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ACCESSION NBR: 8802100329 DOC. DATE: 88/02/05 NOTARIZED: NO DOCKET #
FACIL: 50-331 Duane Arnold Energy Center, Iowa Electric Light & Pow 05000331

AUTH. NAME	AUTHOR AFFILIATION
SMITH, B. K.	Iowa Electric Light & Power Co.
HANNEN, R. L.	Iowa Electric Light & Power Co.
RECIP. NAME	RECIPIENT AFFILIATION

SUBJECT: LER 88-001-01: on 880111, HPCI turbine tripped due to steam supply high flow via isolation signal to steam inlet isolation valve. Caused by loose control room terminal connections. Sys restored from test mode. W/880205 ltr.

DISTRIBUTION CODE: IE22D COPIES RECEIVED: LTR 1 ENCL 1 SIZE: 7
TITLE: 50.73 Licensee Event Report (LER), Incident Rpt, etc.

NOTES:

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	AEOD/DOA	1	1	AEOD/DSP/NAS	1	1
	AEOD/DSP/ROAB	2	2	AEOD/DSP/TPAB	1	1
	ARM/DCTS/DAB	1	1	DEDRO	1	1
	NRR/DEST/ADS	1	0	NRR/DEST/CEB	1	1
	NRR/DEST/ELB	1	1	NRR/DEST/ICSB	1	1
	NRR/DEST/MEB	1	1	NRR/DEST/MTB	1	1
	NRR/DEST/PSB	1	1	NRR/DEST/RSB	1	1
	NRR/DEST/SGB	1	1	NRR/DLPQ/HFB	1	1
	NRR/DLPQ/QAB	1	1	NRR/DOEA/EAB	1	1
	NRR/DREP/RAB	1	1	NRR/DREP/RPB	2	2
	NRR/DRIS/SIB	1	1	NRR/PMAS/ILRB	1	1
	REG FILE 02	1	1	RES TELFORD, J	1	1
	RES/DE/EIB	1	1	RES/DRPS DIR	1	1
	RGN3 FILE 01	1	1			
EXTERNAL:	EG&G GROH, M	5	5	FORD BLDG HOY, A	1	1
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	NSIC MAYS, G	1	1			

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NRC Form 366 (9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/88

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Duane Arnold Energy Center (DAEC)	0 5 0 0 0 3 3 1	1 OF 0 6

TITLE (4): High Pressure Coolant Injection Inoperability Due to Test Circuit Problem with Subsequent Reactor Core Isolation Cooling Inoperability Due to Motor-Operator Bearing Failure

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 1	1 1	8 8	8 8	— 0 0 1 —	0 1	0 2	0 5	8 8	None	0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9): N

POWER LEVEL (10): 1 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)	[X] 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 and 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)	[ ] 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)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (AREA CODE)
Brian K. Smith, Technical Support Specialist	3 1 9 8 5 1 - 7 4 5 6

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
1	B N	2 0	L 2 0 0	Y					

SUPPLEMENTAL REPORT EXPECTED (14)

[ ] YES (If yes, complete EXPECTED SUBMISSION DATE) [X] NO

EXPECTED SUBMISSION DATE (15): MONTH | DAY | YEAR

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

On January 11, 1988 at 0405 hours, the plant was operating at 99.9% power with a scheduled High Pressure Coolant Injection (HPCI) Operability Surveillance Test Procedure (STP) in progress. At 0406 hours, the HPCI turbine tripped due to steam supply high flow via an isolation signal to the Steam Inlet Isolation valve. Subsequent investigation revealed loose control room panel terminal connections for the speed control potentiometer, used to control turbine speed during testing, which ultimately caused the turbine trip.

On the same day at 1540 hours, with the plant operating at 99.8% power, the Reactor Core Isolation Cooling (RCIC) Operability STP was being performed via the HPCI Inoperability Test. At 1543 hours, a RCIC Steam Supply isolation valve was shut per the STP. Coincidentally the valve motor-operator breaker tripped. Subsequent investigation revealed a broken motor-operator torque switch which caused the breaker to trip on overcurrent due to the torque switch's inability to trip and de-activate the valve closing circuit.

The appropriate Limiting Conditions for Operation (LCOs) and Emergency Action Level (EAL) were recognized and, upon restoration, exited. There was no effect on the safe operation of the plant.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	PAGE (3)
Duane Arnold Energy Center (DAEC)	0 5 0 0 0 3 3 1	8 8	— 0 0 1	— 0 0	0 2 OF 0 6

TEXT (If more space is required, use additional NRC Form 366A's) (17)

DESCRIPTION OF EVENTS:

On January 11, 1988 at 0405 hours, the plant was operating with the reactor at 99.9% power (1656 MWth). A scheduled High Pressure Coolant Injection (HPCI) (EIIS System BJ) Operability Surveillance Test Procedure (STP) was in progress with the HPCI turbine operating satisfactorily at 3525 rpm and 1190 PSIG discharge pressure. At 0406 hours, the HPCI turbine unexpectedly tripped due to steam supply high flow via an isolation signal to the Steam Supply Inlet Line Inboard isolation valve, a component of the Primary Containment Isolation System (PCIS) (EIIS System JM). A HPCI Steam Supply Inlet Line differential pressure switch sensed steam flow greater than 300% of rated HPCI turbine steam flow and tripped, shutting the isolation valve which in turn tripped the turbine as designed. The HPCI system was declared inoperable at 0406 hours and a seven day Limiting Condition for Operation (LCO) was entered in accordance with Technical Specification 3.5.D.2. At 0424 hours, the required HPCI System Inoperability Test was initiated to demonstrate operability of the Reactor Core Isolation Cooling (RCIC) System (EIIS System BN), the Automatic Depression System (ADS) (EIIS System SB), the Low Pressure Coolant Injection (LPCI) System (EIIS System BO), and the Core Spray (CS) System (EIIS System BM).

At 1540 hours the same day with the plant operating at 99.8% power (1655 MWth), the RCIC Operability STP was in progress in support of the HPCI System Inoperability Test. At 1543 hours, a RCIC Steam Supply isolation valve was shut per the STP. Coincident to shutting this valve, the valve motor-operator breaker tripped. It was decided to reperform that portion of the STP with a maintenance electrician monitoring the breaker operation for any abnormalities during the open and shut sequence. At 1659 hours, the same RCIC Steam Supply isolation valve was shut per the STP and again the valve motor-operator breaker tripped. At 1702 hours, RCIC was declared inoperable and a twenty-four hour LCO was entered in accordance with Technical Specification 3.5.E.2 due to HPCI and RCIC both being inoperable. An Emergency Action Level (EAL) A-11 was declared due to the twenty-four hour LCO.

