

U.S. NUCLEAR REGULATORY COMMISSION  
REGION I

Report Nos. 50-334/89-12 License: DPR-66  
50-412/89-13 NPF-73

Licensee: Duquesne Light Company  
One Oxford Center  
301 Grant Street  
Pittsburgh, PA 15279

Facility name: Beaver Valley Power Station, Units 1 and 2

Location: Shippingport, Pennsylvania

Dates: May 23 - July 7, 1989

Inspectors: J. E. Beall, Senior Resident Inspector  
P. R. Wilson, Resident Inspector

Approved by: *C. J. Cowgill*  
C. J. Cowgill, Chief, Reactor Projects Section 4B

8/9/89  
Date

Inspection Summary: Combined Inspection Report Nos. 50-334/89-12 and  
50-412/89-13 for May 23 - July 7, 1989.

Areas Inspected: Routine inspections by the resident inspectors of licensee actions on previous inspection findings, plant operations, security, radiological controls, plant housekeeping and fire protection, surveillance testing, maintenance, steam generator tube leak, inadvertent reactor trip, cable separation, and licensee event reports.

Results: Overall, the facility was operated safely. The problems caused by reductions in back shift manning identified in an earlier report (50-338/89-01; 50-412/89-01) appear to be major contributors to the operator error - caused events during the current period (Section 7.1). The repairs for the damaged steam generator tube were well handled. One violation was identified regarding the failure to follow procedures (Section 8). This mistake led to a reactor trip (with rod movement) while in Mode 3. The licensee's report on the event was also reviewed and appeared to overlook a major root cause (Section 10). Another violation was identified involving inadequate separation of safety related cable and inadequate corrective action for a previous violation (Section 9). Two previous open NRC items were closed during this inspection.

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## DETAILS

### 1. Persons Contacted

During the report period, interviews and discussions were conducted with members of licensee management and staff as necessary to support inspection activities.

### 2. Summary of Facility Activities

At the beginning of the period, Unit 1 was at 90% power and Unit 2 was in Mode 5 (Cold Shutdown). On May 27, during the Unit 2 startup, an inadvertent reactor trip occurred while in Mode 3. Unit 2 started up and was placed on the grid on June 3. Unit 2 declared an Unusual Event on June 7 while at 75% power due to excessive reactor coolant leakage to the Containment Building atmosphere. The licensee began to reduce power in an orderly shutdown when the leak was stopped and power ascension was resumed. On June 21, Unit 2 declared an Unusual Event due to steam generator tube leakage. Unit 2 was shut down from 99% power and was in Mode 5 at the end of the period. During the cooldown, Unit 2 experienced two ESF actuations due to level swings in the steam generators. Unit 1 operated without incident during the period and was at 100% power at the conclusion of the inspection period.

### 3. Status of Previous Inspection Findings

The NRC Outstanding Items List was reviewed with cognizant licensee personnel. Items selected by the inspector were subsequently reviewed through discussions with licensee personnel, documentation reviews and field inspection to determine whether licensee actions specified in the OIs had been satisfactorily completed. The overall status of previously identified inspection findings was reviewed, and planned/completed licensee actions were discussed for the items reported below.

- 3.1 (Closed) Unresolved Item (54-412/87-53-02): This item involved the resolution of several test deficiencies identified during Unit 2 pre-operational testing. The inspector reviewed the licensee's actions which included component modifications and satisfactory retests and had no further questions. This item is closed.
- 3.3 (Closed) Violation (50-412/88-16-02): Inadequate Cable Separation. This violation involved the finding by the inspector of several examples of inadequate cable separation due to missing conduit covers, misplaced tray covers, and loosely coiled spare cable. The inspector conducted an independent walkdown of Unit 2 cable spreading area after completion of the licensee's corrective actions and no additional deficiencies were identified. This item is closed, however, the Unit 1 reinspection identified additional cable separation deficiencies as described in Section 9 of this report.

#### 4. Operational Safety

##### 4.1 General

Inspection tours of the following accessible plant areas were conducted during both day and night shifts with respect to Technical Specification (TS) compliance, housekeeping and cleanliness, fire protection, radiation control, physical security/plant protection and operational/maintenance administrative controls.

