, they also appear to be examples of more general, programmatic deficiencies that will be evaluated as more information becomes available on other failures. Until that time, the failure of valves AF-599 and AF-608 will be considered an unresolved item (346/85021-01).

Corrective action for the above valves and generic implications are under evaluation by the licensee and had not officially been presented to the NRC at the time of inspection.

No other action plans were implemented during this inspection period.

8. Operational Safety Verification

The inspector observed control room operations, reviewed applicable logs and conducted discussions with control room operators during the month of June. The inspector verified the operability of selected emergency systems, reviewed tagout records and verified proper return to service of affected components. Tours of auxiliary and turbine buildings were conducted to observe plant equipment conditions, including potential fire hazards, fluid leaks, and excessive vibrations and to verify that maintenance requests had been initiated for equipment in need of maintenance. The inspector by observation and direct interview verified that the physical security plan was being implemented in accordance with the station security plan.

The inspector observed plant housekeeping/cleanliness conditions and verified implementation of radiation protection controls.

While reviewing the unit log on June 9, 1985, the inspector noted that the air supply to the operator for Makeup System valve MU-23 had been found isolated by an equipment operator during the performance of a surveillance test. In this condition, the valve could not be operated from the control room. This would have prevented the control room operator from using the normal pathway to provide boric acid to the reactor coolant system. The inspector verified that an alternate pathway was available while the valve was inoperable. The inspector verified that the licensee had begun an investigation of the reason for the air supply being isolated from the valve operator. This is an open item (346/85021-02).

During a tour of the auxiliary building on June 24, 1985, the inspector noted that 14 individuals assigned duties as fire watches by one of the licensee's contractors had been performing their duties in excess of 24 hours with only short breaks. The fire watches were required because surveillance testing of part of the fire protection system had not been completed within the allowed surveillance interval. The inspector verified that the licensee was finding reliefs for the individuals involved. This item is unresolved (346/85021-03).

9. Open Items

Open items are matters which have been discussed with the licensee, which will be reviewed further by the inspectors, and which involve some action on the part of the NRC or licensee or both. An open item disclosed during this inspection is discussed in paragraph 8.

10. Unresolved Items

Unresolved items are matters about which more information is required in order to ascertain whether they are acceptable items, items of noncompliance, or deviations. Unresolved items disclosed during the inspection are discussed in paragraphs 7 and 8.

11. Exit Interview

The inspectors met with licensee representatives throughout the inspection and summarized the purpose and the scope of the inspection and the findings.

Attachments:

1. Confirmatory Action Letter dtd 6/10/85