CAUSE OF EVENTS:

The cause of the inadvertent trip of the HPCI turbine was the closure of the Steam Supply Inlet Line Inboard isolation valve due to a high steam flow condition. The root cause of the inadvertent trip appears to be loose control room terminal connections for the test potentiometer utilized to control HPCI turbine speed when in the test mode. The loose terminal connections were discovered on January 14 during performance of a subsequent corrective maintenance action to inspect the speed control circuitry. These connections are located behind a control room panel strut which limited access to the terminal strip. When performing the HPCI Operability STP, the HPCI turbine is slow started and controlled manually from the control room with the ten-turn speed control test potentiometer. The speed control test

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potentiometer is directly linked to the HPCI turbine governor control. It appears that the loose connections caused a momentary open-circuit in the test circuit for HPCI turbine speed control. An open-circuit would cause the closure of the HPCI turbine governor. When this momentary open-circuit cleared, the speed input from the test potentiometer to the governor control sensed and caused a sudden open response by the governor. The governor response while the HPCI turbine is at operating speed is very quick. This sudden increase in steam demand/flow resulted in a steam flow spike sensed by the differential pressure switch monitoring inlet line steam flow. The increase exceeded the switch's setpoint causing the trip closure of the Steam Supply Inlet Line Inboard isolation valve which in turn tripped the HPCI turbine as designed.

The cause of the RCIC valve motor-operator breaker tripping when performing the subsequent RCIC Operability STP was overcurrent. The intermediate cause was due to failure of the motor-operator torque switch to trip and de-activate the valve closing circuit. The torque switch responds to closure of the valve via a right-angled gear linkage with the motor-operator spring pack. The spring-pack is directly coupled with the motor-operator worm gear. When the motor-operator is energized to move the valve, the worm gear drives the spring pack which in turn drives the torque switch. The torque switch gear rotates on the spring pack thereby rotating the torque switch tripping mechanism. The tripping mechanism setpoint is set to de-activate the motor-operator closing circuit once the valve is on the closed seat.

The root cause of the breaker tripping was due to failure of the motor-operator spring pack bearing. The failure of the spring pack bearing caused misalignment and slight sagging of the spring pack. This in turn caused loosening of the right-angled gear mesh between the spring pack and the torque switch gear which allowed for slippage and gear-tooth jumping. Eventually, the slippage and gear-tooth jumping wound the torque switch tripping mechanism to where the torque switch gear roll-pin sheared on the valve stroke during performance of the RCIC Operability STP. The roll-pin shear rendered the torque switch inoperable. When the valve was subsequently closed, the torque switch was incapable of performing its intended function. Consequently, the motor-operator continued to drive the valve against the closed seat until the valve motor-operator breaker tripped due to excessive current.

ANALYSIS OF EVENTS:

The inadvertent trip of the HPCI turbine had no effect of the safe operation of the plant. Per Technical Specification 3.5.D.2, inoperability of the HPCI system is a seven day LCO, contingent upon the verified operability of RCIC, ADS, LPCI, and CS systems. The worst case effect of the HPCI inoperability with the reactor in the Run mode would be the loss of the ability to maintain reactor vessel water inventory after small line breaks that do not rapidly depressurize the vessel. ADS, in conjunction with the LPCI and CS systems, provides full redundancy for HPCI. Subsequent testing verified the operability of the ADS, LPCI, and CS systems. The speed control potentiometer utilized for HPCI turbine speed control during testing is automatically removed from the normal speed control circuitry when an actual HPCI initiation occurs, whether HPCI is in the test mode or in the normal, standby condition. The HPCI system would have operated as designed on receipt of an automatic initiation signal.

The failure of the RCIC valve motor-operator breaker was discovered during the RCIC Operability STP. This failure would not have prevented the RCIC system from initially operating as designed prior to identifying the failure. The means by which the RCIC motor-operator breaker failed would have allowed the RCIC system to initiate and operate until either an automatic or manual trip occurred which would shut this inlet steam line isolation valve. After this initial trip, RCIC would not have reinitiated due to the motor-operator failure as, once the valve had shut after initial operation, it would not have reopened to allow steam to be admitted to the turbine. Per Technical Specification 3.5.E.2, inoperability of the RCIC system is a seven day LCO, contingent upon the verified operability of HPCI. The worse case effect of RCIC inoperability with the reactor in the Run mode would be the loss of the ability to maintain reactor vessel water inventory during events that do not depressurize the vessel. HPCI would normally provide full redundancy for RCIC. With HPCI not verified operable, ADS, in conjunction with the LPCI and CS systems, would provide full redundancy for RCIC. At the time when the RCIC failure was discovered, ADS, LPCI, and CS had been previously verified operable. However, as subsequent testing verified, the HPCI system would have initiated and operated in the automatic mode.

RCIC was declared inoperable at 1702 hours on January 11. The HPCI Operability STP was started at 1725 hours. The HPCI turbine was slow started and controlled by the speed control test potentiometer twice. The test was completed satisfactorily at 1855 hours. Due to the previous inadvertent turbine trip, the HPCI Operability STP was modified for additional testing, providing for a quick start of the HPCI turbine which simulates an actual initiation of HPCI. At 2215 hours, this test was completed satisfactorily. The HPCI problem had been narrowed down to the test circuitry at this time. The HPCI system was declared operable at 2216 hours on January 11. The twenty-four hour LCO and the EAL were exited. The plant remained in the original LCO due to the continuing RCIC inoperability.

CORRECTIVE ACTIONS:

Immediate corrective actions for the HPCI turbine trip were to restore the system from the test mode, close the redundant steam supply isolation valve to assure steam inlet line isolation, and to commence the required HPCI System Inoperability Test. The Operations Shift Supervisor (OSS) instructed operations personnel to perform a walkdown

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inspection of the steam tunnel and HPCI room to check for steam leakage. No abnormalities were found. At 0620 hours on January 11, the HPCI trip/isolation was reset and the system returned to the normal, standby condition.

A corrective maintenance action was initiated to perform a calibration check of the differential pressure switch that caused the closure of the Steam Supply Inlet Line Inboard isolation valve. As-found readings for both indication and trip setpoint were well within tolerance and the instrument was returned to service. A second corrective maintenance action was initiated to install a test recorder to monitor the HPCI speed control signal at the HPCI speed control box. This test recorder was installed on January 11. During the three subsequent test runs performed on HPCI on that same day (as discussed previously), satisfactory results were obtained. A third corrective maintenance action was initiated on January 13 to inspect the speed control test circuitry to further investigate the inadvertent trip. This action was performed on January 14 and the loose control room panel terminal connections discovered and tightened.

Immediate corrective action for the RCIC valve motor-operator breaker trip was to reperform those portions of the RCIC Operability STP that affect the valve while having maintenance electricians monitor the breaker during open and shut operations. While reperforming those steps, the valve was shut and the breaker tripped again. The electricians noted current above the expected values when the valve was shut. On January 11, after the breaker was reset and notifications were made, the required HPCI Operability STP was started at 1725 hours. An initial inspection of the RCIC valve motor-operator later that day revealed the broken torque switch.

At 1909 hours on January 11, Operations initiated reducing reactor power in preparation for shutting down the reactor. At 2216 hours, HPCI was declared operable and the twenty-four hour LCO and EAL were exited.

After identification of the broken torque switch, Motor Operated Valve Analysis Testing System (MOVATS) was contacted to have personnel sent to support post-maintenance motor-operator testing. The valve motor-operator spring pack was removed for inspection on January 13. An inspection of the torque switch and spring pack by plant and MOVATS personnel was performed. It was decided to rebuild the motor-operator, perform an in-depth inspection of the spring pack, and to replace the torque switch. During the spring pack inspection, the spring pack bearing was found to be worn out-of-round. The spring pack was rebuilt with a new bearing. The motor-operator was rebuilt and the spring pack and a new torque switch installed. On January 14, MOVATS acceptance testing was performed on the valve and an acceptable thrust value was obtained. The overthrusting that resulted from the torque switch inoperability did not cause overstresses in the valve body. It was then

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

determined that a MOVATS test would be performed during the RCIC Operability STP. This would verify acceptable thrust when the valve was at operating temperature. MOVATS acceptance testing was performed on the valve when cycled per the STP. The RCIC Operability STP was completed satisfactorily, and after verifying that an acceptable thrust value was obtained, the RCIC system was declared operable on January 15 at 1827 hours and the seven day LCO was exited.

