U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No.: 50-334/88-12 License No.: DPR-66

Licensee: Duquesne Light Company
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Pittsburgh, PA 15279

Facility Name: Beaver Valley Power Station, Unit 1

Location: Shippingport, Pennsylvania

Dates: March 3-8, 1988

Inspectors: J. E. Beall, Senior Resident Inspector
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Approved By: Lowell E. Tripp 3/9/88
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Reactor Projects Section No. 3A

Inspection Summary: Inspection Report No. 50-334/88-12 on March 3-8, 1988

Areas Inspected: Special resident inspection (48 hours) of the event discovered on March 3, 1988 which involved the inoperability of two of the four high-high containment pressure channels due to the placement of the associated bistables in the bypassed condition.

Results: Operation with fewer than three operable high-high containment pressure channels available to automatically start the safety systems designed to suppress the pressure rise inside containment that would result from a high energy line break was an apparent violation of Technical Specifications. Additionally, the lack of control room bypass indication associated with the high-high containment pressure bistables is an apparent deviation from licensee commitments in the FSAR.

Licensee investigations and corrective actions were still in progress at the end of the inspection. Inspector concerns about related administrative controls were discussed with licensee senior management.

TABLE OF CONTENTS

DETAILS

1.0 Overview

On March 3, while operating at 30% power, the licensee identified a condition that was outside the design basis of the plant. While performing a Technical Specification (TS) required surveillance test, two out of the four high-high containment pressure (HHCP) bistables (1 per channel) were found to be bypassed. After a brief investigation was unable to identify any reason for the bistables to be bypassed, the bistables were restored to operability.

Actuation of two out of four HHCP channels automatically generates a containment isolation phase B (CIB) signal. A CIB signal, in turn, automatically initiates the containment depressurization system. By TS 3.3.3.1, Engineered Safety Features Actuation System Instrumentation, the licensee is required to maintain a minimum of three HHCP channels operable while in Modes 1 through 3; the above condition had existed since February 22, 1988. Mode 3 was entered following the sixth refueling outage on February 23, 1988. Single failure of either of the two remaining operable channels would have rendered the automatic CIB actuation system inoperable. The above condition was determined to be outside the design basis of the plant, which requires that no single failure result in the loss of a protection function, since February 24, 1988 (approximately 8 days). A review of this event was conducted by the resident inspectors to determine the details of the event with respect to root causes and its safety significance. This special inspection was conducted between March 3 and March 8, 1988.

2.0 System Description and Requirements

2.1 Containment Depressurization System

The ESF system initiates the containment depressurization system (CDS) through the actuation of a containment Phase B (CIB) signal. The CIB signal is generated upon the coincidence of two out of four high-high containment pressure signals or two out of two manual push-button signals. The CDS acts to reduce containment building pressure in the event of a loss of coolant or steam line break accident inside containment. The CDS cools the containment directly via spray manifolds inside containment and limits the release of fission products by absorbing iodine, should it be released into containment. The CIB signal also isolates and pressurizes the main control room, isolates reactor plant river water from non-safeguards systems and trips non-essential loads from the emergency powered buses.

The bistables associated with the HHCP channels are designed to energize to trip, to avoid spurious actuations of the CDS upon loss of supply power. The positions associated with the system final bistable switches are normal and bypass. In the normal position, when the associated setpoint is reached, the bistable will trip and perform its intended protective function. In the bypass position, the actual HHCP condition on that channel does not affect channel output or system actuation. This particular design is documented as being acceptable in the Unit 1 FSAR (Section 7.3.2.1.1) because the protection channels meet the criteria of IEEE Standard 279-1971, Criteria for Protection Systems for Nuclear Power Generating Stations.

2.2 Requirements

2.2.1 Technical Specifications

Technical Specification 3.3.2.1, ESF Actuation System Instrumentation, requires that the channels and interlocks specified in Table 3.3-3 be operable. The required action for inoperable ESF actuation system instrumentation channels specifies that when the number of operable channels is one less than the total number of channels (4), demonstrate that the minimum channels operable requirement is met within 1 hour. Operation may continue with the inoperable channel bypassed and one channel may be bypassed for up to two hours for testing per Specification 4.3.2.1.

2.2.2 Final Safety Analysis Report

Section 7.3.2.1 of the Unit 1 FSAR, Instrumentation and Controls for the ESF System (evaluation of compliance with IEEE Standard 279-1971) addresses the licensee's commitments with respect to indication of bypassed components. The FSAR states that, in general, if any analog channel in the ESF actuation system is taken out of service for any reason, the channel is placed in the tripped mode and the channel trip status light is lit on the control board. The channel bistable output relays associated with the containment spray function are not tripped to reduce the possibility of inadvertent actuation, but are negated (bypassed) for test and maintenance purposes. The FSAR states that a status light indicating a negated condition is provided for each channel.

