U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-346/88009(DRS)

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

Inspection At: Davis-Besse Site, Oak Harbor, Ohio

Inspection Conducted: March 21-22, April 6-7, May 11-12, June 8-10, 21-22, July 6-7, 11-13, 19-21, 26-28, August 3-4, 16, 22-24, 30-31, and September 7-8, 1988.

Inspector: for K. D. Ward — 9/15/88 Date

Approved By: D. H. Danielson, Chief
Materials and Processes Section — 9/15/88 Date

Inspection Summary

Inspection on March 21-22, April 6-7, May 11-12, June 8-10, 21-22, July 6-7, 11-13, 19-21, 26-28, August 3-4, 16, 22-24, 30-31 and September 7-8, 1988 (Report No. 50-346/88009(DRS))

Areas Inspected: Routine, unannounced safety inspection of inservice inspection (ISI) activities including review of program (73051), procedures (73052), observation of work activities (73753), and date review (73755); and of various modifications (37701).

Results: No violations or deviations were identified. The following are the general conclusions reached during the inspection:

- The inservice inspection program was properly implemented.
- Personnel performing nondestructive examinations and modification activities appeared to be knowledgeable and conscientious in their work.
- Management involvement in inservice inspection and the HPI thermal sleeve modification/replacement activities was evident.
- Activities examined were accomplished in accordance with established procedures by qualified personnel.

DETAILS

1. Persons Contacted

Toledo Edison Company (TED)

*P. Hildebrandt, Engineering General Director
*G. Gibbs, Performance Engineering Director
*R. Schrauder, Nuclear Licensing Manager
*A. Zarkesh, Independent Safety Engineer Manager
*G. Homma, Nuclear Licensing, Compliance Supervisor
*E. Caba, Station Performance Supervisor
*M. Shepherd, Lead ISI Code Specialist
*D. Harris, Quality Assurance Engineer
*D. Sargent, Design Engineer
J. Singer, Senior ISI Code Specialist
M. Hurley, Senior QC Inspector

Nuclear Regulatory Commission (NRC)

*P. Byron, Senior Resident Inspector
*D. Kosloff, Resident Inspector

Babcock & Wilcox (B&W)

C. Meredith, Task Leader

Hartford Steam Boiler Inspection and Insurance Co. (HSB)

R. Hogstrum, ANII

The inspector also contacted and interviewed other licensee and contractor personnel.

*Denotes those present at the exit interview, September 8, 1988.

2. Inservice Inspection (ISI)

a. General

(1) Reference: NRC Inspection Report No. 50-346/88005.

(2) B&W performed the ISI in accordance with ASME Section XI, 1977 Edition, Summer 1978 Addenda.

b. Review of Material, Equipment and Personnel Certifications, Audit and Data

The NRC inspector reviewed documents relating to the following:

(1) Ultrasonic instruments, calibration block, transducers and couplant certifications.

(2) Liquid penetrant material certifications.

(3) Magnetic particle equipment certifications.

(4) NDE personnel certifications in accordance with SNT-TC-1A.

(5) Eddy current equipment certifications.

(6) Audits.

(7) Data reports.

(a) During the May 1988 steam generator inspection, two unacceptable indications (No. 400 and No. 401) were found by ultrasonic examinations in the 7.1" thick No. 1-2 steam generator shell (MK-3) near the steam outlet nozzle (MK-14). The No. 400 indication was 1.5" from the inside surface and 1.0" long. The No. 401 indication was 1.4" from the inside surface and 2.2" long.

Stress analysis and fracture mechanics calculations were performed by Babcock and Wilcox. Based on the evaluation the indications were shown to be acceptable in accordance with ASME Section XI, Paragraph IWB-3612.

(b) In steam generator "A" 2,347 tubes were eddy current examined and all were found to be acceptable. In steam generator "B" 1,705 tubes were eddy current examined. Tubes No. 58-129 and No. 103-124 were found to be unacceptable and were plugged. The indications in these two tubes probably resulted from the auxiliary feedwater header misalignment and have been present for several years. Eddy current probe "Eddy-360" used during this examination provided B&W the capability to better characterize these dent type indications.

c. Observation of Work Activities

The NRC inspector observed work and had discussions with personnel during the ISI activities. Theses observations included the following:

(1) Magnetic particle examination of Pipe Weld No. EBB-W01-021-LWA in the main steam system.