- |                              |                                  |
|------------------------------|----------------------------------|
| -- Control Room              | -- Safeguard Areas               |
| -- Auxiliary Building        | -- Service Building              |
| -- Switchgear Area           | -- Diesel Generator Buildings    |
| -- Access Control Points     | -- Containment Penetration Areas |
| -- Protected Area Fence Line | -- Yard Area                     |
| -- Turbine Building          | -- Intake Structure              |
| -- Reactor Containment       | -- Spent Fuel Building           |

##### 4.2 ESF Walkdown

The operability of selected engineered safety features systems were verified by performing detailed walkdowns of the accessible portions of the systems. The inspectors confirmed that system components were in the required alignments, instrumentation was valved-in with appropriate calibration dates, as-built prints reflected the as-installed systems and the overall conditions observed were satisfactory. The systems inspected during this period include the Emergency Diesel Generator, Safety Injection and Recirculation Spray systems. The inspectors conducted detailed, independent valve and breaker alignment checks of the Unit 1 Low Head Safety Injection System and the Unit 2 Auxiliary Feed System. No unacceptable conditions were identified.

##### 4.3 Operations

During the course of the inspection, discussions were conducted with operators concerning knowledge of recent changes to procedures, facility configuration and plant conditions. During plant tours, logs and records were reviewed to determine if entries were properly made, and that equipment status/deficiencies were identified and communicated. These records included operating logs, turnover sheets, tag-out and jumper logs, process computer printouts, unit off-normal and draft incident reports. The inspector verified adherence to approved procedures for ongoing activities observed. Shift turnovers were witnessed and staffing requirements confirmed. Inspector comments or questions resulting from these reviews were resolved by licensee personnel. Onsite Safety Review Committee meetings were attend to evaluate the licensee's self-assessment capability. In addition, inspections were conducted during backshifts and weekends on 5/23, 5/29, 6/13, 6/14, 6/22, 6/27, 6/28 and 7/5.

#### 4.3.1 Inadvertent Reactor Trip (5/27)

On May 27, 1989, an inadvertent Unit 2 low pressure reactor trip occurred while the unit was in Hot Standby (Mode 3). At the time of the trip, all control rods had been withdrawn five steps to prevent thermal binding during the in progress plant heatup. The cause of the trip was the performance of a surveillance test that should not have been conducted for the given plant conditions. For details, see Section 8.0.

#### 4.3.2 Unit 2 Recovery from First Refueling

The inspectors closely monitored licensee startup activities following the completion of the first Unit 2 refueling outage. The licensee utilized detailed checklists to ensure all required plant systems were operable when required while transitioning from Cold Shutdown (Mode 5) to Power Operation (Mode 1).

Due to the addition of low neutron leakage fuel assemblies, the licensee made a slow, conservative approach into the power range. Special low power physics testing was conducted to ensure the proper calibration of nuclear instruments and to verify expected core performance. Control room operators appeared to be fully briefed on the lack of reliability of the nuclear instruments until the completion of the low power physics testing and the first calorimetry.

No unacceptable conditions were identified.

#### 4.3.3 Unusual Event (6/7)

Unit 2 declared an Unusual Event on June 7, 1989 due to excessive reactor coolant system (RCS) leakage and initiated a Technical Specification (TS) required shutdown. The licensee quantified the leak at approximately 8 gallons per minute. The licensee made an entry into the sub-atmospheric Containment Building to locate the leak while conducting an orderly shutdown from 75% power due to RCS unidentified leakage exceeding the TS 3.4.6.2 limit of one gallon per minute. The leak was discovered to be from an instrument line tap due to an instrument valve being out of position and the end fitting becoming dislodged. The valve was immediately returned to the proper position and a replacement end fitting was installed. The licensee stabilized the plant at 20% power, confirmed that the leak was isolated and then terminated the Unusual Event. A walkdown in Containment by licensee personnel identified

other similar out of position valves which were then closed. The unit subsequently returned to full power. This item is Unresolved (50-338/89-12-02; 50-412/89-13-02) pending review of the licensee's critiques to determine root cause for the out of position valves and the program to control the position of these and other similar valves at both units.