ADDITIONAL INFORMATION:

HPCI turbine trip: Investigation revealed no previous problems directly associated with the HPCI speed control test circuitry. Problems have occurred in the HPCI speed control system indicating the sensitivity of the speed control circuitry.

Affected Equipment: MO2238: HPCI Steam Supply Inlet Line Inboard Isolation valve; Mfg - Anchor Darling; Model - 10" Gate Valve

Differential Pressure Switch: HPCI Inlet Steam Pressure; Mfg - ITT Barton; Model - 288

Test Potentiometer: HPCI Speed Control Test Potentiometer; Mfg - Bourns; Type - 10 turn 5000 ohm +/-3%

RCIC valve motor-operator breaker trip: Investigation focused on the valve motor-operator. The associated torque switch has been replaced numerous times, twice due to broken roll-pins (once in 1977 - cause unknown and just recently in 1987 due to a high torque switch setting). Both times, satisfactory post- maintenance test results and acceptable thrust values were obtained. Discussion with MOVATS and the motor-operator vendor revealed few similar problems in the industry with spring pack bearings.

Affected Equipment: MO2404: RCIC Turbine Steam Inlet Isolation valve; Mfg - Anchor Darling; Model - 4" Globe Valve

Valve Operator: Operating Mechanism; Mfg - Limitorque; Model - SMB-0

Breaker: RCIC MO2404 Breaker; Mfg - ITE Circuit Breaker; Model - EF2-B015

These events are being reported pursuant with 10 CFR 50.73 (a)(2)(iv).

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Iowa Electric Light and Power Company
February 5, 1988
DAEC-88- 0125

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

Subject: Duane Arnold Energy Center
Docket No: 50-331
Op. License DPR-49
Licensee Event Report #88-001

Gentlemen:

In accordance with 10 CFR 50.73 please find attached a copy of the subject Licensee Event Report.

Very truly yours,

2/5/88

Rick L. Hannen
Plant Superintendent - Nuclear

RLH/BKS/go

cc: Mr. A. Bert Davis
Regional Administrator
Region III
U. S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, IL 60137

NRC Resident Inspector - DAEC

File A-118a

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Duane Arnold Energy Center • 3277 DAEC Road • Palo, Iowa 52324 • 319/851-7611

DCD|DMB

Iowa Electric Light and Power Company

January 15, 1988
NG-88-0001

Mr. A. Bert Davis
Regional Administrator
Region III
U.S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, IL 60137

Subject: Duane Arnold Energy Center
Docket No: 50-331
Op. License No: DPR-49
Final Report Pursuant to IE Bulletin 85-03

References:
1) Letter, R. McGaughy to J. Keppler, "Preliminary Response to IE Bulletin 85-03, Item e," NG-86-1475, May 28, 1986
2) Letter, R. McGaughy to J. Keppler, "Supplemental Response to IE Bulletin 85-03", NG-86-3044, October 1, 1986
3) Letter, R. McGaughy to H. Denton, "Integrated Plan, Schedule B Change", NG-86-4410, December 22, 1986

File: A-278, A-101a

Dear Mr. Davis:

Enclosed is our final report on the program carried out in response to IE Bulletin 85-03: Motor Operated Valve Common Mode Failures During Plant Transients Due to Improper Switch Settings.

Reference 2) responded to Bulletin item a, identified the HPCI and RCIC valves covered by the Bulletin, and stated the maximum expected differential pressures during opening and closing of those valves. The maximum expected differential pressures for seven of those valves have been revised. These changes are discussed in the enclosed report.

Implementation plans and schedules for completion of Bulletin items b, c and d were addressed in the References listed above. Verification of completion of these bulletin items is provided in our enclosed report.

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Summaries of the findings as to valve operability prior to any adjustments, in accordance with Bulletin Table 2 ("Suggested Data Summary Format"), are provided as Tables B through I to our enclosed report.

Please contact this office if there are any questions concerning this matter.

IOWA ELECTRIC LIGHT AND POWER COMPANY

BY William C. Rothert
William C. Rothert
Manager, Nuclear Division

Subscribed and sworn to Before Me on
this 15th day of January 1988.

Kathleen M. Furman
Notary Public in and for the State of Iowa

WCR/EFB/pjv*

Enclosure: Iowa Electric Light and Power Company Duane Arnold Energy Center (DAEC) Final Report Pursuant to IE Bulletin 85-03

cc: E. Borton
L. Liu
L. Root
R. McGaughy
R. Gilbert (NRC-NRR)
NRC Document Control Desk (Original)
NRC Resident Office
Commitment Control No. 860223, 860215. 860217, 860219-222, 860274

IOWA ELECTRIC LIGHT AND POWER COMPANY
DUANE ARNOLD ENERGY CENTER (DAEC)
FINAL REPORT PURSUANT TO IE BULLETIN 85-03

References:
1) Letter, R. McGaughy to J. Keppler, "Preliminary Response to IE Bulletin 85-03, Item e," NG-86-1475, May 28, 1986
2) Letter, R. McGaughy to J. Keppler, "Supplemental Response to IE Bulletin 85-03", NG-86-3044, October 1, 1986
3) Letter, R. McGaughy to H. Denton, "Integrated Plan, Schedule B Change", NG-86-4410, December 22, 1986

Bulletin Item

For motor-operated valves in the high pressure coolant injection/core spray and emergency feedwater systems (RCIC for BWRs) that are required to be tested for operational readiness in accordance with 10 CFR 50.55a(g), develop and implement a program to ensure that valve operator switches are selected, set and maintained properly. This should include the following components:

a. Review and document the design basis for operation of each valve. This documentation should include the maximum differential pressure expected during opening and closing the valve for both normal and abnormal events to the extent that these valve operations and events are included in the existing, approved design basis, (i.e., the design basis documented in pertinent licensee submittals such as FSAR analyses and fully-approved operating and emergency procedures, etc). When determining the maximum differential pressure, those single equipment failures and inadvertent equipment operations (such as inadvertent valve closures and openings) that are within the plant design basis should be assumed.

Iowa Electric Response to Item a

Iowa Electric's response to Bulletin item a was provided by References 1) and 2). The maximum expected differential pressures for all valves covered by the Bulletin were provided in Table 1A of Reference 2) and are reproduced in Table A of this report with the following revisions:

The maximum expected differential pressure for the High Pressure Coolant Injection System (HPCI) valve MO-2316 has been revised based on actual testing performed under Bulletin item c. The maximum expected differential pressure stated in Reference 2) was based on the fact that the upstream valve (previously designated as MO-2315) was a motor-operated gate valve. During the HPCI testing mode MO-2315 was used to throttle HPCI return flow to the condensate storage tank to obtain proper HPCI pump discharge flow at the required system pressure. Valve MO-2316 is normally closed and is opened only for HPCI system testing. If a signal is generated for HPCI to inject into the vessel during the performance of a system test, valves MO-2315 and MO-2316 simultaneously receive a signal to close. Due to the similar closing times for both valves, no credit was taken for pressure reduction by MO-2315 on MO-2316.