(2) Ultrasonic examination of Pipe Welds No. EBB-W01-019A-LWD, No. EBB-W01-019A-FWBA, and No. EBB-W01-021-LWA in the main steam system.

(3) Visual examination of the inside of both ends of Heat Exchanger No. 1-2.

(4) B&W personnel using the eddy current acquisition equipment.

No violations or deviations were identified.

3. Modifications/Installation

a. Enhanced Feed and Bleed Capability Modification

Reference: NRC Inspection Report No. 50-346/88005.

TED committed to the NRC to modify the Power Operated Relief Valve, Makeup system and supporting auxiliaries to provide enhanced feed and bleed capability.

This modification was performed in accordance with ASME Section III, 1971 Edition, with no Addenda. The NRC inspector reviewed NDE and welding reports and other related NDE and welding documents; also observed cutting, welding, and various stages of installation.

No violations or deviations were identified.

b. Motor Driven Feedwater Pump System Modification

Reference: NRC Inspection Report No. 50-346/88005.

TED committed to the NRC to modify the Motor Driven Feedwater Pump system that will provide the system with an additional source of suction, flow control capability to either steam generator, and capability to power essential auxiliaries (i.e., lube oil pump, motor operated valves) from an emergency diesel generator.

This modification was performed in accordance with ASME Section III, 1971 Edition, with no Addenda. The NRC inspector reviewed NDE and welding reports and other related NDE and welding documents; also observed a QC inspector performing his duties, welding, and various stages of installation.

No violations or deviations were identified.

c. HPI Thermal Sleeve Modification/Replacement

(1) On July 2, 1988, during a pre-fueling remote video inspection of the reactor vessel the following items were discovered:

(a) Two pieces of material that broke off of a high pressure injection/make-up nozzle thermal sleeve. One piece was near core Location E-12 and the other piece was under the grid at Location M-11. The pieces were approximately 3-1/2" long, and 1-1/2" wide, appearing to be the result of one piece of piping that was split down the middle. The two pieces of metal were removed from the reactor vessel, placed in a shipping container, and sent to B&W for a detailed inspection and analysis.

Preliminary laboratory investigations indicated that high cycle thermal fatigue was the probable cause of the nozzle thermal sleeve failure, and that the thermal sleeve end pieces entered the core in 1987.

(b) One paint chip in the northern part of the vessel. The paint chip was approximately 2" x 2" and probably came from work, recently performed on the Control Rod Drive Service Structure Ventilation system. The paint chip had a mark that matched a portion of the paint missing on the East D-Ring wall. The paint chip was not retrieved. The licensee believed that the paint chip may have flowed upward into the reactor system once the flow began. The licensee determined that the following are the three possible effects the paint chip could have on the system once the operation began:

1 The chip would immediately decompose mechanically into small particles and disperse throughout the reactor vessel system due to high flow forces.

2 The chip would retain its dimension and flow through the system and be deposited on a wall surface or filter.

3 The chip would flow through the bottom grid plate into a fuel assembly and adhere to a fuel rod.

The above considerations were valid only if the temperature in the reactor system was below the melting point of the paint chip. Temperatures above 350°F would chemically decompose the chip into very low levels of carbon crude.

It is not known what happened to the chip.

(c) A white rag 18" x 18" located on the bottom of the reactor vessel under core Location G-8. The rag was thought to have come from work recently performed on the decay heat system. The cleanliness control on the work was poor. The licensee revised procedure "Cleanliness and Housekeep, DB-MN-00005," July 27, 1988. The rag was removed and disposed of.

(d) A piece of masking tape approximately 1½" triangle located in a control rod guide tube in the upper plenum. While trying to remove the tape, the tape traveled down the control rod guide tube and was no longer located within the plenum. This was verified by an underwater camera inserted in the control rod guide tube. No further attempts were made by the licensee to remove the tape since the tape is at the bottom of the deep end of the

refueling canal and the licensee believes that it is not at a critical location. The tape in the upper plenum was probably a result of work and activities conducted over the plenum this outage.

