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New York Power
Authority

Ralph E. Beedle
Executive Vice President
Nuclear Generation

August 1, 1991
JPN-91-039

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Stop P1-137
Washington, D.C. 20555

SUBJECT: James A. FitzPatrick Nuclear Power Plant
Docket No. 50-333
Generic Letter 89-10, Supplement 3
Response to Request for Additional Information

Reference: NRC letter, B. C. McCabe to R. E. Beedle, dated June 26, 1991, "Request for Additional Information Re: Generic Letter 89-10, Supplement 3: Consideration of the Results of NRC-Sponsored Tests of Motor-Operated Valves."

Dear Sir:

The NRC requested additional information concerning motor operated valves at the FitzPatrick plant in the referenced letter. Attachment 1 provides the Authority's response. Attachments 2 through 4 provide supplemental information.

If you have any further questions, please contact Mr. J. A. Gray, Jr.

Very truly yours,

Ralph E. Beedle
Executive Vice President
Nuclear Generation

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ATTACHMENT 1 TO JPN-91-039

GENERIC LETTER 89-10, SUPPLEMENT 3
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

New York Power Authority

JAMES A. FITZPATRICK NUCLEAR POWER PLANT
Docket No. 50-333

Attachment 1 to JPN-91-039

NRC Question 1: Identify any modifications (e.g., torque switch setting adjustments, gearing changes, or motor/actuator replacement) for each MOV within the scope of Supplement 3 to GL 89-10 since June 1990 or planned for the future.

NYPA Response: As stated in the Authority's Supplement 3 response (Reference 1), the torque switches for all motor-operated valves (MOVs) within the scope of Supplement 3 are now set at the manufacturer's recommended maximum setting. The Authority reset one of these MOVs (13MOV-16) to this maximum setting (2.5 from 2.0) during the March 1991 Maintenance Outage. Torque switches for all other MOVs within the scope of Supplement 3 had been reset to the manufacturer's recommended maximum setting before June 1990. Attachment 2 shows the current (maximum design conditions) torque switch settings for the affected operators.

As discussed in Reference 1, modification F1-90-197 will replace the actuator and certain valve components for 13MOV-16. This modification will upgrade 13MOV-16. It will also address a previously identified deficiency (Reference 2) in the design full stroke time. No other modifications or adjustments are currently planned.

NRC Question 2: Provide valve, actuator, and motor type and size, torque switch settings (in pounds thrust if known), and information necessary to confirm motor adequacy for each MOV within the scope of Supplement 3 to GL 89-10.

NYPA Response: Attachment 2 (14 pages) provides actuator sizing analysis spread sheets for the Supplement 3 MOVs. The Authority performed analyses for both design conditions and postulated high energy line break (HELB) conditions. This information is also summarized in Tables 1, 2, and 3 of Reference 1. All of the affected actuators are presently set at the maximum torque switch setting determined by using the pull-out efficiency. This is in accordance with Limitorque Corporation recommendations (References 3 and 4).

NRC Question 3: Provide justification for using 100% voltage in evaluating MOV capability.

NYPA Response: As stated in Note 2 of Tables 1, 2, and 3 of Reference 1, the 100% voltage capability assumption applies only to DC powered MOVs for postulated HELB conditions (not design conditions). Justification for this assumption was provided in the note as follows:

> The DC MOV motors were designed to operate at a reduced voltage of 105 VDC, or 84% of nominal bus voltage. The 105 VDC limit was based on the results of the station battery design duty cycle calculations and effectively considered the available voltage two hours after a design basis loss-of-coolant accident

concurrent with a loss of battery charging capability. Under HELB conditions, nominal DC voltage would be available to affect line isolation.