The FSAR documents the licensee's commitment to IEEE Standard 279-1971, Criteria For Protection Systems For Nuclear Generating Station, with respect to ESF System instrumentation and controls. Included in the Standard's requirements are single failure and bypass indication criteria. The single failure criterion states that any single failure within the system shall not prevent proper protection action at the system level. The bypass indication criterion states that if the protective action of some part of the system has been bypassed or deliberately rendered inoperative for any purpose, this fact shall be continuously indicated in the control room.

3.0 Sequence of Events

On March 3, 1988, technicians were in the process of performing periodic maintenance surveillance procedure, MSP 12.01, P-LM 100A Containment Pressure Protection Channel I Monthly Test, when they noted that the HHCP bistable associated with Channel I was in the bypass position. Checks of the remaining three channels identified that the bistable associated with one additional channel (II) was also bypassed. The bistable switches for the two remaining channels (III and IV) were in the normal position. The technicians immediately notified plant operations personnel at 6:05 am on March 3. A brief investigation by control room operators could not identify any apparent reason for the bistables being in the bypass position (e.g., maintenance activities or surveillance testing), and both bistables were restored to normal at 6:31 am. Subsequent discussions determined that the condition was outside the design basis of the plant, since a single failure of either operable HHCP channel would render the CIB automatic actuation safety function inoperative. The licensee subsequently performed the MSPs for HHCP Channels III and IV and confirmed that both channels were operable. The inspector observed the performance of both MSPs.

Licensee investigation into the reason for the bistables being in the bypass position identified the following. On February 21, 1988, Unit 1 was in Mode 5 and performing outage recovery activities. Operations personnel were performing component restoration steps as outlined in Startup Checklist A (Cold Shutdown Conditions). At the same time, technicians were performing maintenance surveillance procedures. Startup Checklist A instructed plant operators to restore the bistable switches associated with each of the four HHCP protection channels to the normal position. Per the associated MSPs (1 per channel), the technicians were instructed to place the bistable associated with the HHCP channels in the defeat (bypass) position following completion of the containment pressure protection channel monthly tests if the plant was in Mode 5 or 6, and in the normal position if the plant was in Modes 1 through 4. The MSPs for Channels I and II were performed while still in Mode 5, hence, the bistables were left in the bypass position. The following sequence of events has been verified by the licensee and has been determined to be the apparent reason for having the two bistables in the bypass position:

4:05 pm, 2/21/88; Technicians completed MSP 12.04 on Channel IV

5:30 pm, 2/21/88; Technicians completed MSP 12.03 on Channel III

NOTE: At this point, all bistable switches were in the bypass position.

6:44 pm, 2/21/88; Operations personnel restored all four bistables to normal position per Startup Checklist A

1:09 am, 2/22/88; Technicians completed MSP 12.02 on Channel II

1:27 am, 2/22/88; Technicians completed MSP 12.01 on Channel I

NOTE: At this point, bistable switches for Channels I and II were in the bypass position. Channels III and IV were in the normal position.

2:00 am, 2/23/88; Unit 1 entered Mode 4 (Hot Shutdown)

7:36 am, 2/24/88; Unit 1 entered Mode 3 (Hot Standby)

6:05 am, 3/3/88; Condition of bistable switches for Channels I and II discovered

6:31 am, 3/3/88; Bistable switches restored by Operations following brief investigation.

The inspector asked whether there were provisions and requirements for channel checks that should have indicated the bypassed conditions. The inspector determined that no such capability or requirements existed; therefore, it appears that the bypassed channels were identified at the first available opportunity.

4.0 Control of Activities

4.1 Outage Recovery

The licensee determined that the cause of the event was the performance of the two MSPs following the performance of Startup Checklist A (Cold Shutdown conditions), for additional details, see Section 3. MSP procedure revisions have been completed to prevent a future similar occurrence. During the review of this event, the inspector determined that Startup Checklist B (to be completed when leaving Mode 5) contains a sign-off (Step 22) which states: The containment depressurization system is in service ready to function when required, by an automatic spray signal or by manual actuation (all high-high containment pressure comparators in NORMAL). The step was initialed as completed on February 22, 1988, during the day shift (8:00 a.m. - 4:00 p.m.). The licensee stated that Step 22 was included in Startup Checklist B only to confirm that the corresponding portion of Startup Checklist A had been completed.