Subsequent to our Reference 2) report and prior to actual testing of MO-2316 under Bulletin item c requirements, valve MO-2315 was replaced with an air-operated throttle valve and its designation was changed to CV-2315. During HPCI testing, valve CV-2315 is approximately 56% closed in order to achieve system test pressure and flow conditions and valve MO-2316 is fully open. The calculated closing time for CV-2315 upon initiation of a close signal while in the HPCI testing configuration is 11 seconds. The closing time for valve MO-2316 is 20 seconds. As such, credit for pressure reduction across CV-2315 due to its closing prior to MO-2316 can be taken. Diagnostic signature traces and actual test observations showed that, when CV-2315 was fully closed, the differential pressure at MO-2316 upon closure was 0 psid and that the pressure subsequently built up to 680 psid over a 30 second period. This gradual pressure buildup is due to the design leakage characteristic of valve CV-2315 in its closed position. Therefore, the maximum expected differential pressure across MO-2316 reported in Reference 1) (1403 psid) is overly conservative. A differential pressure of 700 psid more accurately reflects the differential pressure value for valve MO-2316 and is still conservative. Therefore, thrust requirements for MO-2316 under maximum differential pressure conditions are based on this 700 psi differential pressure.

The differential pressures for valves MO-2426, MO-2510, MO-2511, MO-2512, MO-2516 and MO-2517 have been re-evaluated and revised from the values stated in Reference 2) to reflect new pump curve information and corrections to previously calculated values. The maximum expected differential pressures for valves MO-2426, MO-2510, MO-2511 and MO-2512 were revised because an overly conservative pump discharge pressure had been used in the original calculations. New RCIC pump curves were obtained subsequent to our Reference 2) submittal which more accurately reflect the actual pump shut-off head. Use of this more accurate information resulted in the revised pressures provided in Table A, attached. The maximum expected differential pressure for valves MO-2516 and MO-2517 have been revised based on correction of a mathematical error which added static head pressure rather than subtracting it. For these valves the differential pressure values stated in Reference 2) were higher than the values stated in Table A of this report. However, the torque switch settings and target thrust values (except for MO-2316) are based on the original Reference 2) differential pressures. This has provided additional conservatism for the calculated minimum required thrust and resulting torque switch setting.

<u>Bulletin Item</u>

b. Using the results from item a above, establish the correct switch settings. This shall include a program to review and revise, as necessary, the methods for selecting and setting all switches (i.e., torque, torque bypass, position limit, overload) for each valve operation (opening and closing).

Iowa Electric Response to Item b

Iowa Electric's response to item b was provided by Reference 1) and supplemented by References 2) and 3). The following provides an update of our previous responses to reflect the final status for item b:

The drawing E-200 has been revised to designate the 24 motor-operated valves (identified in Reference 1)) which are controlled by Iowa Electric's diagnostic signature trace program. Information is provided on the drawing such as the maximum expected differential pressure, required thrust, torque switch and bypass switch setting, and limit switch setting range. A caution note was also added stating that no switch settings for these valves may be changed without performance of an engineering evaluation.

A Design Guide, DGC-E108, was developed and implemented for calculating the required valve stem thrust to overcome maximum expected differential pressure (DP) and to determine the corresponding torque switch, limit switch, bypass switch and thermal overload switch settings. Iowa Electric evaluated the various available diagnostic signature trace methodologies and determined that the MOVATS, Inc. methodology is the most suitable methodology at this time for determining, establishing and maintaining correct switch settings for the valves identified in response to Bulletin 85-03. Design Guide DGC-E108 incorporates the MOVATS methodology for setting torque switches.

Iowa Electric previously had one maintenance procedure (Repair Procedure GPE-002) which provided guidance for disassembly, maintenance and switch setting for valve motor-operators manufactured by the Limitorque Co. This procedure has been superseded by a set of seven maintenance procedures which provide the instructions for disassembly, maintenance and adjustment of torque, bypass and limit switch settings for each of the specific types and sizes of Limitorque operators used at the Duane Arnold Energy Center (DAEC). The new maintenance procedures (VALVOP-L200-001 through -007) refer to the controlled drawing E-200 to identify which MOVs are subject to diagnostic signature trace testing requirements in order to maintain compliance with Bulletin 85-03.

A note was added to each MOV logic diagram (identified in Reference 1)) referencing the drawing E-200 for the appropriate torque switch setting.

The Iowa Electric administrative control procedure, Nuclear Generation Division Procedure NGD 103.175, titled "Second Level Review", has been revised to require an additional review of proposed design changes that could affect MOV switch settings. Procedure NGD 103.006, titled "Design Requirements Listing", has been revised to include an evaluation of any design change that affects MOV mechanical and electrical parameters that could impact MOV operability.

Bulletin Item

c. Individual valve settings shall be changed, as appropriate, to those established in item b, above. Whether the valve setting is changed or not, the valve will be demonstrated to be operable by testing the valve at the maximum differential pressure determined in item a above with the exception that testing motor-operated valves under conditions simulating a break in the line containing the valve is not required. Otherwise, justification should be provided for any cases where testing with the maximum differential pressure cannot practically be performed. This justification should include the alternative to maximum differential pressure testing which will be used to verify the correct settings.

NOTE: This bulletin is not intended to establish a requirement for valve testing for the condition simulating a break in the line containing the valve. However, to the extent that such valve operation is relied upon in the design basis, a break in the line containing the valve should be considered in the analyses prescribed in items a and b above. The resulting switch settings for pipe break conditions should be verified, to the extent practical, by the same methods that would be used to verify other settings (if any) that are not tested at the maximum differential pressure.

Each valve shall be stroked tested, to the extent practical, to verify that the settings defined in item b above have been properly implemented even if testing with differential pressure can not be performed.

Iowa Electric Response to Item c

Motor-operated valve testing was performed as delineated in Table 1B of Reference 2) using the MOVATS diagnostic signature trace methodology. In addition to the six valves identified for testing by hydrostatic differential pressure means an additional valve, MO-2316, was tested in both the opening and closing direction under differential pressure (DP) conditions. As a result, the maximum expected differential pressure for MO-2316 was changed in Table A to reflect actual conditions.

The justification for MOV operability is based on the MOVATS methodology, provided in the attached Appendix to this report, "Synopsis of U.S.N.R.C IEB 85-03 Program for DAEC" (MOVATS Synopsis). The MOVATS Synopsis includes the methodology for testing and supporting bases for justifying valve operability. MOVATS has demonstrated, based on an accumulated test data base, that their setpoint methodology is conservative and that valves set up based on the MOVATS settings are capable of functioning at maximum expected DP requirements with a 90% confidence band. The MOVATS test data base will continue to grow as MOVATS completes additional differential pressure testing at other plants. Expansion of the MOVATS test data base will provide the opportunity in the future to refine target thrust requirements based on individual valve type and size and statistical confidence bands.