(e) One 8" round deformed underwater light lens cover located in the upper plenum. It was determined that the underwater lights were on temporarily with no water, got hot, and fell off some time during this outage. The lens cover was removed and disposed of. The vessel core support could not be inspected at this time due to high radiation. After the thermal sleeves and safe-ends were installed a video inspection was made of the core support. A small piece of paper, a small lock washer and two more deformed underwater light lens covers were found. The items were all retrieved. To prevent recurrence of the underwater light lens covers falling in the vessel again, a restraining wire was placed over the underwater lights.

After all the video inspection tapes were reviewed by B&W and the licensee it was determined that no other debris or loose parts were identified in the accessible areas inside the reactor vessel. The inspection included the upper plenum and all incore guide tubes. The inspection tapes showed no signs of damage to the tubes.

(2) There was a drain down of the refueling canal and reactor vessel to support the fiberscope inspection of all four HPI lines in order to determine if the thermal sleeves were intact. The results of the inspection were as follows:

(a) HPI-50 and HPI-51 thermal sleeves were found to be acceptable.

(b) HPI-58 thermal sleeve showed shadows, like linear indications. The thermal sleeve and safe-end were removed and sent to B&W. The safe-end was liquid penetrant examined and found to be acceptable. The thermal sleeve was cleaned, sectioned, liquid penetrant examined, and found to be acceptable. In removing the safe-end, two elbows were also removed. The two elbows were welded together and welded to the safe-end. The two elbows were liquid penetrant examined on both the ID. and OD. of the weld area and found to be acceptable.

(c) HPI-59 thermal sleeve had the end opposite the safe-end broken off. The thermal sleeve was removed with the safe-end and sent to B&W for analysis. It was determined that the ends found in the vessel matched the remaining HPI-59 thermal sleeve. The safe-end was liquid penetrant examined and found to be acceptable.

In removing the safe-end, two elbows were also removed. The two elbows were welded together and welded to the safe-end. The two elbows were liquid penetrant examined, on both the ID and OD of the weld area and found to be acceptable.

(3) The two new redesigned hard rolled stainless steel thermal sleeves were developed with the following improvements:

(a) Bell shaped upstream end on the thermal sleeve - This should prevent movement of the sleeve towards the RC cold leg piping.

(b) Increased length and width of the upstream end of the thermal sleeve - This feature provides more roll surface contact area and more metal to be cold worked during the rolling process.

(c) Hard roll of the thermal sleeve shoulder - The original thermal sleeve was only contact rolled. The increased compression and subsequent deformation of the thermal sleeve material should provide a more secure bond with the safe-end. Also, the additional wall thinning should mitigate sleeve to safe-end separation during HPI events.

(d) Contact roll at the thermal sleeve collar - The effects of possible flow induced vibration will be reduced with the sleeve surface in contact with the nozzle ID.

(e) Axially notched upstream end of the thermal sleeve - The notches allow the placement of weld beads to provide additional anti-rotation protection.

No design changes have been incorporated which would be expected to result in improved performance compared to the original thermal sleeve design for the thermal transients experienced by the failed thermal sleeve.

(4) The makeup and purification (MU)/High Pressure Injection (HPI) nozzle forms a part of the Reactor Coolant System (RCS) piping pressure boundary at the MU/HPI piping connection to the RCS cold leg. The nozzle and RCS piping is carbon steel with a internal stainless steel cladding. The function of the stainless steel cladding is to provide corrosion protection for the carbon steel.

(5) An ultrasonic examination (UT) was performed on the OD of nozzle No. HPI-58, finding no recordable indications. Liquid penetrant examinations (PT) were performed on the nozzle ID bore, button, and approximately 1/2 of the knuckle area. The other half of the knuckle area was inaccessible. An evaluation was performed using a fiberscope and TV monitor and was videotaped by B&W personnel. The PT results are as follows:

(a) One 1" long linear indication located approximately 1/2" from the nozzle to the safe-end weld prep.

(b) One 1/4" long linear indication located at the base of the button, HPI side of the weld buttons.