The AC powered MOVs were evaluated at + or - 10% of nominal voltage which was the original equipment specification requirement. According to the FitzPatrick plant Final Safety Analysis Report (FSAR) Section 8.6 (Reference 5), the minimum 600 V emergency bus voltage is 535 volts. This is about 93% of the MOVs' rated voltage of 575 volts. This allows an additional 3%, or about 17.5 volts, of line loss from the bus to the MOV motor terminals to reach the 90% level. Voltage drop calculations performed for Modification F1-89-096 (Reference 8) determined that this allowance (17.5 volts) will not be exceeded for all safety-related AC MOVs.

Limitorque SEL-3 (Reference 6) indicates that no reduced voltage factor is required for 90% of rated voltage. Evaluation without a reduced voltage factor is, therefore, justified. As required by Generic Letter 89-10, Item e, MOV capabilities with degraded voltage and cable voltage drop will be verified.

NRC Question 4: In Information Notice 90-72 (November 28, 1990), "Testing of Parallel Disc Gate Valves in Europe," the NRC staff indicates that foreign utilities are using a valve factor of 0.4 for a new German design of parallel disc gate valve. Describe the results of your evaluation of this information notice.

NYPA Response: The Authority reviewed Information Notice 90-72 in accordance with Plant Standing Order (PSO) 28 for Industry Operating Experience Review (OER). OER 900484 (Reference 7) included Reference 1 as an attachment. It concluded that no immediate safety concern existed because of "leak before break" considerations. The review noted that Anchor/Darling parallel double disc gate valves were not tested in the test program discussed in Information Notice 90-72. The OER added that a final assessment of the required valve factor will be made when the results of the proposed Anchor/Darling test program (Question 5) are available.

NRC Question 5: Describe the Anchor/Darling testing program and its schedule for completion.

NYPA Response: Attachment 3 provides a summary description of the Anchor/Darling Valve Co. blowdown test program including a tentative schedule. This information was obtained from an Anchor/Darling representative on July 24, 1991.

NRC Question 6: The safety assessment prepared by the NRC staff in conjunction with the development of Supplement 3 to GL 89-10 supports continued operation for 18 months or one refueling outage to complete any necessary MOV modifications. Provide a safety assessment to support continued operation if any corrective action is scheduled for completion beyond that date.

NYPA Response: Attachment 4 is the Plant Specific Safety Assessment prepared for Item 1 of Generic Letter 89-10, Supplement 3. It notes specific features including parallel double disc gate valves and the 1 inch warming line for the High Pressure Coolant Injection (HPCI) turbine steam supply. The 1 inch bypass warming line permits the outboard HPCI steam supply isolation valve (23MOV-16) to be normally closed. This avoids the need for 23MOV-16 to close under HELB conditions and reduces the flow and differential pressure that the inboard valve (23MOV-15) would experience. Due to the smaller size of the RWCU and RCIC lines (6 inches and 13 inches, respectively), margin (above design valve disc factor) is available at the maximum torque switch setting as shown in Attachment 2. These features and design considerations provide additional safety assurance beyond that of the "standard" BWR design (the subject of the generic assessments performed by the BWROG and the NRC staff). The NRC sponsored testing program, which is the subject of Supplement 3, focused exclusively on flexible wedge gate valves. As noted in Reference 1 and Attachment 4, none of the Supplement 3 valves at the FitzPatrick plant are flexible wedge gate valves. Therefore, the Authority considers that the Plant-Specific Safety Assessment provides justification for operation until the need for further modifications can be determined.

NRC Question 7: What practice is employed in the use of torque switch bypass and thermal overload protection.

NYPA Response: For the open torque switch, the Authority uses the bypass for approximately the first 33% travel. The close torque switch is not bypassed for any significant amount of valve travel. The thermal overloads are set for 300% of the full rated current (run current) of the actuator motor. This effectively prevents thermal overload trips from stopping motor operation.

NRC Question 8: How have you addressed the rate of loading phenomenon in MOV sizing and torque switch settings.