For example, subsequent to adjusting the valves in accordance with the MOVATS methodology, MOVATS identified six valves that should have their torque switch settings increased to meet updated target thrust values. The MOVATS target thrust values for the six valves were increased because the MOVATS data base had expanded to a size which permitted validation of the MOVATS closing thrust equation using a statistical calculation method. The six MOVs identified were MO-2202, MO-2311, MO-2312, MO-2400, MO-2401 and MO-2511. The torque switches were adjusted on MO-2400 and MO-2511 to meet the new MOVATS target thrust requirements. The torque switch for MO-2401 was adjusted but not as high as MOVATS recommended to meet the MOVATS target thrust. The other three MOV torque switch settings were not adjusted to meet the updated MOVATS target thrust. Therefore, the present torque switch settings for MOVs MO-2401, MO-2202, MO-2311 and MO-2312 are such that less thrust is developed by the MOV in the closing direction than the thrust needed to meet the MOVATS 90% confidence band. The revised MOVATS confidence bands for these valves under reduced closing thrust conditions are as follows:

MOV	MOVATS Revised Confidence Band
MO-2202	80-85%
MO-2311	70-75%
MO-2312	70-75%
MO-2401	80-85%

Iowa Electric has decided not to adjust the torque switch settings to the updated values for these valves at this time based on the following:

1. The MOVATS test data base is increasing as MOVATS completes additional differential pressure testing at other plants for the same type and size valves. This increase in the MOVATS test data base may substantiate decreasing the MOVATS updated target thrust requirments for these valves back to their present thrust range.

2. These MOVs have operated properly during regular monthly system testing.

3. The MOVATS recommendations to increase the torque switch settings for these valves are very near or exceed the upper range of torque switch settings tested during initial MOVATS calibration. Therefore, further torque switch adjustment will not be performed until additional testing by MOVATS of each valve motor operator in the new torque switch setting range and engineering evaluation of the test results are complete. Testing and engineering evaluation will be performed during the next scheduled refueling outage.

4. The conservatism built into the MOVATS target thrust values, as demonstrated by actual testing results discussed below, provides additional confidence that these valves will function properly under maximum expected DP conditions.

MOVATS has been informed of our decision not to adjust these torque switches and has advised us orally that they believe these MOVs are operable with their present switch settings.

Iowa Electric performed opening DP tests on 6 MOVs as delineated in Table 1B of Reference 2) to verify that the MOVATS setpoints ensured MOV operability. These 6 DP tests demonstrated that each valve opens at less than the target thrust, which confirmed valve operability against test DP using the MOVATS methodology. In all cases, the test DP was equal to or greater than the maximum expected DP. Based on these tests and other test results contained in the MOVATS data base, Iowa Electric concluded that DP testing the remaining MOVs in Reference 2) was unnecessary. To demonstrate the conservatism of the MOVATS setpoint methodology, the following table compares the target thrust calculated by the MOVATS methodology as necessary to overcome test DP and the thrust actually measured during the DP testing for each of the 6 MOVs.

Comparison of Target Thrust to Actual Thrust for DP Pressure

MOV	Test DP,psid	MOVATS Target Thrust (lbs)	Measured Thrust (lbs) during DP testing
2202	1110	53157	13255
2312	1289	88994	45953
2318	1416	13238	1681
2322	123	11575	11015
2512	1417	11393	5150
2517	128	2470	1991

Bulletin Item

d. Prepare or revise procedures to ensure that correct switch settings are determined and maintained throughout the life of the plant.* Ensure that applicable industry recommendations are considered in the preparation of these procedures.

*This item is intended to be completely consistent with action item 3.2, "Post-Maintenance Testing (All Other Safety-Related Components)," of Generic Letter 83-28, "Required Actions Based on Generic Implications of Salem ATWS Events." These procedures should include provisions to monitor valve performance to ensure the switch settings are correct. This is particularly important if the torque or torque bypass switch setting has been significantly raised above that required.

Iowa Electric Response to Item d

The new MOV maintenance procedures (VALVOP-L200-001 thru -007) refer to drawing E-200, which is a controlled design document, to identify the MOVs which are in the diagnostic signature trace program. The new maintenance procedures also delineate what maintenance items impact the switch settings on the MOVs set up by diagnostic signature trace methods. In addition, preventative maintenance work packages have been prepared through the Preventative Maintenance Action Request (PMAR) program to ensure that these MOVs are inspected and maintained in their present configuration.

An additional surveillance test procedure, STP NS 13G002, which was not described in our previous responses (References 1), 2), and 3)), has been subsequently developed to specify the MOV inspection and lubrication to be performed each refueling outage. The motor control center (MCC) motor load test section of SMP-87-001 has been included in maintenance procedure GMP-TEST-011, which is used for routine and preventative maintenance of MOVs. Maintenance Engineering has been provided MCC motor load test threshold values and valve stem packing torque values to be used to determine the impact of any maintenance activity on MOV operability. The criteria for re-performing the diagnostic signature trace testing are available in the plant repair procedures (VALVOP-L200-001 thru -007) for Limitorque motor operators and in the diagnostic signature trace procedure (SMP-87-001). The criteria in these procedures define maintenance activities that could affect MOV operability and which could therefore require further diagnostic signature trace testing.

Bulletin Item

e. Within 180 days of the date of this bulletin, submit a written report to the NRC that: (1) reports the results of item a and (2) contains the program to accomplish items b through d above including a schedule for completion of these items.

Iowa Electric Response to Item e

The Iowa Electric response to item e was provided in Reference 1), 2) and 3).

Bulletin Item

f. Provide a written report on completion of the above program. This report should provide (1) a verification of completion of the requested program, (2) a summary of the findings as to valve operability prior to any adjustments as a result of this bulletin, and (3) a summary of data in accordance with Table 2, Suggested Data Summary Format. The NRC staff intends to use this data to assist in the resolution of Generic Issue II.E.6.1. This report shall be submitted to NRC within 60 days of completion of the program. Table 2 should be expanded, if appropriate, to include a summary of all data required to evaluate the response to this bulletin.

Iowa Electric Response to Item f

Tables B through I have been prepared in accordance with Table 2 to IE Bulletin 85-03, "Suggested Data Summary Format". The following listing identifies each attached table.

Table	Summary Information
A	Revised Valve Maximum Expected Differential Pressures
B	Valve Information
C	Operator Information
D	Valve Function and Maximum Expected DP
E & F	Valve Test DP and Switch Settings Prior to Adjustment
G	Final Switch Settings
H	As Found Valve Operability
I	Test Method Description/Justification
Appendix	MOVATS Synopsis of US NRC IEB85-03 Program for DAEC

TABLE A
Revised Valve Maximum Expected Differential Pressures

MAXIMUM EXPECTED DIFFERENTIAL PRESSURES FOR THE
DAEC 10 CFR 50.55a(g) INSERVICE TESTING PROGRAM
HPCI AND RCIC SYSTEM MOTOR-OPERATED VALVES

