U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Reports No. 50-295/82-22(DPRP); 50-304/82-19(DPRP)

Docket Nos. 50-295; 50-304 Licenses No. DPR-39; DPR-48

Licensee: Commonwealth Edison Company
Post Office Box 767
Chicago, IL 60690

Facility Name: Zion Nuclear Power Station, Units 1 and 2

Inspection At: Zion, IL

Inspection Conducted: September 1 through October 15, 1982

Inspectors: J. R. Waters DC Boyd/for 11-4-82
Date

F. R. Dunaway DC Boyd/for 11-4-82
Date

P. L. Hartmann DC Boyd/for 11-4-82
Date

Approved By: L. Reyes, Chief DC Boyd/for 11-4-82
Projects Section 2B Date

Inspection Summary

Inspection on September 1 through October 15, 1982 (Reports No. 50-295/82-22(DPRP); 50-304/82-19(DPRP))

Areas Inspected: Routine Unannounced Resident Inspection of Licensee Action on Previous Inspection Items; Unit 2 Shutdown; Violation of Dilution and Containment Integrity Requirements; Vandalism to Meterological Data Station; 1B Charging Pump Failure; Unit 2 Inadvertant Safety Injection; Unit 1 Reactor Trip and Rod System Failure; Unit 2 Control Rod Drive Failures; Primary to Secondary Leak Test; Tritium Release Reporting; Licensee Action on TMI Items; Operational Safety Verification; Monthly Maintenance Observation; Monthly Surveillance Observation and Licensee Event Reports. This inspection involved a total of 270 inspector-hours by three NRC inspectors including 30 inspector-hours onsite during off-shifts.

Results: Of the 15 areas inspected no items of noncompliance were identified in 14 areas; one item of noncompliance was identified in the other area (violation of Boron Dilution and Containment Integrity Requirement, Paragraph 5).

DETAILS

1. Persons Contacted

*K. Graesser, Station Superintendent
*E. Fuerst, Assistant Station Superintendent, Operations
*G. Pliml, Assistant Station Superintendent, Administrative and Support Services
*K. Kofron, Assistant Station Superintendent, Maintenance
R. Budowle, Unit 1 Operating Engineer
J. Gilmore, Unit 2 Operating Engineer
L. Pruett, Assistant Technical Staff Supervisor
*P. LeBlond, Assistant Technical Staff Supervisor
A. Miosi, Technical Staff Supervisor
B. Schramer, Station Chemist
F. Ost, Health Physics Engineer
C. Silich, Technical Staff Engineer, ISI
*B. Harl, Quality Assurance Engineer
T. Lukens, Quality Control Engineer
B. Kurth, Master Instrument Mechanic
F. Lentine, Nuclear Licensing Administrator
J. Marianyi, Operating Engineer
*E. Broccolo, Quality Control Technician
*J. Johnson, Westinghouse Site Representative

*Denotes those present at the exit meeting of October 15, 1982

2. Summary of Operations

Unit 1 operated at power levels up to 100%. One reactor trip (Paragraph 9) occurred.

Unit 2 operated at power levels up to 100%. One unscheduled shutdown (Paragraph 4) occurred.

3. Licensee Action on Previous Inspection Items

The following are items where corrective action was taken but the item was not closed in an inspection report. This report is being used to document their closure.

(Closed) Open Item (295/79-08-01): Violation of Technical Specification 3.15.2.C. The Licensee's corrective action was reviewed and found to be acceptable.

(Closed) Open Item (295/79-14-01): Excessive Number of 1B Feed pump Trips. The number of 1B feed pump trips have been reduced to a normal amount.

(Closed) Open Item (295/79-24-03; 304/79-22-01): Failure to maintain a portable fire extinguisher at the job site. The licensee's corrective action was reviewed and found to be acceptable.

(Closed) Open Item (295/80-14-04): Failure to Follow Procedures During Shift Turnover. The licensee's corrective action was reviewed and found to be acceptable.

(Closed) Open Item (295/80-25-03; 304/80-27-03): Installation of nitrogen flow measuring equipment. The installation of all flow meters has been completed. Data from the meters is being used to monitor the gas inventory for losses.

