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ILLINOIS POWER COMPANY



CLINTON POWER STATION, P.O. BOX 678, CLINTON, ILLINOIS 61727

April 23, 1990

10CFR50.73

Docket No. 50-461

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Subject: Clinton Power Station - Unit 1
Licensee Event Report No. 90-005-00

Dear Sir:

Please find enclosed Licensee Event Report No. 90-005-00:
Failure to Consider Capability of Actuators Prior to Adjusting Actuators
to Achieve 110% of Design Thrust Results in Motor Operated Valves
Outside Their Design Capabilities. This report is being submitted in
accordance with the requirements of 10CFR50.73.

Sincerely yours,

A handwritten signature in cursive script that reads 'F. A. Spangenberg, III'.

F. A. Spangenberg, III
Manager - Licensing and Safety

RSF/rgw

Enclosure

cc: NRC Resident Office
NRC Region III, Regional Administrator
INPO Records Center
Illinois Department of Nuclear Safety
NRC Clinton Licensing Project Manager

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LICENSEE EVENT REPORT (LER)

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (F-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

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TITLE (4) Failure to Consider Capability of Actuators Prior to Adjusting Actuators to Achieve 110% of Design Thrust Results in Motor Operated Valves Outside Their Design Capabilities

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)		
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)	
0 3	1 6	9 0	9 0	0 0 5		0 3	0 4	2 3 9 0	NONE	0 5 0 0 0 0	
										0 5 0 0 0 0	

OPERATING MODE (9) 4

POWER LEVEL (10) 0 0 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §. (Check one or more of the following) (11)

20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below end in Text, NRC Form 366A)
20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
20.405(a)(1)(iv)	X 50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(ix)	

LICENSEE CONTACT FOR THIS LER (12)

NAME: T. R. Chitester, Director - Design and Analysis Engineering, extension 3981

TELEPHONE NUMBER: AREA CODE 2 1 7, NUMBER 9 3 5 - 8 8 8 1

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS
B	D A	I S V	L 2 0 0	Y	B	B D	I S V	L 2 0 0	Y
B	B O	I S V	L 2 0 0	Y					

SUPPLEMENTAL REPORT EXPECTED (14)

YES (If yes, complete EXPECTED SUBMISSION DATE) NO

EXPECTED SUBMISSION DATE (15)

MONTH	DAY	YEAR

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

On March 22, 1990, with the plant in COLD SHUTDOWN, a containment penetration was identified to have a motor operated valve (MOV) with an inadequate actuator on its inboard isolation valve 1FC007 and a potentially inadequate actuator on its outboard isolation valve 1FC008. The actuator problems were identified while investigating the failure of MOV 1FC007 to achieve minimum required closing thrust. Investigation determined that the actuator on MOV 1FC007 was not geared to supply the specified 110 percent of design thrust to operate 1FC007 and that 1FC008 could have the same problem. Further investigation identified six additional MOVs (one not required to be in service) with the same problem. The cause of this event is attributed to the failure to consider the design capabilities of the actuators prior to establishing diagnostic testing acceptance criteria at 110 percent of the design thrust and adjusting the actuators to achieve this criteria. Corrective action includes repairing/reworking the seven actuators so that they will deliver at least 110 percent of design thrust while operating within design limits, revising a maintenance procedure to ensure potential future degradation of MOVs is identified from MOVATS testing, and performing a design basis review of MOVs with active safety functions to assure that they will function under design basis conditions.

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DESCRIPTION OF EVENT

On March 22, 1990, with the plant in Mode 4 (COLD SHUTDOWN), at approximately 2200 hours, engineering identified that Fuel Pool Cooling and Cleanup (FC) system [DA] containment outlet inboard isolation valve [ISV] 1FC007 had an inadequate motor [MO] actuator and that, based on its similar design, FC system containment outlet outboard containment isolation valve 1FC008 had a potentially inadequate motor actuator. Subsequently, the Shift Supervisor determined that these conditions could have prevented isolation of penetration [PEN] LMC-53 and thus were reportable under the provisions of 10CFR50.73 (this determination was later revised as indicated in the Analysis of Event section of this LER).

On March 16, 1990, the plant was in Mode 4 with the reactor [RCT] at atmospheric pressure and approximately 130 degrees Fahrenheit and a planned maintenance outage (PO-3) was in progress. While operators were closing valve 1FC007 to restore the system from a tagout, the valve's motor thermal overload protection tripped. In response to the trip, operators initiated Maintenance Work Request (MWR) D13065 for investigation and repair of the motor operated valve (MOV). On March 20, during the investigation and repair activities, electrical maintenance technicians discovered that during closing of valve 1FC007, its actuator was approaching a stall condition just prior to opening of the torque switch.