NYPA Response: The rate of loading phenomenon is still an area of research. Currently, there is no clear understanding of when this phenomenon exists or how to determine its magnitude. However, the FitzPatrick plant uses a diagnostic system (VOTES) that can detect this phenomenon during flow/differential pressure tests. The Authority will consider the rate of loading phenomenon if it is detected during these tests. When it becomes available, the Authority also plans to use guidance provided by appropriate industry organizations (Electrical Power Research Institute, Motor-Operated Valve Users Group, Limitorque, etc.).

REFERENCES

1. NYPA letter JPN-91-013, R. E. Beedle to NRC Document Control Desk, "Generic Letter 89-10, Supplement 3, Item 2, HPCI, RCIC and RWCU MOVs," dated April 17, 1991.

2. NYPA, PORC Meeting Minutes, dated June 27, 1990.

3. Notes of telecon, P. Swinburne, NYPA and Mark Smith, Limitorque Corp., dated April 9, 1991.

4. Limitorque Corporation letter, M. H. Smith to P. G. Trudell, Tennessee Valley Authority, "Engineering Data for Limitorque Actuators," dated April 16, 1991.

5. FitzPatrick plant Updated FSAR Section 8.6, Emergency AC Power System.

6. Limitorque Corporation, Gate and Globe Valve Operator Selection Procedure, SEL-3, page 4 of 4, dated July 1, 1977.

7. Operating Experience Review (OER) Report 900484, Source Document: NRCN 90-72, "Testing of Parallel Disc Gate Valves in Europe," dated April 26, 1991.

ATTACHMENT 2 TO JPN-91-039

GENERIC LETTER 89-10, SUPPLEMENT 3
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