(Closed) Open Item (295/81-06-02): Improper Adjustments During CILRT. The licensee's corrective action was reviewed and found to be acceptable.

(Closed) Open Item (295/81-14-01; 304/81-10-01): De-energizing of Radiation Monitors. The licensee has increased the training effort pertaining to rad monitor operation and surveillance. The problem has not reoccurred since.

(Closed) Open Item (295/81-23-01; 304/81-19-01): Lack of a Procedure for Torque Wrench Multiplier Calibration. The licensee's corrective action was reviewed and found to be acceptable.

(Closed) Open Item (304/81-16-02): Mispositioned Purge Valves During Purge at Hot Shutdown. The licensee's corrective action was reviewed and found to be acceptable.

(Closed) Open Item (295/82-04-02; 304/82-04-01): De-energizing of Power Supply to Safeguards Sequence Timer. Circumstances indicate that power loss was due to radiation monitor modification work. The problem has not reoccurred since the modification work was completed.

4. Unit 2 Shutdown caused by Turbine Blade Failure

At 9:15 a.m. September 7, 1982, a controlled shutdown of Unit 2 from full power was commenced. The shutdown was conducted in response to a sudden high vibration (12 to 13 mils) at the number three bearing. At 2:45 a.m. the same day the reactor tripped from hot standby due to an instrument spike on source range channel N-32. The licensee proceeded to take the unit to cold shutdown.

Upon removal of the upper casing on the A low pressure turbine it was found that a blade had been lost from the L-2 stage on the generator end. This was the same location where a blade had been lost in February of 1982. (See Inspection Reports No. 50-295/82-04; 50-304/82-04). In both instances the failure occurred in the blade root. Following the February 1982 failure the entire rotor assembly was replaced with a refurbished unit. There were no malfunctions until the September 7, 1982 failure.

After consultation with Westinghouse representatives, the licensee elected to machine off the remaining L-2 blades and continue operation with the existing rotor. To equalize the shaft thrust the L-2 blades on the other end of the rotor were also machined off. Pressure reducing baffles were installed in place of the L-2 stationary blades to approximate the pressure drop that would have existed across the L-2

rotating blades. Damage caused by blade fragments required the repair of numerous L-0 and L-1 blades and five L-0 blades had to be replaced. It is anticipated that the reduction in turbine efficiency caused by the removal L-2 stage will result in about 40 MW of lost generating capacity.

The licensee and Westinghouse have intensified their efforts to determine the root cause of the turbine blade failures. In addition to metallurgical studies, a torsional loading test is planned for the Unit 2 turbine upon initial loading following the outage. The unit remained shutdown for the remainder of the reporting period.

No items of noncompliance or deviations were identified.

5. Violation of Containment Integrity and Dilution Requirements

On September 7, 1982, a shutdown, cooldown and depressurization of Unit 2 was initiated for unscheduled turbine repairs (see Paragraph 4).

On September 27, 1982 at 7:00 p.m. operators commenced refilling of the Unit 2 pressurizer and re-pressurization of the reactor coolant system per maintenance instruction (M1)-2A. During this evolution the boron concentration of the fill water is controlled by the unit operator. Using a nomograph, the boric acid flow and the pure water flow is adjusted to achieve the desired boron concentration. MI-2A contains the following caution in two places:

> Reactor coolant system makeup boron concentration must be equal to or greater than - the minimum boron concentration to satisfy shutdown margin requirement as calculated by the nuclear engineer and issued in the standing Orders.

The technical staff nuclear engineer had previously determined that a boron concentration of 1000 ppm should be maintained to provide a 5% shutdown margin. This information was documented in the shutdown margin notebook kept at the unit operator's desk. Technical Specifications only require a 1% shutdown margin in cold shutdown. The 5% shutdown margin is maintained to provide sufficient indication of an inadvertant boron dilution and is the result of a licensee committment in LER 50-295/80-34.