An investigation identified that the last MOVATS test of MOV 1FC007 had been performed in accordance with MWR B26675 on January 20, 1986. At that time, the closing torque switch had been adjusted to 1.5, the maximum setting allowed by the limiter plate. At this setting, the closing thrust at torque switch trip was 6834 pounds which satisfied the minimum thrust requirements of 6026 pounds.

On March 21, technicians replaced the torque switch in the actuator of 1FC007 in accordance with MWR D13065 and retested the valve at the maximum closed torque switch setting of 1.5, but the valve failed to achieve the minimum required closing thrust. Technicians then requested that engineering revise the torque switch limiter plate size.

On March 22, at approximately 2200 hours, further investigation by engineering identified that the actuator on 1FC007 was inadequate in its current configuration for supplying the specified 110 percent of design thrust to operate valve 1FC007. The Limitorque actuator on 1FC007 is a model SMB-000 with a five foot-pound starting torque motor. The actuator has an overall gear ratio of 33.5:1, a heavy torque spring (number 024) and a torque switch limiter plate which allows a maximum setting of 1.5. The stem of valve 1FC007 has an outside diameter of 1.25 inches with a one-fourth inch pitch and a one-fourth inch lead thread. The installed torque spring and limiter plate combination would allow an actuator stem

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torque of sixty-five to seventy-five foot-pounds which would produce approximately 6075 to 7000 pounds of thrust (assuming a well lubricated stem), but would demand approximately 5.4 to 6.2 foot-pounds of torque from the motor. The actuator installed on valve 1FC007 was limited by its motor which stalls at about six foot-pounds. Engineering confirmed with Limitorque, the manufacturer of the actuator on valve 1FC007, that the actuator was not geared to deliver a stem torque in excess of sixty-five foot-pounds with the existing motor. Limitorque also expressed concern that the actuator of valve 1FC008 may be inadequate because it shares the same design data sheet as valve 1FC007 and is identical to the 1FC007 actuator except for the torque spring and limiter plate.

At approximately 2245 hours on March 22, engineering initiated Condition Report (CR) 1-90-03-128 to document the actuators. At approximately 2330 hours the SS was notified that the actuator on 1FC007 was inadequate and the actuator on 1FC008 was potentially inadequate.

On March 23, 1990, at approximately 0130 hours, the SS determined that the actuators were reportable under the provisions of 10CFR50.73. The SS directed that engineering 1) evaluate 10CFR Part 21 applicability of the condition, 2) determine if the valves would perform their design functions and 3) determine if the condition was applicable to other MOVs, and then directed that the actuators be corrected prior to plant entry into Mode 2 (STARTUP).

Engineering identified an initial scope of 245 active safety function MOVs that required investigation for similar actuators. The most recent MOVATS signatures for these MOVs were reviewed using motor current screening criteria found in Electric Power Research Institute (EPRI) Technical Repair Guidelines for the Limitorque Model SMB-000 Actuator, Report Number NP6229, Section 18.5.4. This criteria compares motor current achieved at valve closure with motor nameplate full load current. MOVs with Alternating Current (AC) motor current exceeding 300 percent of motor nameplate full load current at valve closure and MOVs with Direct Current (DC) motor current exceeding 400 percent of motor nameplate full load current at valve closure were identified as having potentially over-worked motors. This review, completed on March 28, identified thirteen additional MOVs as potentially degraded.

At approximately 1600 hours on March 28, the SS was notified of the thirteen potentially degraded MOVs. The SS requested that he be immediately informed if further investigation identified actual degraded MOVs.

On March 29, engineering performed an actuator sizing evaluation of the thirteen MOVs. Gear and stem data provided by the valve and actuator manufacturers was used to evaluate each of the thirteen MOVs. This data was used to calculate the motor torque required for valve closure and was

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then compared to the actuator motor's rated starting torque to determine if the motor was correctly sized. Based on the sizing evaluation results, seven of the thirteen valve actuators were found to be adequately sized. One MOV, 1E12-F052A, is part of the steam condensing mode of RHR which has been disabled and is not used at Clinton Power Station (CPS). The remaining five MOVs required rework to bring their calculated motor torque required for valve closure below the actuator motor's rated starting torque.

At 1727 hours, engineering notified the SS that the following five MOVs were inadequate in their current configuration for supplying the specified 110 percent of design thrust to operate the valves.