(c) One 1/8" long linear indication located at the RCS side of the weld buttons.

(d) One 1" long linear indication located at the RCS side of the weld buttons.

(e) One 1/16" diameter rounded indication that was non-relevant located at the HPI side of the weld buttons.

(f) One 1/16" diameter round indication that was non-relevant located at the base of the weld buttons.

After performing four liquid penetrant examinations and using a flapper wheel after each examination to remove the indications, all unacceptable indications were removed.

The new thermal sleeve, safe-end and the two elbows were welded in place. Liquid penetrant, ultrasonic, and radiographic examinations were performed at various stages of fabrication on various welds and found to be acceptable.

(6) UT was performed on the OD and ID of nozzle No. HPI-59, finding no recordable indications on the OD. UT was performed on the ID to determine the depth of one of the long linear indications; but because of the access limitations, the results were not considered to be extremely accurate. A liquid penetrant examination was also performed on the HPI-59 nozzle ID bore, button, and approximately 1/2 of the knuckle area. The other half of the knuckle area was inaccessible. The evaluation was performed using a fiberscope and TV monitor and was videotaped by B&W personnel. All indications were linear and were located on the RCS side of the button. Three of the indications were from 9/16" to 1-3/4" long and approximately 40 were from 1/8" to 5/16" long. After performing three liquid penetrant examinations and using a flapper wheel following each examination to remove the indications, three indications 1-1/2" to 1-3/4" and approximately 42 indications 1/4" to 3/8" still remained.

After a meeting at NRC Headquarters (see next paragraph for details) the new thermal sleeve, safe-end and the two elbows were welded in place. Liquid penetrant, ultrasonic, and radiographic examinations were performed at various stages of fabrication on various welds and found to be acceptable.

(7) The licensee kept NRR informed of the above. A meeting was held at the NRC Headquarters, Rockville, Maryland, August 16, 1988, to discuss the "High Pressure Injection/Makeup Thermal Sleeve Failure". In attendance were personnel from Toledo Edison, B&W, NRC/NRR, an individual from MPR Association (it was an open meeting) and the NRC inspector. TED discussed the reactor vessel inspection, HPI thermal sleeve, and nozzle inspections, evaluation of failures, and current actions. TED's decision was to leave the HPI-59 nozzle as is for the following reasons:

(a) Tooling development required to remove known and potential indications.

(b) Provide inspection capabilities to see the rest of the knuckle.

(c) Ensure dimensional control.

(d) Preclude loose parts and debris.

(e) Address RCS clad surface near knuckle.

NRR agreed TED could operate for one cycle, approximately 18 months. NRR requested that a formal submittal be made of the presentation including fracture mechanics analysis, and near term planned actions. NRR also suggested that TED monitor the area using acoustic emission. As of September 8, 1988, the date of the NRC inspector's exit interview, the formal submittal had not been submitted to NRR.

(8) Replacement safe-ends, thermal sleeves, and elbows were in accordance with ANSI B31.7, 1968 errata dated June 1968. The weld metal, welding and NDE of the safe-end thermal sleeves and elbows were in accordance with ASME Section III, 1971 Edition with no addenda. The ISI of the completed welds was in accordance with ASME Section XI, 1977 Edition, Summer 1978 Addenda. The NRC inspector viewed the video tapes of the inspection of the four thermal sleeves, safe-ends, and nozzles; radiographs of safe-end and elbow welds; demonstration mock-ups for the equipment and welders; NDE and welding reports and related NDE and welding documents. The NRC inspector observed liquid penetrant examinations, welding of the safe-ends, and the ANII inspecting the welds. The NRC inspector visually examined welders qualifications of pipe welds, the ID and OD. of the new safe-ends and thermal sleeves, and of the final safe-end welds.

No violations or deviations were identified.

4. Exit Meeting

The inspector met with site representatives (denoted in Persons Contacted paragraph) at the conclusion of the inspection. The inspector summarized the scope and findings of the inspection noted in this report. The inspector also discussed the likely informational content of the inspection report with regard to documents or processes reviewed by the inspector during the inspection. The licensee did not identify any such documents/processes as proprietary.