#### 4.3.4 Unusual Event (6/21) and ESF actuations (6/22)

Unit 2 declared an Unusual Event on June 21, 1989, due to a plant shutdown necessitated by excessive reactor coolant (RCS) leakage into the "C" steam generator. The initial leak rate was estimated at approximately 495 gallons per day (gpd) (Technical Specification 3.4.6.2 limit is 500 gpd). The licensee elected to shut down after sample results indicated the inventory loss was into the "C" steam generator. Follow-up tests after the unit was stabilized in Hot Standby (Mode 3), indicated a leak rate of about 177 gpd and the Unusual Event was terminated.

During the cooldown, the unit experienced three engineered safety features inadvertent actuations due to difficulties in maintaining proper steam generator water level, an automatic start of Auxiliary Feedwater and feedwater automatic isolation due to low and high steam generator levels, respectively.

For details of the above event, see Section 7.

#### 4.4 Plant Security/Physical Protection

Implementation of the Physical Security Plan was observed in various plant areas with regard to the following:

- Protected Area and Vital Area barriers were well maintained and not compromised;
- Isolation zones were clear;
- Personnel and vehicles entering and packages being delivered to the Protected Area were properly searched and access control was in accordance with approved licensee procedures;
- Persons granted access to the site were badged to indicate whether they have unescorted access or escorted authorization;
- Security access controls to Vital Areas were being maintained and that persons in Vital Areas were properly authorized.
- Security posts were adequately staffed and equipped, security personnel were alert and knowledgeable regarding position requirements, and that written procedures were available; and

-- Adequate illumination was maintained.

No unacceptable conditions were identified.

#### 4.5 Radiological Controls

Posting and control of radiation and high radiation areas were inspected. Radiation Work Permit compliance and use of personnel monitoring devices were checked. Conditions of step-off pads, disposal of protective clothing, radiation control job coverage, area monitor operability and calibration (portable and permanent) and personnel frisking were observed on a sampling basis.

No unacceptable conditions were identified.

#### 4.6 Plant Housekeeping and Fire Protection

Plant housekeeping conditions, including general cleanliness conditions and control and storage of flammable material and other potential safety hazards, were observed in various areas during plant tours. Maintenance of fire barriers, fire barrier penetrations, and verification of posted fire watches in these areas were also observed. The inspector conducted detailed walkdowns of the accessible areas, including normally locked high radiation areas, of both Unit 1 and Unit 2. No significant deficiencies were identified.

While touring the Unit 1 Process Instrumentation Area, the inspector noted measuring and test equipment (M&TE) which did not appear to be controlled as required by the licensee's procedure for M&TE (Section 2 of I&C Administrative Manual). There were two calibrated decade boxes, a calibrated power supply and a calibrated multi-meter (Fluke) that had not been returned to the M&TE storage area when not in use. There was also a multi-channel recorder with a reject sticker being stored with other calibrated recorders. These instances of lack of control of M&TE are considered a weakness. This area will be reviewed in a future NRC inspection.

#### 5. Surveillance Testing

The inspectors witnessed/reviewed selected surveillance tests to determine whether properly approved procedures were in use, details were adequate, test instrumentation was properly calibrated and used, Technical Specifications were satisfied, testing was performed by qualified personnel and test results satisfied acceptance criteria or were properly dispositioned. The following surveillance testing activities were reviewed:

OST 2.36.2 Emergency Diesel Generator (2EGS& EG2-2) Monthly Test on June 21, 1989.

OST 1.36.1 Diesel Generator No. 1 Monthly Test on July 5, 1989.

No deficiencies were identified.

## 6. Maintenance

The inspector reviewed selected maintenance activities to assure that:

- the activity did not violate Technical Specification Limiting Conditions for Operation and that redundant components were operable;
- required approvals and releases had been obtained prior to commencing work;
- procedures used for the task were adequate and work was within the skills of the trade;
- activities were accomplished by qualified personnel;
- where necessary, radiological and fire preventive controls were adequate and implemented;
- QC hold points were established where required, and observed;
- equipment was properly tested and returned to service.