Operators on the following shift were aware that the 1000 ppm boron concentration being maintained in the RCS was well above the 1% shutdown margin required by Technical Specifications. They were also aware that the scheduled completion of the Unit 2 outage was approaching. In anticipation of having to perform a dilution for the unit startup, the operators reduced the boron concentration of the makeup water to approximately 500 ppm. This makeup concentration was maintained between approximately 1:00 a.m. and 5:00 a.m. September 28, 1982. During this period containment integrity was not maintained in that the personnel air lock doors were open. The operators were not aware of a Technical Specification requirement that while containment integrity is not intact, reactivity additions by boron dilution shall not be made unless the shutdown margin is greater than 10%.

Following the dilution RCS boron samples indicated a concentration of 940 ppm. This corresponds to a shutdown margin of 4.47%. The September 19, 1982 day shift restored the RCS boron concentration to greater than 1000 ppm and a deviation report was written.

Zion Technical Specification 3.9.5.D states that "Positive reactivity changes shall not be made by boron dilution when the containment integrity is not intact unless the reactor is maintained subcritical by at least 10% Δ K/K".

Contrary to the above, on September 28, 1982, a positive reactivity change by boron dilution was made with containment integrity not intact and with the reactor subcritical by less than 10% Δ K/K.

This is designated as item 50-304/82-19-01. No other items of non-compliance or deviations were identified.

6. Vandalism to Meteorological Data Station

On September 12, 1982, the site meteorological data station was vandalized. The data station is located approximately on block north of the protected area. Vandals climbed a protective fence and damaged or destroyed a psychrometer, a wind speed indicator and a rectifier. The wind speed recorder stopped at 2:15 a.m. on September 12, 1982, thus fixing the time of the occurrance. The Zion Police Department was notified. All damage was repaired within 24 hours. The licensee is strengthening the protective measures for the data station.

No items of noncompliance or deviations were identified.

7. Failure of 1B Charging Pump

On September 19, 1982, Unit 1 was operating at full power with the 1B centrifugal charging pump running. At 2:38 p.m. a pressurizer level deviation alarm alerted operators to a decrease in charging flow. Within five minutes charging flow had dropped to zero and the 1B charging pump motor current had risen to 130 amps (normal is about 50 amps). The pump was secured and the 1A centrifugal charging pump started to restore normal charging flow.

Disassembly of the 1B charging pump revealed that the shaft had broken at the keyway of the 11th stage impeller. The preliminary evaluation by the licensee is that the failure was caused by metal fatigue. The pump was installed during the January - April 1981 refueling outage, and had accumulated 6500 hours of run time prior to the failure. The licensee plans to section the shaft for metalurgical analysis at their Dresden facility.

Repairs to the pump consisted of replacing the rotating element and the bearings with parts obtained from onsite stores. The licensee anticipated that the pump repairs might extend beyond the seven days allowed by Technical Specifications for reactor operation with a charging pump inoperable. A temporary Technical Specification change allowing an additional three days of operation was requested by the

licensee. Based on acceptable analysis of small break LOCA, large break LOCA and steam line rupture accidents with no operable charging pumps, the Technical Specification change was approved by the Office of Nuclear Reactor Regulation.

The maintenance work was completed sooner than expected and upon completion of post repair testing at 9:30 p.m. September 25, 1982, the 1B charging pump was returned to an operable status. This item is open pending results of the metalurgical analysis (50-295/82-22-01).

No items of noncompliance or deviations were identified

8. Unit 2 Inadvertant Safety Injection

On September 30, 1982 at 1:06 p.m. Unit 2 experienced a safety injection while in cold shutdown. Operators had been performing a test of safeguards logic per station procedure PT-10C. A defective relay caused them to secure the test while the relay was replaced. The safeguards system was de-energized while still in the test mode. This leaves the safety injection master actuating relay mechanically latched. When Train B of safeguards was re-energized to resume the test a safety injection occurred. Several safeguards components did not actuate since they were in pull to lock for the cold shutdown condition. The licensee has initiated changes to station Procedures GOP-1 and GOP-2 to prevent reoccurrance of the problem.

No items of noncompliance or deviations were identified.