ACTUATOR SIZING ANALYSIS

New York Power Authority

JAMES A. FITZPATRICK NUCLEAR POWER PLANT
Docket No. 50-333

Attachment 2

MOV THRUST SIZING ANALYSIS FOR 12MOV-15 - CALC. NO. JAF-91-033
ANALYSIS OF HELB REQUIREMENTS FOR NRC GL 89-10 SUPP. 3

Formulas ---->		Valve Number	C1 12MOV-15 Design Conditions	C2 12MOV-15 HELB w/ PO Eff	C3 12MOV-15 HELB w/ Run Eff	C4 12MOV-15 HELB w/ Stall E
	R1	Manufacturer	Anchor/Darling	Anchor/Darling	Anchor/Darling	Anchor/Darling
	R2	Mfg. ID No.	EA570-14	EA570-14	EA570-14	EA570-14
	R3	Valve Size,	6"	6"	6"	6"
	R4	Press. and Type	900 DD Gate	900 DD Gate	900 DD Gate	900 DD Gate
	R5	Ref Mfg. Dwg. No.	W8822747	W8822747	W8822747	W8822747
	R6	File No.	6.37-280	6.37-280	6.37-280	6.37-280
	R7	Limitorque Order No.	127173-06	127173-06	127173-06	127173-06
	R8					
	R9	Seat Mean Dia.	5.300	5.300	5.300	5.30
@PI*(R9*R9)/4	R10	Seat Area	< 22.062	< 22.062	< 22.062	< 22.06
	R11	Line Design Press.	1,750	1,045	1,045	1,0
	R12	Design Diff. Press.	1,020	1,045	1,045	1,04
R10*R12	R13	Disc dP Load	< 22,503	< 23,055	< 23,055	< 23,05
	R14	Valve Disc Factor	0.20	0.20	0.20	0.2
R13*R14	R15	Disc dP Thrust	< 4,501	< 4,611	< 4,611	< 4,61
	R16	Stem Dia (in valve)	1.500	1.500	1.500	1.50
@PI*R16*R16/4	R17	Stem Area (in valve)	< 1.767	< 1.767	< 1.767	< 1.76
R11*R17	R18	Stem End Load	< 3,093	< 1,847	< 1,847	< 1,84
	R19	Stuff Box Load	1,200	1,200	1,200	1,20
R15+R18+R19	R20	Total Stem Load	< 8,793	< 7,658	< 7,658	< 7,65
	R21					
	R22	Stem Dia. (thread)	1.2500	1.2500	1.2500	1.250
	R23	Stem Pitch	0.250	0.250	0.250	0.25
	R24	Stem Lead	0.500	0.500	0.500	0.50
	R25	Stem Friction Coeff.	0.15	0.15	0.15	0.1
(R25*(R22-R23/2)+0.96815*R24/@PI)/(24*(0.96815-R25*R24/(@PI*(R22-R23/2))))	R26	Stem Factor	< 0.0142	< 0.0142	< 0.0142	< 0.014
R20*R26	R27	Stem Torque	< 124.91	< 108.78	< 108.78	< 108.7
	R28	Stem Total Travel (in)	6.00	6.00	6.00	6.0
	R29	Design Stroke Time (sec)	18.0	18.0	18.0	18.
R28*60/R29	R30	Nominal Speed (in/min)	< 20.00	< 20.00	< 20.00	< 20.0
R30/R24	R31	Drive Sleeve RPM	< 40.00	< 40.00	< 40.00	< 40.0
	R32	Motor RPM	1,700	1,700	1,700	1,70
	R33	AC or DC	AC	AC	AC	AC
	R34	Overall Gear Ratio				
R32/R31	R35	Calculated	< 42.50	< 42.50	< 42.50	< 42.5
	R36	Actual	38.60	38.60	38.60	38.6
R32/R36	R37	Actual Drive Sleeve RPM	< 44.04	< 44.04	< 44.04	< 44.0
R37*R24	R38	Actual Stem Speed (in/min)	< 22.02	< 22.02	< 22.02	< 22.0
R28*60/R38	R39	Actual Stroke Time (sec)	< 16.35	< 16.35	< 16.35	< 16.3
	R40	Unit Pull-Out Eff.	0.40	0.40	0.40	0.4
	R41	Run Efficiency	0.50	0.50	0.50	0.5
	R42	Stall Efficiency	0.60	0.60	0.60	0.6
	R43	Application Factor	0.90	0.90	0.90	0.9

Preparer/Date 4/11/91 Approval/Date 4/16/91
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MOV THRUST SIZING ANALYSIS FOR 12MOV-15 - CALC. NO. JAF-91-033
ANALYSIS OF HELB REQUIREMENTS FOR NRC GL 89-10 SUPP. 3

