

Report No. 50-334/80-26

Docket No. 50-334

License No. DPR-66

Licensee: Duquesne Light Company
435 Sixth Avenue
Pittsburgh, PA 15219

Facility Name: Beaver Valley Power Station, Unit 1

Inspection at: Shippingport, Pennsylvania 15219

Inspection Conducted: August 18-22, 1980

Inspector: P. C. Theobald, Jr., for 10/30/80
L. E. Foster, Inspection Specialist, PAB Date Signed

Approved by: P. C. Theobald, Jr., for 10/30/80
W. D. Shafer, Acting Chief, Date Signed
Performance Appraisal Branch

Inspection Summary

Inspection on August 18-22, 1980, (Report No. 50-334/80-26)

Areas Inspected: Special, announced Performance Appraisal Inspection of the licensee's program and documentation associated with the control of centrifugal Charging/Safety Injection Pumps manufactured by Pacific Pump Division of Dresser Industries. This inspection involved 34 inspector-hours onsite by one Performance Appraisal Branch inspector.

Results: Of the areas inspected, no items of noncompliance or deviations were identified.

DETAILS

1. Persons Contacted

Licensee Employees

- *H. P. Williams, Chief Engineer
- *W. S. Lacey, Technical Advisory Engineer
- *J. J. Carey, Director of Nuclear Operations
- *J. W. Waslousky, QA Engineer
- *J. D. Sieber, Superintendent, Licensing and Compliance
- *G. D. Whitmore, Lead Mechanical Engineer
- *R. L. Hanson, Station Maintenance Supervisor
- *P. J. Valenti, Station Engineer
- R. Zabawski, Technical Supervisor
- J. F. Cuning, Chemist
- D. Shultz, Shift Supervisor
- R. F. Burski, Senior Licensing Engineer

The inspector also interviewed several other licensee employees, including administrative staff personnel.

NRC Resident Inspectors

- *D. A. Beckman, Senior Resident Inspector
- J. D. Hegner, Resident Inspector

*Attended exit interview

2. Exit Interview

The inspection scope and findings were summarized on August 22, 1980, with those persons indicated in Paragraph 1 above. The licensee was informed that no items of noncompliance or deviations were identified.

3. Licensee Action on Previous Inspection Findings

The inspector did not review previous items of noncompliance or unresolved items.

4. Unresolved Item

One unresolved item concerning the reporting of a damaged pump to the NRC was identified during this inspection. This item is discussed in paragraph 17.

5. General

The Performance Appraisal Branch conducted an indepth review of the licensee's program and performance associated with control of the charging and safety injection pumps. The pumps selected for this series of performance appraisal inspections were the centrifugal pumps manufactured by Pacific Pumps Division of Dresser Industries. These pumps are used on several safety related systems such as the Charging, Safety Injection, and Auxiliary Feedwater

Systems. The Beaver Valley Power Station (BVPS) Unit 1 utilizes these pumps in the Charging and Safety Injection Systems.

The selection of centrifugal pumps was based on problems encountered with centrifugal pumps as described in NRC Information Notice No. 80-07, dated February 29, 1980, and failure rates reported in the "Nuclear Plant Reliability Data System Report" (NPRD). Subsequent to IE Notice 80-07, cracks in the stainless steel cladding of a Pacific Pump have been reported by the Zion Plant. During this inspection, the inspector was notified that pump 1A had experienced a cladding failure in March 1978. The failure was found when the internals were removed (see paragraph 17 for details).

6. Objective and Scope

The objectives of this inspection were to verify that the component had been designed, fabricated, installed, tested, operated, modified, and maintained as required by applicable specifications and procedures; to verify that the licensee/vendor has, and is implementing, controls to ensure that the component fulfills its design objectives and functions; and to determine the effectiveness of the licensee's program associated with these components.

The scope of the inspection included a review of purchase orders, specifications, drawings, vendor inspection reports, test results, procedures, modification packages, and maintenance records associated with Pacific Pumps, Serial Nos. 46351, 46352, and 46353. Interviews with licensee personnel were also held.