9. Unit 1 Rod Control Failure and Reactor Trip of September 30, 1982

At approximately 4:45 p.m. September 30, 1982 with Unit 1 at full power, control room operators noticed that power had been lost to the balance of plant M/A stations. They found that the 115 volt a.c. power supply breaker had tripped. When the breaker was reclosed it immediately tripped open again. To locate the fault, the power supplies to all balance of plant M/A stations were unplugged and the power supply breaker reclosed. The intent was to re-energize each M/A station individually until the fault was found. The first M/A station reenergized was the feed pump master controller. Upon re-energization the operator waited a few seconds and pushed the "manual" button. The speed of the B feed pump dropped to idle. The C feed pump speed remained unchanged.

The operators immediately ran the turbine back to 50% power in an effort to keep the unit from tripping. The control rods which should have automatically stepped inward in response to the increasing Tave failed to do so. The operator attempted to insert rods in the manual mode but the rods still did not move. Seeing that primary plant pressure and temperature were still increasing and that the control rods were not responding, the shift engineer ordered a manual trip of the reactor. This occurred at 4:50 p.m. September 30, 1982. The steam dump valve controller was without power due to the loss of balance of plant M/A station power. Thus with no steam dump valves operable and the turbine valves closed by the reactor trip, the heat

in the primary system could only be released via the steam generator code safety valves. All twenty safety valves lifted for approximately 30 seconds. Immediately after the reactor trip , operators observed that there was no bottom light indication for five of the control rods. The operators commenced emergency boration of the reactor coolant system until the faulty rod bottom lights and position indicators were corrected and all rods were verified to be inserted. The emergency boration lasted about six minutes. Within 3 minutes after the reactor trip, power to the steam dump valves was restored making them available for decay heat removal. Forty minutes after the trip a fire alarm from a containment smoke detector was received. The station fire brigade entered containment and found no fire. There was a leaking steamp trap in the vicinity of the smoke detector which may have caused the spurious alarm. The alarm cleared itself shortly thereafter. The plant was maintained in hot shutdown pending evaluation of the various problems identified.

The peak reactor coolant system temperature, pressure and pressurizer level recorded during the transient were 581°F, 2355 psig, and 62% respectively. The downsteam temperature sensors indicated that at least one primary power operated relief valve lifted during the event. Since there was no discernable increase in the primary relief tank temperature, it was concluded that the opening of the power operated relief valve was of very short duration. Activity samples of the steam generator water prior to the event had not shown any short-lived activity. The day after the transient, 5.9×10^{-5} µCi/cc of Iodine 131 activity was detected on a C steam generator sample. This indicates that the transient may have opened a small primary to secondary leak. The licensee will continue to monitor steam generator activity and will attempt to quantify the leak rate.

Investigation into the rod control system failure revealed that there was a malfunction in the pulser circuit on the pulse-oscillator card. The result was that when the difference between T-ref and auctioneered T-ave exceeded 5°F the master cycler would send a sequence start signal to the slave cycler before the slave cycler had finished its previous sequence. The slave cycler receiving a start signal while in the middle of a sequence resulted in a rod system urgent failure condition. This precluded any further rod motion. This was verified using test inputs to simulate T-ref/T-ave mismatches in excess of 5°F. The rods would move about 1 1/2 steps and then an urgent failure alarm would occur. When the pulseoscillator card was replaced and the test procedure repeated, no urgent failure or rod system lockup occurred.

Since the pulser circuit malfunction resulted in an urgent failure condition only when T-ave differed from T-ref by 5°F or more, the malfunction could have existed undetected for some period of time. The licensee has committed to perform appropriate surveillance testing at every refueling outage to detect the problem in advance. The licensee is also determing if any surveillance testing can be performed with the unit at power.