		MAXIMUM EXPECTED DIFFERENTIAL PRESSURE (PSID)	
Valve	Function	Valve Opening	Valve Closing
MO-2202	HPCI Steam Supply Valve	1110	1110
MO-2238	HPCI Inboard Steam Line Isolation	1110	1110
MO-2239	HPCI Outboard Steam Line Isolation	1110	1110
MO-2247	HPCI Lube Oil Cooling Valve	45	47
MO-2290A	HPCI/RCIC Exhaust Vacuum Breaker Isolation	0	43
MO-2290B	HPCI/RCIC Exhaust Vacuum Breaker Isolation	0	43
MO-2300	HPCI Pump Suction From CST	21	22
MO-2311	HPCI Outboard Pump Discharge	1289	1316
MO-2312	HPCI Inboard Pump Discharge	1289	1316
MO-2316	HPCI Full Flow Test/Redundant Shutoff	700*	700*
MO-2318	HPCI HPCI Minimum Flow Bypass	1416	1429
MO-2321	HPCI Inboard Pump Suction From Torus	123	45
MO-2322	HPCI Outboard Pump Suction From Torus	123	45
MO-2400	RCIC Inboard Steam Line Isolation	1110	1110
MO-2401	RCIC Outboard Steam Line Isolation	1110	1110
MO-2404	RCIC Steam Supply	1110	1110
MO-2405	RCIC Trip Throttle Valve	0	1110
MO-2426	RCIC Lube Oil Cooling	1357*	45
MO-2500	RCIC Pump Suction From CST	21	23
MO-2510	RCIC Minimum Flow Bypass	1354*	1428*
MO-2511	RCIC Outboard Pump Discharge	1277*	1312*
MO-2512	RCIC Inboard Pump Discharge	1277*	1312*
MO-2516	RCIC Inboard Pump Suction From Torus	122*	45
MO-2517	RCIC Outboard Pump Suction from Torus	122*	45

* Maximum expected differential pressures have been revised from those provided in our Reference 2 submittal.

TABLE B
Valve Information

Valve Component ID	Manufacturer	Type	Model	Size in.	Rating psig
MO-2202	Anchor	Gate	Flex Wedge	10	600
MO-2238	Anchor	Gate	Flex Wedge	10	900
MO-2239	Anchor	Gate	Flex Wedge	10	900
MO-2247	Velan	Globe	Standard	2	1500
MO-2290A	Velan	Gate	Solid Wedge	2	1500
MO-2290B	Velan	Gate	Solid Wedge	2	1500
MO-2300	Anchor	Gate	Flex Wedge	14	150
MO-2311	Anchor	Gate	Flex Wedge	12	600
MO-2312	Anchor	Gate	Flex Wedge	12	900
MO-2316	Anchor	Gate	Flex Wedge	8	600
MO-2318	Anchor	Globe	Standard	4	600
MO-2321	Anchor	Gate	Flex Wedge	14	150
MO-2322	Anchor	Gate	Flex Wedge	14	150
MO-2400	Anchor	Gate	Flex Wedge	4	900
MO-2401	Anchor	Gate	Flex Wedge	4	900
MO-2404	Anchor	Globe	Standard	4	600
MO-2405	Schutte&Koerting	Globe	Throttletrip	3	900
MO-2426	Velan	Globe	Standard	2	1500
MO-2500	Anchor	Gate	Flex Wedge	6	150
MO-2510	Velan	Globe	Standard	2	1500
MO-2511	Anchor	Gate	Flex Wedge	4	600
MO-2512	Anchor	Gate	Flex Wedge	4	900
MO-2516	Anchor	Gate	Flex Wedge	6	150
MO-2517	Anchor	Gate	Flex Wedge	6	150

TABLE C
Operator Information

Valve Component ID	Operator Manufacturer	Model	Motor RPM	Output Speed RPM
MO-2202	Limitorque	SMB-2	1900	45.8
MO-2238	Limitorque	SB-2	3400	72.9
MO-2239	Limitorque	SB-3	1900	43.3
MO-2247	Limitorque	SMB-000	1900	19
MO-2290A	Limitorque	SMB-000	1725	35.5
MO-2290B	Limitorque	SMB-000	1725	35.5
MO-2300	Limitorque	SMB-00	1900	20.2
MO-2311	Limitorque	SMB-3	1900	35.4
MO-2312	Limitorque	SMB-3	1900	31.6
MO-2316	Limitorque	SMB-0	1900	24.1
MO-2318	Limitorque	SMB-0	1900	24.2
MO-2321	Limitorque	SMB-00	1900	20.5
MO-2322	Limitorque	SMB-00	1900	20.2
MO-2400	Limitorque	SMB-00	1700	47
MO-2401	Limitorque	SMB-00	1900	46.4
MO-2404	Limitorque	SMB-0	1900	12
MO-2405	Limitorque	SMB-000	1900	35
MO-2426	Limitorque	SMB-000	1900	23.2
MO-2500	Limitorque	SMB-000	1900	39.8
MO-2510	Limitorque	SMB-00	1900	63.3
MO-2511	Limitorque	SMB-00	1900	72.3
MO-2512	Limitorque	SMB-00	1900	34.1
MO-2516	Limitorque	SMB-000	1900	47.5
MO-2517	Limitorque	SMB-000	1900	39.8

TABLE D
Valve Function and Maximum Expected DP

Valve Component ID	Valve Function	Maximum Expected DP Opening	Maximum Expected DP Closing
MO-2202	HPCI Steam Supply Valve	1110	1110
MO-2238	HPCI Inboard Steam Line Isolation	1110	1110
MO-2239	HPCI Outboard Steam Line Isolation	1110	1110
MO-2247	HPCI Lube Oil Cooling Valve	45	47
MO-2290A	HPCI/RCIC Exhaust Vacuum Breaker Isolation	0	43
MO-2290B	HPCI/RCIC Exhaust Vacuum Breaker Isolation	0	43
MO-2300	HPCI Pump Suction From CST	21	22
MO-2311	HPCI Outboard Pump Discharge	1289	1316
MO-2312	HPCI Inboard Pump Discharge	1289	1316
MO-2316	HPCI Full Flow Test/ Redundant Shutoff	700	700
MO-2318	HPCI HPCI Minimum Flow Bypass	1416	1429
MO-2321	HPCI Inboard Pump Suction From Torus	123	45
MO-2322	HPCI Outboard Pump Suction From Torus	123	45
MO-2400	RCIC Inboard Steam Line Isolation	1110	1110
MO-2401	RCIC Outboard Steam Line Isolation	1110	1110
MO-2404	RCIC Steam Supply	1110	1110
MO-2405	RCIC Trip Throttle Valve	0	1110
MO-2426	RCIC Lube Oil Cooling	1357	45
MO-2500	RCIC Pump Suction From CST	21	23
MO-2510	RCIC Minimum Flow Bypass	1354	1428
MO-2511	RCIC Outboard Pump Discharge	1277	1312
MO-2512	RCIC Inboard Pump Discharge	1277	1312
MO-2516	RCIC Inboard Pump Suction From Torus	122	45
MO-2517	RCIC Outboard Pump Suction From Torus	122	45