7. Documents Reviewed

- (a) FSAR Section 6.3, "Emergency Core Cooling System"
- (b) BVPS Technical Specifications, Sections 3/4 and 6.0
- (c) BVPS Organization Chart
- (d) BVPS Operations Manual, Chapters 7 and 11
- (e) Purchase Order No. 546-CAZ-103311BN and Change Notices dated 12/16/70, 1/14/72 and 5/25/74
- (f) Selected BVPS Quality Assurance Procedures
- (g) Selected BVPS Quality Control Procedures
- (h) Westinghouse (W) Equipment Specification (E. Specs) No. 677125 and other W Specifications related to cleanliness, packing, shipping, and testing
- (i) Pump Test Procedure No. 1.1-4.7.1 and Operation Surveillance Test Procedures 1.7.4, 5, and 6
- (j) Pump Assembly, Foundation, and Installation Drawings
- (k) Pump Performance Curve Nos. 35096-A, 35096-B and 35096-C
- (l) Selected BVPS Maintenance Procedures
- (m) Selected Maintenance Requests Concerning Charging/SI Pumps from 1975 to 1980
- (n) Pump Storage Histories from 1971 - 1974
- (o) Various correspondence between NRC (NRR), Westinghouse, Pacific Pump, and the Licensee concerning pumps problems and corrective action

- (p) Corrective Maintenance History of Pumps
- (q) Pump Installation and Alignment Data Sheets (1975)
- (r) Pump Initial Operating and Retest Performance Data
- (s) W letter Nos. NS-CE-1536 dated 9/1/77 to NRC "Report of Safeguard Pump Shaft Failures" and NS-TMA-224 dated May 8, 1980 "Safety Injection Termination"
- (t) Vendor Instruction Manuals (2600.70, 8700)
- (u) Design Change Package (DCP) Nos. 270 and 274
- (v) Various Receipt Inspection, Equipment Release, and Nonconformance Reports
- (w) Duquesne Light Company Audit of Pacific Pump dated August 31, 1970; Shop Test Reports 17 and 41 dated June 1, 1971 and January 18, 1972
- (x) Stone and Webster's Field QC Manual
- (y) Pump Trend Charts for Vibration and Temperature
- (z) Ten LER's concerning Charging Pumps from 1975 to 1979

8. Purchase Order, Contract and Specifications

The Charging and Safety Injection Pumps for the BVPS Unit 1 were purchased from Pacific Pumps by Westinghouse (W), the licensee's NSSS supplier. W also purchased pumps for other licensees under the same contracts and purchase orders. The High Head SI/Charging system at BVPS contains three centrifugal motor driven pumps. The original charging pump casings were stainless steel clad carbon steel; however, a Unit 2 pump casing (stainless steel) had been installed in Unit 1. W prepared the equipment specifications (677125 and 676428), supplied vendor inspection, witnessed tests, and performed final acceptance inspections at the vendor's facility. W QA Specifications were a part of the purchase order requirements. Requirements in the contracts and purchase orders specified that the pumps be fabricated and tested to W specifications and be inspected per the November 1968 ASME Draft Code for Pumps and Valves. Material specifications, testing requirements, QA/QC requirements, and other requirements were specified in other W specifications. Examination of records showed that several additional purchase orders had been let with Pacific Pumps for spare parts and repair of the pumps. The licensee had contracted Stone and Webster (S&W) and Nuclear Services Corporation to review the design, design changes, procurement documents, and to furnish QA/QC functions associated with the charging and safety injection pumps.

Based on examination of purchase orders, specifications, and other related documents, (material certs, heat treat records and performance curves) it appeared that the technical and QA requirements were adequately specified and met. The detailed inspection records for individual pump parts and assemblies were not available for review; therefore, the inspector could not confirm whether the individual parts and assemblies were fabricated and assembled as required by detailed drawings. Since the vendor and W have changed the heat treating procedure to help alleviate shaft failures, this may indicate lack of detailed engineering evaluation of the original heat treat procedure. It is noted that the licensee depended mostly upon other agencies for QA/QC activities performed on these pumps. The licensee and W witnessed the original vendor pump performance test for pump 46353 (Shop

Test No. 17). The licensee, W and S&W witnessed the retest of this pump (Shop Test No. 41) which was performed after the pump was dropped, inspected and reassembled.