The licensee also investigated the loss of power to the balance of plant M/A stations and loss of the 1B feedwater pump upon the restoration of power. The loss of power to the M/A stations was caused by a short circuit in an Amphenol connector which supplied power to the M/A station for the C steam generator power operated relief valve. This connector had been unplugged at about 3:00 p.m. September 30, 1982 to allow removal and repair of the M/A station. The short caused the tripping of the power supply breaker for all the balance of plant M/A stations. On loss of power the M/A stations are designed to maintain their last signal. Since the unit was operating at steady state it was not immediately apparent that M/A station power had been lost. When an M/A station is re-energized the auto light energizes while the circuitry matches the output to that existing at the time of de-energization. This is the auto hold mode and takes 15 to 20 seconds. When the output is matched, auto light goes out and the M/A station reverts to the manual mode. When the operator went to manual on the feedwater master M/A station prior to completion of the auto hold phase, there was still a large discrepency between the last existing signal and the M/A station output. The M/A station output went to zero. Since the C feedpump slave M/A station was in manual it was divorced from the output of the master M/A station. The B feed pump slave M/A station was in auto and transmitted the zero output of the master M/A station to the B feed pump controller. This caused the B feed pump to run back to idle speed. As a result of this occurrance written instructions on re-energizing M/A stations at power are being generated for the use of operating personnel.

The reactor was taken critical at 9:20 p.m. October 1, 1982 and tied to the grid at 5:18 a.m. October 2, 1982.

No items of noncompliance or deviations were identified.

10. Failure of Control Rod Drive Coils

On October 6, 1982 operators commenced a startup of Unit 2 following an outage for turbine repairs (see Paragraph 4). When shutdown bank A was withdrawn rod P-12 did not move. The stationary gripper coil fuses were found to be blown. Measurements taken by the licensee indicated low internal resistance for the stationary gripper coil. A check of other rod banks showed several other rods with blown fuses and low coil resistances. The licensee performed resistance to ground and internal resistance checks for all three coils on all the control rods. These checks indicated that a total of 12 stationary coils, one moveable coil and one lift coil should be replaced due to low internal resistance. The primary plant was taken to cold shutdown and the twelve coils replaced. All the defective coils were located in the vicinity of a primary coolant leak on the reactor vessel level indicator piping that occurred in November of 1981. (see Inspection Reports No. 50-295/81-26; 50-304/81-23). This indicates that the steam and/or boric acid from the coolant leak may have had a long term detrimental effect on the control rod drive coils. The licensee and Westinghouse plan to dissect some of

the faulty coils in an attempt to determine the failure mode. The licensee estimates that Unit 2 will be restored to operation October 17, 1982.

No items of noncompliance or deviations were identified.

11. Unit 1 Primary to Secondary Leakage

A primary to secondary leak rate test was performed on all four Unit 1 steam generators on October 8, 1982. The test was performed to investigate the indications of steam generator activity that was found after the Unit 1 pressure excursion of September 30, 1982 (see Paragraph 9). The test results indicate a leak rate of 0.5 gal/day for the 1 C steam generator. The accuracy of the test method is such that very little credibility can be attached to the 0.5 gal/day number. The test results do indicate the likelihood of a small tube leak on the 1C steam generator. No leakage was found on the other three steam generators. The licensee intends to repeat the leak test periodically.

No items of noncompliance or deviations were identified.

12. Reporting of Tritium Released in Gas Vapors

In response to inquiries from the NRC and concerned citizens, the licensee re-examined their practice of omitting tritium from their semi-annual report of gaseous releases. Although the licensee does not consider it to be a Technical Specification requirement, they intend to include tritium released in gas vapors in subsequent semi-annual release reports. Based on a typical month, tritium released in gas vapors amounted to about 0.15% of the total activity released.

No items of noncompliance or deviations were identified.

13. Licensee Action on TMI Items

The inspector reviewed the licensee's action on the following NUREG-0737 items:

II.B.4 Training for Mitigating Core Damage:

The course consists of 32 hours of classroom instruction utilizing Westinghouse supplied texts. Acceptance of the program is documented in a May 28, 1982 letter from S.A. Varga, NRC to L. O. DelGeorge. The inspector verified that the personnel required by NUREG-0737 attended the course.

II.F.1.6 Installation of Containment Hydrogen Monitors:

The inspector verified that the system is installed and operational. The inspector also reviewed the operating instructions. Deficiences not affecting the system operability remain to be corrected.

Both the above items are considered to be completed.

No items of Noncompliance or deviations were identified.