TABLES E and F
Valve Test DP and Switch Settings Prior To Adjustment

Valve Component ID	Test DP, psid	Torque Opening Setting (1)	Torque Closing Setting	Limit Opening %	Limit Closing % (2)	Bypass Opening % (3)	Bypass Closing % (4)
MO-2202	1110 (o)	3 1/2	3 1/2	97	na	na	6.5
MO-2238		2 3/4	2 3/4	100	na	na	10.4
MO-2239		1 1/2	1 1/2	72	na	na	3.4
MO-2247		2	2	81	na	na	27.0
MO-2290A		1 1/2	1	85	na	na	11.5
MO-2290B		1 1/2	1 1/2	93	na	na	9.4
MO-2300		2	1 1/2	96	na	na	2.1
MO-2311		2	2	100	na	na	8.8
MO-2312	1289(o)	2	2	94	na	na	3.0
MO-2316	700(o&c)	3 3/4	4	86	na	na	2.1
MO-2318	1416 (o)	3	3 1/2	95	na	na	8.1
MO-2321		1 1/2	1 1/2	95	na	na	5.2
MO-2322	123(o)	1	1	93	na	na	2.3
MO-2400		2	1	92	na	na	3.1
MO-2401		2	2	94	na	na	0.7
MO-2404		1 1/2	1 1/2	83	na	na	3.7
MO-2405		2	3	92	na	na	8.8
MO-2426		1	1	98	na	na	14.8
MO-2500		2	1 1/4	96	na	na	2.5
MO-2510		1	1	95	na	na	17.6
MO-2511		2	1	100	na	na	4.1
MO-2512	1417(o)	1 1/2	1	87	na	na	6.3
MO-2516		2	2	96	na	na	2.1
MO-2517	128(o)	3 1/2	4	97	na	na	2.6

(o) - opening direction
(c) - closing direction

(1) This is provided for information only. The opening torque switch is jumpered out, therefore the opening torque applied is the maximum the operator is capable of producing.

(2) Not used on these valves; the operator is controlled by the closing torque switch.

(3) The opening torque switches are jumpered out for all valves listed. Therefore no adjustment or setting is applicable to the torque switch bypass switches for these valves.

(4) Closing torque switch bypass has no significant affect because there is no hammer blow or thrust rise when the valve is in the open position.

TABLE G
Final Switch Settings

Valve Component ID	Torque (1) Opening Setting	Torque Closing Setting	Limit Opening %	Limit Closing	Bypass Opening	Bypass Closing %(2)
MO-2202	na	3	91	na	na	6.5
MO-2238	na	2 1/2	92	na	na	10.4
MO-2239	na	1 1/2	92	na	na	3.4
MO-2247	na	3	81	na	na	27.0
MO-2290A	na	1	85	na	na	11.5
MO-2290B	na	1	93	na	na	9.4
MO-2300	na	2 1/2	95	na	na	2.1
MO-2311	na	2	91	na	na	8.8
MO-2312	na	2 1/2	94	na	na	3.0
MO-2316	na	2 3/4	91	na	na	2.1
MO-2318	na	2 3/8	95	na	na	8.1
MO-2321	na	1 1/2	95	na	na	5.2
MO-2322	na	1	93	na	na	2.3
MO-2400	na	1 1/2 (3)	92	na	na	3.1
MO-2401	na	2 1/4 (3)	94	na	na	0.7
MO-2404	na	2 5/8	83	na	na	3.7
MO-2405	na	3	92	na	na	8.8
MO-2426	na	3 1/2	94	na	na	14.8
MO-2500	na	2	94	na	na	2.5
MO-2510	na	1 3/4	95	na	na	17.6
MO-2511	na	1 3/4 (3)	92	na	na	4.1
MO-2512	na	2 1/2 (3)	92	na	na	6.3
MO-2516	na	1	94	na	na	2.1
MO-2517	na	3 1/2	94	na	na	2.6

Notes:

(1) Torque switch is jumpered out in the opening direction.

(2) Same as the as-found condition; no adjustments made.

TABLE G (Continued)

Notes (Continued):

(3) On October 27, 1987 MOVATS informed IELP that the MOVATS data base had expanded to the size that permits MOVATS to perform statistical analysis to assure that the thrust requirements meet the 90% confidence band. In 4 cases MOVATS recommended that the torque switch settings be raised to assure MOV operability. The MOVs affected were MO-2400, MO-2401, MO-2511 and MO-2512. With the revised DP from Table D taken into account, MOVATS determined that the torque switch setting for MO-2512 was adequate. The three other MOV torque switch settings were adjusted as follows:

MOV	Previous TSS	Final TSS
MO-2400	1 1/4	1 1/2
MO-2401	2	2 1/8
MO-2511	1 1/2	1 3/4

On November 13, 1987, MOVATS informed IELP that the torque switch settings for MOVs MO-2202, MO-2311, and MO-2312 should also be increased. IELP's engineering evaluation concluded that additional MOVATS testing of these valves would be required before the torque switches can be adjusted higher.

TABLE H
As-Found Valve Operability

Valve Component ID	As-Found Thrust Capability Notes	Other Findings That Could Affect As-Found Operability Notes	As-Found Operability Conclusion
MO-2202	2	7	Operable
MO-2238	1,2	8	Operable
MO-2239	1,2	9	Operable
MO-2247	1,2	10	Operable
MO-2290A	1	6	Operable
MO-2290B	1	6	Operable
MO-2300	1,2	11	Operable
MO-2311	3	12	Operable
MO-2312	3	13	Operable
MO-2316	1,2	14	Operable
MO-2318	1,2,4	15	Operable
MO-2321	1,2	6	Operable
MO-2322	1,2	6	Operable
MO-2400	1,2	16	Operable
MO-2401	1,2	17	Operable
MO-2404	1,2	18	Operable
MO-2405	1,2	6	Operable
MO-2426	1	19	Operable
MO-2500	1	6	Operable
MO-2510	5	20	Operable
MO-2511	2	21	Operable
MO-2512	2	22	Operable
MO-2516	1,2	23	Operable
MO-2517	1,2	6	Operable

Notes to Table H:

1 As-found thrust met or exceeded the MOVATS target thrust.

2 As-found thrust met or exceeded the original Limitorque design thrust requirement.

3 As-found closing thrust was less than the original Limitorque design thrust. Due to the valve's function in the HPCI system, it is not necessary for this valve to close at maximum expected DP during HPCI injection. This valve did close properly during regular monthly HPCI system testing.

TABLE H (Continued)

4 As-found thrust was 20,400 lb. The original Limitorque design thrust was 20,500 lb. This is considered within the range of instrument accuracy and repeatability.

5 The as-found thrust was less than the original Limitorque design thrust. As-found thrust was 3440 lb. Limitorque required thrust was 4862 lb. However, the valve functioned properly during monthly STPs when it was required to open and close during normal RCIC pump startup and shutdown. Therefore, this valve was operable during normal monthly system testing.

6 No adverse valve conditions affecting operability were found. The as-found thrust was adequate to meet the original Limitorque design thrust and thus the valve is considered operable as-found.

7 MO-2202 spring pack was replaced due to a spring pack gap of 0.586 inch. However, the valve, in the as-found condition, developed adequate thrust with this gap to meet the original Limitorque design thrust and is therefore considered operable.

8 MO-2238 was found backseating with 42500 lbs thrust. The valve manufacturer's analysis concluded that the backseat area should be inspected during the next refueling outage. The valve developed adequate thrust to meet the original Limitorque design thrust and thus is considered operable in the as-found condition. The backseat area will be inspected during the next refueling outage per the valve manufacturer's recommendation.

9 MO-2239 was found with a spring pack gap of 0.017 inch, slight corrosion of the torque switch and limit switch contacts. The spring pack gap and slight corrosion were considered insignificant and having no impact on valve operability. MO-2239 developed adequate thrust to meet the original Limitorque design thrust and thus is considered operable in the as-found condition.

10 MO-2247 spring pack was replaced due to a spring pack gap of 0.390 inch. The drive sleeve bevel gear was found chipped and was replaced. MO-2247 developed adequate thrust to meet the original Limitorque design thrust and thus is considered operable in the as-found condition.