Maintenance activities reviewed included:

- MWR 899025-RHS Isolation Valve 2RHS\*MOV720B
- MWR 898759-Inspection of "2C" Steam Generator to Locate Leak
- MWR 8987060-Repair of "2C" Steam Generator Tubes
- MWR 899836-Eddy Current Testing of "2C" Steam Generator

No deficiencies were identified.

## 7. Steam Generator Tube Damage from Foreign Object

A steam generator tube leak was caused by a loose part from a main feedwater regulating valve. The valve had failed in February 1989 and the part had not been found. The tube damage led to a tube leak and a Unit 2 shutdown. Operator error caused three ESF actuations during the cooldown process.

### 7.1. Shutdown due to Steam Generator Tube Leak

On June 21, 1989, with Unit 2 operating at full power, control room operators received alarms (main condenser air ejector discharge and steam generator blow down high radiation level) indicating leakage from the Reactor Coolant System (RCS) into a steam generator (SG). As required, Abnormal Operating Procedure 2.6.4 "Steam Generator Tube

leakage" was entered and the initial estimate of SG tube leakage was approximately 495 gallons per day (GPD) into "C" SG. The Unit 2 Technical Specification (TS) 3.4.6.2 limit on SG tube leakage is 500 gpd. The licensee conservatively declared an Unusual Event and a controlled shutdown was performed in accordance with station procedures. Once the unit was stabilized in Hot Standby (Mode 3), follow up tests determined that actual RCS leakage into "C" SG was 177 gpd and the Unusual Event was terminated.

The unit was cooled down to repair the SG. While cooling down, three inadvertent Engineered Safety Features (ESF) actuations occurred. The first ESF actuation was the automatic start of the Auxiliary Feedwater System due to low water level in "B" SG. This was attributed to operator error. The licensee raises the SG water level trip setpoints when at greater than 45% reactor power to compensate for water level variation problems identified during initial power ascension testing (see Inspection Report 50-412/87-69). When the reactor is at low power or shut down, but the SG low level trip is at the high power setpoint, a low level trip will occur before a level deviation alarm is annunciated. The control room operator mistakenly believed that the steam generator water level trip setpoints had been reset to the less than 45% power setting and was relying on the level deviation alarm to alert him to the need to take action to raise SG water level. The operator restored SG water level and secured the auxiliary feed pump.

Later, two additional inadvertent ESF actuations occurred due to operator error. A feedwater isolation, the main feed pumps tripped and the AFW pumps automatically started as a result of over feeding the "C" SG. The control room operator assigned to control SG water level was distracted by performing Operating Surveillance Tests. Due to the lack of prompt action to stop the AFW pumps, a second feedwater isolation signal was generated. Subsequently, control room operators reestablished proper SG water level, stopped the AFW pumps and restored main feedwater flow.

The initial operator actions and responses from discovery of the tube leak until the third ESF actuation all occurred during the midnight shift. A major contributor to the operator errors was the concurrent tasking of the licensed operators with items such as tests. These back shift personnel errors during times of peak activity but reduced manning, indicates that the problems noted in Inspection Report No. 50-338/89-01; 50-412/89-01 are still present.

## 7.2 Steam Generator Tube Repair and Loose Part Recovery

Once Cold Shutdown (Mode 5) was established, the licensee isolated and drained RCS loop "C". The "C" SG primary side manways were removed and a secondary side hydrostatic test was performed to locate the source of the leak. The test indicated there was a leaking SG tube on the periphery of the hot leg side (row 31, column 16).

Subsequent eddy current testing of the suspect tube revealed a 100% through-wall defect, approximately 3.75 inches above the SG tube sheet.

Visual inspection of the SG secondary side located an object wedged between the failed tube and an adjacent tube. The 1 inch by 3/4 inch by 3/4 inch object was identified as the anti-rotation device from the "C" feedwater regulating valve that had catastrophically failed in February, 1989 (see Inspection Report 50-412/89-01). The licensee had made two previous attempts (immediately following the valve failure, and during the recent refueling outage) to locate and retrieve the object.