- 1E12-F037A - Residual Heat Removal (RHR)[BO]A to Containment Pool Cooling Shutoff
- 1E12-F037B - RHR B to Containment Pool Cooling Shutoff
- 1E32-F007 - Main Steam Isolation Valve (MSIV) - Leakage Control System (LCS)[BD] Outboard Bleed Valve
- 1E32-F008 - MSIV-LCS Outboard Depressurization Valve
- 1FC037 - FC Supply Containment Inboard Isolation Valve

No automatic or manually initiated safety system responses were necessary to place the plant in a safe and stable condition. No equipment or components were inoperable at the start of this event such that their inoperable condition contributed to this event.

CAUSE OF EVENT

The cause of this event is attributed to the failure of Illinois Power to consider the design capabilities of motor actuators prior to establishing diagnostic testing acceptance criteria at 110 percent of the design thrust and adjusting the actuators to achieve this criteria.

Valve actuators are generally supplied by the valve manufacturer as part of the motor operated valve assembly. The valve manufacturer may order the actuator either by specifying component characteristics or performance requirements. Regardless of which method was used to specify the actuator, each actuator has a range of capabilities dependent on the components utilized.

In response to NRC Bulletin 85-03, "Motor-Operated Valve Common Mode Failures During Plant Transients Due to Improper Switch Settings," Clinton Power Station management made a decision to use MOVATS MOV diagnostic equipment to determine appropriate adjustments for valve actuators and to ensure the adjusted actuators would produce the stem thrusts required to operate the valves under design conditions. Required stem thrusts were obtained from valve manufacturers. Following standard industry practice, the minimum required thrust for diagnostic testing was

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established at 110 percent of the required (design) stem thrust obtained from the valve manufacturer. The additional ten percent of required stem thrust allowed for measurement error and provided some margin for potential MOV degradation. During MOVATS testing, MOVs were adjusted to obtain at least 110 percent of required stem thrust.

During the investigation of this LER, IP recognized that the design thrust is sometimes at the upper end of an actuator's range of capabilities. The actuator's range of capability was not fully considered when the minimum required thrust criteria was established at 110 percent of design thrust.

CORRECTIVE ACTION

Engineering calculation number 330 was performed and Field Engineering Change Notice (FECN) 24705 was issued to provide a new gear configuration which would enable the actuator motors of valves 1FC007 and 1FC008 to deliver at least 110 percent of design thrust while operating within their design limits. MWR D15878 was issued to install the new gear configuration for 1FC008. MWR D13065 was revised to install the new gear configuration for 1FC007.

The torque switch setting for valve 1FC037 was reduced to bring the closing torque of its actuator motor below the rated starting torque while still meeting 110 percent of design thrust requirements. This work was performed in accordance with MWR D15033 and no design change was required.

To determine what modification was required to achieve at least 110 percent of design thrust within actuator design limits for valves 1E32-F007 and 1E32-F008, engineering calculation number 331 was performed. Since a gear change to the valves' actuators would result in slower valve stroke times which in turn would require a detailed review of the MSIV leakage control system control logic, larger motors were selected to eliminate the motor over-torque condition at valve closure. The larger motors were installed via MWRs D15035 for valve 1E32-F007 and D15034 for valve 1E32-F008 in accordance with Field Alteration 1SF004.

Engineering calculation number 332 was performed to identify the actuator modifications required to achieve at least 110 percent of design thrust within actuator design limits for valves 1E12-F037A and 1E12-F037B. This calculation determined that the required closing motor torque would be reduced below the starting torque of the present motors by revising the gear ratio. FECN 24715 has been issued to change the gear ratio. This change will be implemented on valves 1E12-F037A and 1E12-F037B in accordance with MWRs D15037 and D15036 respectively when parts become available. Pending receipt of parts, MWRs D15037 and D15036 will be scheduled to be completed prior to startup from the plant's second

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refueling outage (RF-2). These valves have been tagged closed pending repair of their actuators.

The motor current screening criteria (from EPRI Technical Repair Guidelines for the Limitorque Model SMB-000 Actuator, Report Number NP6229, section 18.5.4) that IP used for investigation of this event will be incorporated into the MOVATS diagnostic testing acceptance criteria of Procedure 8451.02, "MOV Signature Analysis". Addition of this screening criteria will ensure potential future degradation of MOVs is identified at MOVATS testing. Incorporation of this criteria is scheduled to be completed prior to the plant's second refueling outage (RF-2) currently scheduled to begin September 9, 1990.

IP will perform a design basis review of safety-related MOVs as identified in IP's response to Generic Letter 89-10, "Safety-Related Motor Operated Valve Testing and Surveillance," submitted to the Nuclear Regulatory Commission in letter U-601573, dated December 29, 1989. This design basis review will be performed for each MOV with an active safety function to assure that the MOVs will function correctly when subjected to design basis conditions.