9. Surveillance and Audits

The licensee stated that the pump vendor surveillances and audits were primarily performed by Westinghouse (W) and Stone and Webster, their A/E. W had the contract with the pump vendor and the licensee had also contracted Stone and Webster to perform audits and surveillances of W and Pacific Pump. It was noted that W purchased the same Charging/SI Pumps for several plants; therefore, W performed the vendor surveillances and audits for these plants. The licensee stated that Nuclear Services Corporation and their Corporate Office also performed audits and surveillances on W, Stone and Webster, and Pacific Pumps. The inspector examined representative reports and documentation which were on microfilm and in the pump file folders. Duquesne Light Company (DLC) audit of Pacific Pump (Report No. 17 dated August 27, 1970) was also examined. One problem identified by the DLC audit report was the inadequacies of shop travelers at certain fabrication stations. Other problems identified by the licensee were weaknesses in weld control and material procurement. DLC recommended that an audit of the vendor's shop be performed; but the inspector could not find any evidence where this recommendation was followed; however, DLC's letter of June 7, 1971 stated that they felt that all quality requirements were met as the pumps passed their performance tests. The inspector noted that Pacific Pumps had been audited by ASME in December 1971 and were not issued an "N" stamp due to an inadequate QA manual.

The inspector examined pump performance curves, vendor test results, W quality release forms, W and S&W witness of tests, W certifications, and correspondence between the licensee, W, S&W, and the vendor. These appeared to conform the W and S&W performed surveillances of vendor activities.

Surveillances and audits of site activities associated with the charging and safety injection pumps were performed by the site QA group and S&W. Site audits and surveillances were performed on storage of pumps and parts; instrument calibration; procedure implementation; qualification of personnel; work orders; disassembly; assembly; modifications; and Inservice Testing of Pumps. Based on the review of the above documentation and interviews, it appeared that adequate site audits and surveillances were performed on pump activities. The inspector noted that the frequency of DLC Offsite Review Committee audits of their QA program have been changed from 12 months to 24 months.

10. Receipt Inspection, Storage and Handling

Receipt inspection and storage inspections were controlled and performed by the utilization of W, S&W, and DLC procedures. The inspector examined several receipt inspection reports for pumps and spare parts which utilized inspection check lists. The inspection packages included W release forms, hold tags, nonconformance reports, evaluations, return to vendor notices,

and final acceptance tags. These records had been microfilmed and were on tapes in the document control center. Records were available in a timely manner and the microfilm equipment made the records easy to review.

The licensee had issued nonconformance reports which identified damage during shipment, rotor unbalance, bent shafts, wear ring rub, casting and machining defects, and lack of complete documentation. Pump storage history from August 17, 1971 to January 1, 1974 were reviewed and found satisfactory.

Review of receipt inspection reports dated from 1977-1979 associated with repair and replacement parts showed that detailed inspections were performed and discrepancies were identified. These discrepancies included bent shaft, scored impeller wear rings, chipped bushings, cracked tack welds and foreign material. It appeared to the inspector that the receipt inspections have improved since 1977.

11. Installation, Testing, Acceptance and Operation

Documentation associated with the installation, testing, and operation of the Charging and Safety Injection Pumps was examined. DLC and S&W procedures were utilized along with the vendor's technical manuals and approved supplements as required by Section 6.8 of the Technical Specifications (TS). The manuals, procedures, and drawings appeared satisfactory. Installation inspections were performed utilizing S&W Field QC Manual 6.1 and applicable check sheets to ensure that the pumps and accessories were installed and aligned properly. Preoperational testing was performed as specified by procedure BVT 1.1-4.7 and drawings. Section 6.8 of the TS specified that procedures were required and that changes must be reviewed prior to implementation. Startup data sheets included acceptance criteria such as speed, vibration, motor current, suction head, temperature, discharge head, flow and lube oil pressure. The inspector pointed out to the licensee that Procedure BVT 1.1-4.7 did not contain acceptance criteria for pump suction or discharge pressures; however the acceptance criteria was specified in Surveillance Procedures 1.7.4, 1.7.5, and 1.7.6. Plant Operating Manual Chapter 55A was the controlling document used during operational surveillance. Operating Surveillance Tests (OST) were performed monthly as required by OST 1.7.4, 1.7.5, and 1.7.6.

Operating and surveillance test data were reviewed and found satisfactory. The tests were performed by qualified personnel and were conducted per procedures. Acceptance criteria was specified and the test data forms included instruments used and the actual test results obtained during the test. Surveillance requirements as specified in Paragraph 4.1.2.4 of the TS required demonstration that the charging pumps be operable at least once every 31 days on a staggered basis. These requirements included the following:

- (1) Each pump must be started from the control room
- (2) Verify that the discharge pressure is equal to or greater than 2402 psig.
- (3) Each pump operates at least 15 minutes.