11 MO-2300 spring pack was replaced due to a spring pack gap of 0.302 inch. The valve still developed adequate thrust to meet the original Limitorque design thrust and thus is considered operable in the as-found condition.

TABLE H (Continued)

12 MO-2311 spring pack was replaced due to a spring pack gap of 0.797 inch. MO-2311 was found backseating with a thrust of 21266 lbs. The valve manufacturer's analysis concluded that the backseating area should be inspected during the next refueling outage. In the as-found condition MO-2311 developed 35100 lb. of thrust in the closing direction; the original Limitorque design thrust is 36000 lb. This valve did open and close properly during regular monthly HPCI system testing. This valve has no active safety function in the closing direction, therefore this valve is considered operable in the as-found condition. The backseat area of MO-2311 will be inspected during the next refueling outage per the valve manufacturer's recommendation.

13 MO-2312 spring pack was replaced due to a spring pack gap of 0.798 inch. The valve developed 18600 lbs of thrust in the closing direction; the original Limitorque design thrust is 32500 lb. MO-2312 is required to close for system isolation. MO-2312 opened and closed properly during regular monthly HPCI system testing. Therefore this valve is considered operable in the as-found condition.

14 MO-2316 spring pack was replaced due to a spring pack gap of 0.629 inch. The valve was found with a corroded torque switch and a broken bolting ear on the motor end bell. The torque switch and the motor end bell were replaced. The valve developed adequate thrust to meet the original Limitorque design thrust and therefore is considered operable in the as-found condition.

15 MO-2318 spring pack was replaced due to a spring pack gap of 0.170 inch. This valve was found with a loose stem nut lock nut which was tightened and staked. The valve developed adequate thrust to meet the original Limitorque design thrust and therefore is considered operable in the as-found condition.

16 MO-2400 was found with a loose stem nut lock nut which was tightened and staked. The valve developed adequate thrust to meet the original Limitorque design thrust and therefore is considered operable in the as-found condition.

17 MO-2401 spring pack was replaced due to a spring pack gap of 0.316 inch. The valve developed adequate thrust to meet the original Limitorque design thrust and therefore is considered operable in the as-found condition.

TABLE H (Continued)

18 MO-2404 spring pack was replaced due to a spring pack gap of 0.629 inch. The valve in the as-found condition was overthrusting with 44000 lb. This condition was analyzed by the valve manufacturer and another engineering company; both concluded that the operator could withstand another 33 cycles. This is considered adequate for operation until a replacement operator is available. The valve manufacturer has recommended replacement of the stem clamp key and the yoke clamp and inspection of the stem keyway, the valve disc and valve yoke. This inspection and replacement are planned for the next scheduled refueling outage. The torque switch was replaced because it was found with a bad roll pin. The valve developed adequate thrust to meet the original Limitorque design thrust and, therefore, is considered operable in the as-found condition.

19 MO-2426 spring pack was cleaned and a gap of 0.016 inch was reduced to 0.003 inch. Gaps of 0.016 are not detrimental to MOV operation but are adjusted where possible to optimize operator performance. Spring pack gaps of 0.005 and less are acceptable. Gaps of up to 0.015 inch are accepted when the gap can not be reduced by adjustment. The valve developed adequate thrust to meet original Limitorque design thrust and therefore the valve is considered operable in the as-found condition.

20 MO-2510 spring pack was replaced due to a spring pack gap of 0.321 inch. The valve in the as-found condition developed less thrust than the original Limitorque design thrust. However, the valve functioned properly during regular monthly RCIC testing. Therefore, the valve is considered operable in the as-found condition.

21 MO-2511 developed adequate thrust to meet the original Limitorque design thrust and thus is considered operable in the as-found condition. The valve was also found backseating with 1717 lb. of thrust and with a loose stem nut lock nut. The valve manufacturer evaluated the backseating condition and determined that adjustment of the limit switch to stop the backseating was the only action needed. The limit switch was adjusted as part of the maintenance program. No inspection of the backseat area was required. The stem nut lock nut was tightened and staked.

TABLE H (Continued)

22 MO-2512 developed thrust adequate to meet the original Limitorque design thrust, therefore this valve is considered operable in the as-found condition.

23 MO-2516 developed adequate thrust to meet the original Limitorque design thrust, therefore this valve is considered operable in the as-found condition. The spring pack had grease in it and the drive sleeve bevel gear was worn. The spring pack was cleaned and the drive sleeve bevel gear was replaced.

TABLE I
Test Method Description/ Justification

Valve Component ID	Test Method Codes Opening	Closing	Justification Notes
MO-2202	S,D,HP	NASF; S,D	4, 2, 3
MO-2238	NASF; S,D	S,D	1, 3
MO-2239	NASF; S,D	S,D	1, 3
MO-2247	S,D	S,D	1, 3
MO-2290A	NASF; S,D	S,D	1, 3
MO-2290B	NASF; S,D	S,D	1, 3
MO-2300	NASF; S,D	S,D	1, 3
MO-2311	NASF; S,D	NASF; S,D	5, 3
MO-2312	S,D, HP	S,D	5, 2, 3
MO-2316	NASF,S,D,OP	NASF,S,D, OP	1, 2, 3
MO-2318	S,D,HP	S,D	1, 2, 3
MO-2321	S,D,TT2322	S,D	1, 3
MO-2322	S,D,HP	S,D	1, 2, 3
MO-2400	NASF; S,D	S,D	1, 3
MO-2401	NASF; S,D	S,D	4, 3
MO-2404	S,D, TT2318	S,D	1, 3
MO-2405	NASF; S,D	S,D	1, 3
MO-2426	S,D	S,D	1, 3
MO-2500	NASF;S,D	S,D	1, 3
MO-2510	S,D	S,D	1, 3
MO-2511	NASF;S,D	S,D	1, 3
MO-2512	S,D,HP	S,D	1, 2, 3
MO-2516	S,D,TT2517	S,D	1, 3
MO-2517	S,D,HP	S,D	1, 2, 3

Notes to Table I

S Valve stroke test

D Diagnostic Signature Trace Testing and Analysis

HP Hydrostatic Pressure Testing In Opening Direction

OP Operational Pressure Testing In Closing and Opening Directions

TT Type Test to Another Valve (e.g.,TT2318=type testing to valve MO-2318)

NASF No Active Safety Function

1 Torque switch setting develops thrust greater than MOVATS target thrust requirement for 90% confidence band that these valves will function at maximum expected differential pressure in the closing direction.

TABLE I (Continued)

2 Present torque switch setting is capable of developing thrust greater than the thrust required to overcome differential pressure as measured at valve opening and/or closing during actual DP testing.

3 Torque switch is jumpered out of control circuit. Therefore these operators will develop thrust up to the operator design capability in order to open the valve.

4 Torque switch setting develops thrust greater than MOVATS target thrust requirement for 80 to 85% confidence band that these valves will function at maximum expected differential pressure in the closing direction (reference Iowa Electric response to Item c, page 4 of this Final Report).

5 Torque switch setting develops thrust greater than MOVATS target thrust requirement for 70 to 75% confidence band that these valves will function at maximum expected differential pressure in the closing direction (reference Iowa Electric response to Item c, page 4 of this Final Report).