The design basis review will be documented and will become the bases for the MOV program for IP. The design basis review will identify the following as a minimum:

- 1) Maximum differential pressures (DP) under which the valve is expected to perform for normal operation and abnormal events.
- 2) The stem thrust (or torque as applicable) required to position the valve under normal and maximum DP in the active safety direction(s) using analytical techniques standard to the industry.
- 3) The deliverable thrust (or torque) capabilities of the valve actuators in their current configuration in the active safety direction(s).

This review is scheduled to be completed by January 1, 1991.

ANALYSIS OF EVENT

This event is reportable under the provisions of 10CFR50.73(a)(2)(ii)(B) because the failure to consider design capabilities of motor actuators prior to establishing diagnostic testing acceptance criteria at 110 percent of the design thrust and adjusting the actuators to achieve this criteria, resulted in MOVs 1FC007, 1FC037, 1E32-F007, 1E32-F008, 1E12-F037A, and 1E12-F037B being in a condition that was outside their design capabilities. (1FC008 was determined to be acceptable as discussed below

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and therefore isolation of penetration LMC-53 would have occurred if required.)

Assessment of the safety consequences and implications of this event has determined that this event is not nuclear safety significant.

MOVs 1E32-F007 and 1E32-F008 are required to operate to assure that the MSIV-LCS system routes leakage past the outboard MSIVs to the correct process points. Failure of these valves to open prevents the outboard MSIV-LCS system from performing its function. However, the MSIV-LCS system consists of two independent subsystems (inboard and outboard) and each is capable of processing main steam leakage past the MSIVs. Therefore, leakage past the inboard MSIVs would still be processed by the inboard MSIV-LCS system. In the event 1E32-F007 and 1E32-F008 fail to close, MOVs 1E32-F006 and 1E32-F009 respectively could be used to provide isolation.

MOV 1FC037 is required to close to isolate the containment in the event of an accident. This valve also opens to supply the upper containment pools with cooling flow, however, this is not a safety function. In the event 1FC037 fails to close, containment isolation would be assured by closure of outboard isolation valve 1FC036.

Although calculations identify MOV 1FC008 as having an actuator which was inadequate, subsequent MOVATS diagnostic testing on March 28, 1990 confirmed that the actuator was capable of achieving its design basis closing thrust without motor stall or overheating (that is, the motor current was within acceptable limits). Therefore, this valve would have performed its active safety function of containment isolation based on the acceptable test results.

MOVs 1FC007 and 1FC008 are required to close to isolate the containment in the event of an accident. These valves also open to allow cooling water flow to the upper containment pool, however, this is not a safety function. In the event inboard containment isolation valve 1FC007 failed to close, containment isolation would be assured by closure of outboard containment isolation valve 1FC008.

MOVs 1E12-F037A and 1E12-F037B are required to close to isolate the containment in the event of an accident. During operation in Modes 1 (POWER OPERATION), 2 and 3 (HOT SHUTDOWN), these valves are normally closed. Additionally, if these valves were open and failed to close, containment isolation would be assured by closure of outboard containment isolation valves 1E12-F027A and 1E12-F027B respectively. During cold shutdown conditions, 1E12-F037A and 1E12-F037B may be opened to establish shutdown cooling flow to the containment pools (the spent fuel cooling assist mode of RHR). However, one of the two FC system trains normally provides adequate cooling of the upper containment and fuel building

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spent fuel pools. Therefore failure of 1E12-F037A and 1E12-F037B to open is not a safety concern.

The failure of MOV 1FC007 was discovered on March 16, 1990.

MOV 1FC007 was inoperable from the time of discovery that its actuator was inadequate on March 16, 1990.

MOV 1FC008 was initially determined to be potentially inoperable on March 22, 1990 but MOVATS diagnostic testing of the MOV on March 28, 1990 identified that this valve was actually operable.

MOVs 1E12-F037A, 1E12-F037B, 1E32-F007, 1E32-F008 and 1FC037 were determined to be inoperable at the time of discovery that their actuators were inadequate on March 29, 1990.

MOVs 1E12-F037A and 1E12-F037B are presently inoperable and have been tagged closed pending repair of their actuators. MOVs 1FC007, 1FC008, 1E32-F007, 1E32-F008, and 1FC037 were returned to service prior to startup from PO-3 on April 7, 1990.

ADDITIONAL INFORMATION

The motor actuators for the valves discussed in this LER were manufactured by Limatorque Corporation and are model number SMB-000 except for 1E12-F037A and 1E12-F037B which are model number SMB-1.

No LERs have been issued at CPS for similar events.

For further information regarding this event, contact T. R. Chitester, Director-Design and Analysis Engineering, at (217) 935-8881, extension 3981.