The licensee organized a Foreign Object Search And Retrieval (FOSAR) team and brought in a SG mockup. Using the mockup, the FOSAR team developed the necessary tools and techniques to dislodge and remove the object. The use of a mockup kept personnel radiation exposures to a minimum.

After the object was removed, the licensee conducted eddy current testing of 33 SG tubes in the area around the failed tube. This testing indicated that 3 other tubes had been damaged by the object. The damage consisted of 96%, 53% and 26% through-wall defects respectively; all were located approximately 3.75 inches above the tube sheet adjacent to the fail tube. The licensee tested an additional 21 tubes to verify that the special FOSAR tools did not damage any other tubes.

The licensee plugged and sleeved the failed tube and the 3 damaged tubes. A satisfactory secondary side SG hydrostatic test verified the adequacy of the above repairs and the RCS loop was returned to service.

The licensee's investigation and repair activities were considered to be very good. Especially notable was the acquisition and use of the full size SG mockup, which allowed the development of retrieval techniques without risking further tube damage or personnel radiation exposure.

#### 8. Inadvertent Reactor Trip in Mode 3

On 27 May, 1989, while performing Maintenance Surveillance Procedure (MSP) "26.01-I", "2 MSS-P446 First Stage Pressure Protection Channel III Test", in Hot Standby (Mode 3), an inadvertent low pressure reactor trip occurred resulting in inward movement of all control rods. At the time of the trip, a plant heatup was in progress with reactor pressure at approximately 1300 psig. All control rods had been withdrawn five steps to prevent thermal binding during the heatup.

The low pressure reactor trip is manually blocked when the unit is shut down and is automatically reinstated whenever turbine power (1 out of 2

logic) or nuclear power is greater than 10%. The technicians, performing the above MSP, placed the test switch for P-13 (Turbine at power permissive) bistable to "Test", as required by the procedure. This caused the block signal that prevents a low pressure reactor trip (setpoint 1945 psig) to become unblocked. The reactor trip breakers opened and all control rods fully inserted as designed. Control room operators responded to the trip in accordance with emergency procedures.

The technicians performing the MSP temporarily had stopped the test when they identified that the low pressure reactor trip bistables were actuated. The technicians' foreman reviewed the MSP, consulted with the reactor operator, and determined that the bistables were in their proper state for the existing plant condition. The foreman then mistakenly instructed the technicians to continue with the MSP.

Subsequent review of MSP26.01-I revealed that the procedure should not have been performed for the given plant conditions. The initial conditions section at the beginning of the procedure allowed the performance of the surveillance if the plant was operating above 10% power, the reactor trip breakers were open or the low pressure reactor trip was not actuated. The MSP contained a signoff block verifying proper plant condition which was completed and signed by the technician. The nuclear shift supervisor and the technicians performing the test failed to adequately review the required initial conditions prior to the performance of the test.

The licensee's Independent Safety Evaluation Group (ISEG) identified additional contributors to the event. These included inadequate planning in that there was pressure to complete the MSP due to technical specification surveillance time restraint. Another identified contributor was that the technicians' foreman may not have been alert as normal due to working 68 days of continuous night shift. Initial investigation by the inspectors into this area of consecutive work days indicate that the above may not be an isolated case.

Another contributor to this event, not covered in the ISEG review, was the practice of the technicians who perform surveillance testing to make the determination of required plant conditions. It was not clear that the technicians were qualified to make such a determination.

Although there were several contributors to this event, the fact that the MSP was performed, despite not meeting the required initial conditions, is a Violation (50-412/89-13-01).

#### 9. Inadequate Cable Separation

Previous inspection reports identified a programmatic weakness in the assurance of adequate separation of safety related cable and a Notice of Violation was issued (50-334/88-22-03; 50-412/88-15-02). The progress of the licensee's corrective actions was reviewed in Inspection Report 50-334/89-01; 50-412/89-01. Substantial licensee resources were noted to be dedicated to walkdowns and other reverification efforts. The licensee's December 16, 1988 response committed to completion of all activities

by March 31, 1989 with the exception of those Unit 1 areas not normally accessible during operation. The licensee informed the inspector that the actions due by March 31 were complete and the inspector conducted a re-inspection of the areas involved.