A review of the above records showed that the tests were performed as required by Procedure OST 1.7.4, 1.7.5, and 1.7.6 and TS 3/4.5.2. Trend analyses were being performed to keep track of pump operating parameters. The Technical Advisory Group evaluated this data for adverse trends.

Ten LERs concerning the charging pumps had been issued. These LERs ranged from dropping a pump to shaft failures. Other problems such as rotor seizure, vibration, oil leaks, water in the oil, and operator errors had been reported. Operator errors have been similar to those experienced at other plants. Examples of operator errors were:

- (1) Suction valves not open
- (2) River water cooling valve inadvertently left shut after maintenance activities
- (3) Racked in wrong relay.

Correspondence between the licensee, W, and Pacific Pumps concerning the operations of these pumps was reviewed. Correspondence appeared to address the reported problems; however, the latest W correspondence was dated October 2, 1978. It was noted that some of the documentation identified the pumps as 1A, 1B, and 1C and did not reference the pump serial numbers. Due to interchanging of pumps and pump internals this method of identification makes it difficult to follow the history associated with a particular serial numbered pump and rotating assemblies.

12. Maintenance and Modification

The licensee had an approved QA program and procedures to control the maintenance and modification of these pumps. The Beaver Valley Operating QA Program, Operating Procedure No. OP-10, "Maintenance and Modification Planning" was the basic controlling document. Other QA/QC procedures had been prepared, based on OP-10, to control parts, processes, qualification of personnel, inspections, housekeeping, bypassing other systems, and other maintenance activities. Vendor's technical manuals had also been used, along with DLC procedures, during maintenance and modification.

The inspector examined maintenance, modification, and repair records dated from 1975 to the present. These records included the removal and replacement of shafts, internal assemblies, adding vibration dampers, counterweights, replacement of oil coolers, and correction of oil leaks. Nonconforming reports had been issued for bent shafts, broken shafts, high vibration, cladding failure (see para. 17) water in the oil, parts installed incorrectly, loose set screws, and rotor rubbing.

Interviews with personnel and review of documentation confirmed findings at other plants concerning difficulties encountered during the maintenance and replacement of parts associated with these pumps. It appeared that the capability to perform maintenance received minimal consideration during the original design and layout of the pump areas.

Modifications to the Beaver Valley pumps have paralleled modifications made at other plants, except that BVPS substituted a Unit 2 stainless steel casing for a Unit 1 carbon steel clad casing which was sent back to the vendor due to a failure in the stainless steel clad. Other modifications included shaft replacement, vibration dampers, counterweights, oil coolers, and vents. Review of documentation showed that the modifications were reviewed, approved and implemented by written procedures.

Beaver Valley records and histories of maintenance, modifications, problems, corrective action, and operating data of the charging pumps were current, very detailed, and complete. W and vendor correspondence, plus licensee documents, concerning changes to the next generation pumps to improve reliability were also reviewed.

13. Inservice Testing (IST)

The licensee stated that they submitted an IST program to NRR on March 17, 1980 which committed Beaver Valley to ASME Section XI-1974 through Summer 1975 addenda. The licensee stated that their program was developed using NRC guidance and information received during the NPR (DOR), EG&G and DLC workshop held on December 12-14, 1979. The inspector examined operational surveillance test results obtained from tests being performed by Procedure OST Nos. 1.7.4, 1.7.5, and 1.7.6. Results of examination of documentation showed the following:

- (a) Test procedures were utilized.
- (b) The above procedures appeared to meet the minimum IST requirements (IWP test program).
- (c) Procedures specify that if the TS requirements were not met, the pump was to be declared inoperative.
- (d) Pumps were tested on a monthly schedule
- (e) Test data was reviewed by the Shift Supervisor and the Technical Advisory Engineer.
- (f) Values obtained from test programs were used to assess operational readiness.
- (g) Test information was used by plant management to identify deteriorating equipment and to schedule corrective action.
- (h) Trend analyses were being compiled to keep track of vibration, bearing temperatures, flow, and differential pressure. DLC had been keeping these trends since 1978.