The inspector identified several factors which contributed to th' event. The MSPs were very general in nature and, as the licens identified, did not address imminent Mode changes. The control o outage recovery activities displayed weakness in that different station groups were allowed to perform mutually opposing activities concurrently. In particular, Startup Checklist A was not performed subsequent to all planned maintenance activities, nor were the controls in place to prevent the subsequent switch repositioning performed during the MSPs. Startup Checklist B was found not to be an independent check of system status, but placed reliance on the completion of Startup Checklist A sections without either providing guidance on allowable elapsed time or controls on subsequent activities. The cumulative result of these contributory factors was a period of plant vulnerability to unidentified configuration changes which, in this case, led to operation outside the design bases. It should be noted that a minor change in the timing of the sequence of events (e.g., technicians complete Channel II testing two hours later) would have resulted in a complete loss of safety function (CIB automatic initiation) until discovery 8 days later.

4.2 Design Control

The Beaver Valley Unit 1 Control Room design, as documented in the FSAR and as originally licensed in 1976, included status lights on the control board which lit when each bistable associated with Containment Spray, high-high containment pressure (HHCP), was placed in the negated condition. These status lights were part of the design to implement the licensee's commitment to IEEE Standard 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations." That Standard requires that if the protective action of some part of the system has been defeated or bypassed, then that fact must be continuously indicated in the Control Room (see Section 2.2.2).

During the first refueling outage in 1980, the licensee implemented a station modification (DCP-94) to effect automatic ECCS switchover from the injection phase following a LOCA to the recirculation phase (RWST empty, recirculation from Containment sump). This design change was required by the Operating License. One portion of this major modification was to provide the Control Room operators with visual indication of the trip status of the Refueling Water Storage Tank (RWST) low-low level bistables. The control board lights used by DCP-94 were those originally used by the HHCP circuits to indicate that the bistables had been placed in the negated condition; no replacement HHCP bypassed indication was provided.

The inspector was unable to find any evidence that the safety significance of deleting HHCP bypassed indication had been evaluated. The FSAR, as updated in 1982 and amended annually thereafter, still contains text, table and figure references to the HHCP bypassed lights in Chapter 7. Licensee investigation concerning the history and design rationale of DCP-94 was still in progress at the close of the inspection. The licensee announced at the exit meeting plans to reinstall HHCP bypassed indication in the Control Room to correct this apparent Deviation from FSAR design commitments.

5.0 Corrective Actions

5.1 Immediate Corrective Actions

The licensee initiated several immediate corrective actions following identification of this event on March 3, 1988. Approximately twenty-six (26) minutes after the identification of the two bypassed HHCP channels the licensee restored the channels to the normal position. A walkdown of all reactor protection bistables was subsequently conducted, using Operating Manual Table 1-6, Reactor Protection Bistable Function and Location List. All bistables were found in the normal alignment. Additionally, plant operators walked down and verified the normal system alignment positions of specified ESF valves, switches, breakers and power supplies as per Special Operating Order No. 85-9, Unexplained or Malicious Degradation of Safeguards Operability. The licensee elected to implement this Special Operating Order since the reason for the two bistables being in the bypass position had not been explained. The ESF verification identified no components out of normal system alignment. The licensee also completed a review of all maintenance surveillance procedures to determine if additional procedural deficiencies existed with respect to protection bistables directed to be placed in off-normal positions that are dependent upon plant mode. No similar discrepancies of this type were identified.

5.2 Long-term Corrective Actions

The licensee is currently reviewing licensing documentation, drawings and applicable codes and standards to determine if additional deficiencies exist with respect to bypass indications on other system components. At the close of this inspection, one additional similar problem had been identified. Specifically, the automatic ECCS switchover feature installed in 1980 is also an energize-to-trip circuit, which uses a normal-bypass switch for testing/maintenance purposes. It appears that the required remote bypass indication (per IEEE Standard 279-1971) does not exist for this circuit.

6.0 Summary of Findings

Listed below are some issues to be discussed by the NRC and the licensee at an enforcement conference.

-- Adequacy of controls allowing work on safety related equipment during the approach to changes in plant Operating Mode.

-- Adequacy of safety evaluations for past station modifications involving safety related equipment.

-- Licensee plans to restore the CIB circuitry to meet original design commitments (i.e., HHCP bypassed indication).

-- Adequacy of other ESF circuits to meet IEEE Standard 279-1971 commitments.

7. Exit Interview

A summary of findings was presented to the licensee at the exit meeting on March 8, 1988. In addition to the issues listed in Detail 6 above, the following conclusions were discussed:

a. There was an apparent violation of Technical Specification 3.3.2 which specifies the minimum number of operable ESF actuation system instrumentation channels and which existed from February 24 to March 3, 1988. (50-334/88-12-01)

b. There was an apparent deviation from the FSAR commitment to IEEE Standard 279-1971 which requires indication of bypassed protective action functions in the Control Room. (50-334/88-12-02)