14. Operational Safety Verification

The inspector observed control room operations, reviewed applicable logs and conducted discussions with control room operators during the months of September and October. The inspector verified the operability of selected emergency systems, reviewed tagout records and verified proper return to service of affected components. Tours of the auxiliary building and turbine building 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. During the month of September, the inspector walked down the accessible portions of the auxiliary feedwater system to verify operability. The inspector also witnessed portions of the radioactive waste system controls associated with radwaste shipments and barreling.

These reviews and observatons were conducted to verify that facility operations were in conformance with the requirements established under Technical Specifications, 10 CFR, and administrative procedures.

No items of noncompliance or deviations were identified.

15. Monthly Maintenance Observation

Station maintenance activities of safety related systems and components listed below were reviewed to ascertain that they were conducted in accordance with approved procedures, regulatory guides and industry codes or standards and in conformance with Technical Specifications.

The following items were considered during this review: The limiting conditions for operation were met while components or systems were removed from service; approvals were obtained prior to initiating the work; activities were accomplished using approved procedures and were inspected as applicable; functional testing and/or calibrations were performed prior to returning components or systems to service; quality control records were maintained; activities were accomplished by qualified personnel; parts and materials used were properly certified; radiological controls were implemented; and, fire prevention controls were implemented.

Work requests were reviewed to determine status of outstanding jobs and to assure that priority is assigned to safety related equipment maintenance which may affect system performance.

The following maintenance activity was reviewed:

Repair of 1B charging Pump

No items of noncompliance or deviations were identified.

16. Monthly Surveillance Observation

The inspector observed Technical Specifications required surveillance testing on the 1B diesel generator and verified that testing was performed in accordance with adequate procedures, that test instrumentation was calibrated, that limiting conditions for operation were met, that removal and restoration of the affected components were accomplished, that test results conformed with Technical Specifications and procedure requirements and were reviewed by personnel other than the individual directing the test, and that any deficiencies identified during the testing were properly reviewed and resolved by appropriate management personnel.

No items of noncompliance or deviations were identified.

17. Licensee Event Reports Followup

Through direct observations, discussions with licensee personnel, and review of records, the following event reports were reviewed to determine that reportability requirements were fulfilled, immediate corrective action was accomplished, and corrective action to prevent recurrence had been accomplished in accordance with Technical Specifications.

LER No.	UNIT 1
82-05	Flow Reduction to 1D RCS Loop
82-12	1D S/G Level Transmitter Drifted High
82-13	Loop C&D RC Flow Transmitters Drifted High
82-18	ORT-AR08 Out of Tolerance
82-19	1RE0051 Reading Low
82-20	ORE0005 Failure
82-21	PP Zone 2 Low Pressure
82-22	PP Zone 1 Low Pressure Due to Rupture Disc
82-23	Loss of CC Flow to SI Pump
82-24	Accumulator Level Instrument Out of Tolerance
82-25	Fire in O Diesel Generator Room - O and 1A diesel Generator Inoperable
82-26	Inadvertant SI During PT-10

LER No.	UNIT 2
82-04	Failed BFD 225 Relay
82-05	2A S/G Pressure Transmitter Failed High
82-07	Over Boration of RIT
82-09	Failure of Service Water Valves to AFP Oil Cooler to Open
82-11	RE0015 Drifted Low
82-12	Loss of Power to Safeguards Sequence Timer
82-14	2A SG Comparator Set Point Dri.
82-16	Logic Relay Mechanical Binding
82-17	2B MSIV Drifted Open in Hot Shut Down
82-18	Failure of 2C S/G Pressure Transmitter
82-20	Diesel Generator and Two Auxiliary Feed Pumps Inoperable

No items of noncompliance or deviations were identified.

18. Meetings, Offsite Functions

During the inspection period the Senior Resident Inspector attended the following offsite function:

September 9, 1982	Zion Enforcement Conference	Region III Headquarters Glen Ellyn, IL

19. Open Items

Open Items are matters about which more information is required in order to determine what, if any, corrective action is required. Two open items (Paragraphs 5 and 7) were disclosed during this inspection.

20. Exit Interview

The inspector met with licensee representatives (denoted in Paragraph 1) throughout the inspection period and at the conclusion of the inspection on October 15, 1982, and summarized the scope and findings of the inspection activities.

The Licensee acknowledged the inspector's comments.