The inspector noted that the pumps were normally identified as pumps 1-A, 1-B, and 1-C instead of by pump serial numbers. This practice makes it difficult to track performance and or problems by the pump serial number. Other licensees also record the pumps 1A, 1B, and 1C on most documentation.

14. Documentation and Records

The purchase orders, W specifications, drawings, vendor's technical manuals, pump test data, W Quality Release Forms, Certificate of Performance, material certification, and witnessed shop performance tests were available. Several

S&W documents were also available; however, the documents at the site did not give the inspector an overall view of S&W's involvement during the design, fabrication, and testing of these pumps. It was noted that the above documentation was generated between 1969 and 1975 and was on tapes in the controlled record room. Documentation appeared to be complete and the computerized system resulted in timely retrieval.

Correspondence between W, Pacific Pump, the licensee, and NRC concerning the failed shaft evaluations, corrective action, and immediate remedial action was available; however, a current pump status report from W or Pacific Pump was not available.

Licensee's QA Manual, FSAR, TS, procedures, vendor's manuals, and other instructions were available. An excellent history of the pumps including modifications, repair, maintenance, assembly, test data, and problems encountered was filed in the controlled document room.

Results of documentation and record review showed that the licensee (plant site) was documenting and keeping records as described above. The records appeared to be complete and were easily retrievable.

15. Responsibility, Qualification and Training

Personnel interviewed appeared to be qualified and knowledgeable of their responsibilities and procedures associated with the charging and safety injection pumps. QA/QC, technical, administrative, and maintenance personnel appeared to be trained to perform their position functions. Training consisted of indoctrination training, training in use of clearance permits, rework permits, tool control and the use of procedures. Technical training on pumps had been obtained by on the job training, lectures, demonstrations by the vendors representative, and by studying and using the technical manuals.

16. Cracking in Pump Casing Cladding (Zion Plant)

The licensee was notified of a reported crack in the stainless steel cladding (reported to RIII by Commonwealth Edison on January 14, 1980) of a Zion Plant Charging Pump (Type IJ) manufactured by Pacific Pump. The crack was found during RT examination of the pump suction end plate. Investigations by Commonwealth Edison, Pacific Pump, and Westinghouse revealed the crack extended through the stainless steel cladding but not into the parent metal. Additional examinations showed a slight penetration into the parent metal. Probable cause (as reported) was the manufacturing technique used to apply the cladding around a sharp inner corner. The licensee was advised that the NRC staff is presently reviewing this item, and Region I would follow this problem at the Beaver Valley Plant.

17. Cladding Failure in Pump Casing (S/N 46351) at Beaver Valley

During the discussion of the cladding failure at Zion Plant, the licensee notified the inspector that BVPS had experienced a cladding failure in Unit 1A charging pump casing (Serial No. 46351) in 1978. Further discussions with site personnel and review of documentation revealed the following information:

- (1) The pump was run dry in 1975 during initial preoperational testing
- (2) The rotating assembly was replaced in 1975
- (3) During another rotating assembly replacement in September 1978, difficulties were encountered as the assembly could not be fully inserted.
- (4) The partially inserted assembly was removed and the casing was inspected.
- (5) The inspection showed two large defects (eroding of cladding and parent material) near the suction end of the pump.
- (6) The defects were approximately 2 inches long by $\frac{1}{2}$ inch wide and 1 inch deep.
- (7) The licensee's evaluation was that the defects were caused by galvanic action.
- (8) The licensee believed that the cracks in the stainless steel cladding started in 1975 when the rotating element seized.
- (9) During the period from 1975 to 1978, the break (crack) in the stainless steel cladding allowed the borated water to contact the parent metal (carbon steel), thus resulting in the large defects.
- (10) The licensee planned to repair weld the damaged areas, but finally decided to ship the casing back to the vendor for repair.

- (11) The licensee substituted a Unit 2 casing for the damaged Unit 1 casing per Maintenance Work Request 796028.

- (12) Confirmation that this cladding failure was reported to the NRC could not be substantiated.

It appears to the inspector that this problem is similar to the problem identified at the Zion Plant; however, the deterioration of the cladding and parent metal was more severe. Confirmation that NRC was notified of this damaged pump could not be substantiated; therefore, this matter is considered unresolved pending resolution (334/80-26-01). This item will be followed by the Resident Inspector.