The Unit 2 reinspection identified no deficiencies (see Section 3.3), but several additional deficiencies were found in the Unit 1 cable spreading room. These deficiencies were as follows:

- Orange train cables in tray 1TC6410 were found with inadequate separation from purple train cables entering floor penetration 1FC730P11.
- Orange train cables from tray 1CC3290 had inadequate separation from purple train cables from tray 1TC166P.
- Orange train cables entering penetration 1UC160012 had inadequate separation from purple train cables entering penetration 1UC160P14.
- A neutral cable was found routed in both orange train tray 1TC1350 and in purple train tray 1TC035P.

The above deficiencies were found in the same area as the earlier violation (50-334/88-22-03) and demonstrated that licensee efforts to correct the problem of cable separation were not successful nor did licensee reverification activities identify the continuing deficiencies. The failure to take adequate corrective action for previous NRC findings is a violation of 10 CFR 50, Appendix B, Criterion XVI, "Corrective Action" (50-334/89-12-01).

Licensee corrective actions were in progress at the close of the inspection, including additional walkdowns of the area on a cable tray by cable tray basis. The licensee had identified other examples of inadequate separation before the end of the period.

#### 10. Inoffice Review of Licensee Event Reports (LERs)

The inspector reviewed LERs submitted to the NRC Region I Office to verify that the details of the event were clearly reported, including accuracy of the description of cause and adequacy of corrective action. The inspector determined whether further information was required from the licensee, whether generic implications were indicated and whether the event warranted onsite followup. The following LERs were reviewed:

##### Unit 1:

LER:89-06-00 Exceeding Technical Specification Requirement

LER:89-07-00 Reactor Trip/Safety Inspection on Loss of Power to AMSAC Panel

Unit 2:

- LER:89-05-01 Inadvertent Safety Injection (Revision 1)
- LER:89-10-00 Containment Purge/Exhaust Ventilation Realignment-ESF Actuation
- LER:89-11-00 Recirculation Spray Pumps' Timer Failure
- LER:89-12-00 Loss of Power to Train "A" Emergency Bus
- LER:89-13-00 Degraded Recirculation Spray System Heat Exchanger Service  
Water Flow
- LER:89-14-00 Leak Collection Ventilation Flowpath Automatic Realignment  
Actuation
- LER:89-15-00 Feedwater Isolation (FWI) During Surveillance Testing of  
Auxiliary Feedwater Pump
- LER:89-16-00 Radwaste in Transit Not Properly Posted
- LER:89-17-00 Technical Specification Required Shutdown (Hot Standby to Hot  
Shutdown)
- LER:89-18-00 Low Pressure Reactor Trip

The above LERs were reviewed with respect to the requirements of 10 CFR 50.73 and the guidance provided in NUREG 1022. Generally, the LERs were found to be of high quality with good documentation of event analyses, root cause determinations and corrective actions. One LER (Unit 1 LER 89-18) determined the event cause to be personnel error and a lack of procedural guidance with the focus of the LER's review on the error immediately prior to the actuation. Corrective actions were focused on human factors and procedural clarification. The inspector conducted an independent review of the event and noted that the procedure being used clearly stated what plant initial conditions were required to perform the procedure. These conditions were not met, but the step was signed off by a technician and the procedure was initiated. This event is further discussed in Section 8.

The previous resident report (50-334/89-05; 50-412/89-05) noted a possible inconsistency between Unit 2 LER 89-05 and the site Emergency Plan. The licensee concurred with the inspector's observation and revised the LER. The inspector reviewed the revised LER and had no additional questions.

11. Unresolved Items

Unresolved items are matters about which more information is required in order to ascertain whether they are acceptable items, violations or deviations. An unresolved Item is identified in Section 4.3.3 of this report.

12. Meetings

Periodic meetings were held with senior facility management during the course of this inspection to discuss the inspection scope and findings. A summary of inspection findings was further discussed with the licensee at the conclusion of the report period on July 14, 1989.