Formulas		Valve Number	C1 12MOV-15 Design Conditions	C2 12MOV-15 HELB w/ PO Eff	C3 12MOV-15 HELB w/ Run Eff	C4 12MOV-15 HELB w/ Stall Ef
R36*R40*R43	R44	Adj. Motor Torque Factor	< 13.90	< 13.90	< 13.90	< 13.9
R27/R44	R45	Mtr Calc Torque @ 100% V	< 8.99	< 7.83	< 7.83	< 7.8
	R46	Minimum Voltage %	90	90	90	9
	R47	Voltage Factor	1.00	1.00	1.00	1.0
R45/R47	R48	Mtr Calc Torque @ Min V	< 8.99	< 7.83	< 7.83	< 7.8
	R49	Rated Motor Torque	10	10	10	1
	R50	Selected Mtr, Unit & Type	SB 00-10	SB 00-10	SB 00-10	SB 00-10
	R51	Actuator Max. Thrust	14,000	14,000	14,000	14,00
	R52	============================	==================	==================	==================	==================
R20-R19	R53	Available Thrust	< 7,593	< 6,458	< 6,658	< 6,45
R18+R19	R54	Running Load	< 4,293	< 3,047	< 3,047	< 3,04
100*R54/R20	R55	Running % of Total Load	< 48.8	< 39.8	< 39.8	< 39.
(R26*R54)/(R36*R41)	R56	Motor Run Torque	< 3.16	< 2.24	< 2.24	< 2.2
100*R56/R49	R57	Motor Run Torque % Rated	< 32	< 22	< 22	< 2
R49*R36*R42*1.1	R58	Calculated Stall Torque	< 254.8	< 254.8	< 254.8	< 254.
	R59	Max Act Stall Torque	500	500	500	50
R58/R26	R60	Stem Thrust at Stall	< 17,934	< 17,934	< 17,934	< 17,93
2.5*R51	R61	Max Act Stall Thrust	< 35,000	< 35,000	< 35,000	< 35,00
	R62	============================	==================	==================	==================	==================
	R63	Cont. Duty Torque Limit	250	250	250	25
R51*R26	R64	Torque for Act Max Thrust	< 199	< 199	< 199	< 19
R27	R65	Stem Torque	< 125	< 109	< 109	< 10
R44*R49	R66	Max Pull-Out Torque @ 100% V	< 139	< 139	v 174	v 20
					N:	N:
					F:R44*R49*R41/R40	F:R44*R49*R42/R4
R66*R47	R67	Max Pull-Out Torque @ Min V	< 139	< 139	< 174	< 20
	R68	Selected Spring Pack	0049	0049	0049	0049
	R69	New Spring Pack Number	0301-112	0301-112	0301-112	0301-112
	R70	Required TSS	1.50	1.00	1.00	1.0
	R71	Torque at TSS	130	115	115	11
R71/R26	R72	Thrust at TSS	< 9,151	< 8,096	< 8,096	< 8,09
	R73	Maximum TSS	1.75	1.75	2.75	3.0
	R74	Torque at Max TSS	139	139	175	185
R74/R26	R75	Thrust at Max TSS	< 9,785	< 9,785	< 12,319	< 13,023
	R76	Limiting Factor for Max TSS	Motor (Pull-Out)	Motor (Pull-Out)	Motor (Pull-Out)	Spring Pack
	R77	Effective Valve Disc Factor				
(R75-R19-R18)/R13	R78	at Maximum TSS	< 0.24	< 0.29	< 0.40	< 0.43

Preparer/Date 4/11/91 Approval/Date 4/12/91
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MOV THRUST SIZING ANALYSIS FOR 12MOV-18 - CALC. NO. JAF-91-034
ANALYSIS OF HELB REQUIREMENTS FOR NRC GL 89-10 SUPP. 3

Formulas-------------------------------------->

Formulas		Valve Number	C8 12MOV-18 Design Conditions	C9 12MOV-18 HELB w/ PO Eff	C10 12MOV-18 HELB w/ Run Eff	C11 12MOV-18 HELB w/ Stall Ef
	R1	Manufacturer	Anchor/Darling	Anchor/Darling	Anchor/Darling	Anchor/Darling
	R2	Mfg. ID No.	EA570-15	EA570-15	EA570-15	EA570-15
	R3	Valve Size,	6"	6"	6"	6"
	R4	Press. and Type	900 DD Gate	900 DD Gate	900 DD Gate	900 DD Gate
	R5	Ref Mfg. Dwg. No.	W8822748	W8822748	W8822748	W8822748
	R6	File No.	6.37-263	6.37-263	6.37-263	6.37-263
	R7	Limitorque Order No.	127173-07	127173-07	127173-07	127173-07
	R8	============================	================	================	================	================
	R9	Seat Mean Dia.	5.300	5.300	5.300	5.30
@PI*(R9*R9)/4	R10	Seat Area	< 22.062	< 22.062	< 22.062	< 22.06
	R11	Line Design Press.	1,750	1,045	1,045	1,04
	R12	Design Diff. Press.	1,020	1,045	1,045	1,04
R10*R12	R13	Disc dP Load	< 22,503	< 23,055	< 23,055	< 23,05
	R14	Valve Disc Factor	0.20	0.20	0.20	0.2
R13*R14	R15	Disc dP Thrust	< 4,501	< 4,611	< 4,611	< 4,61
	R16	Stem Dia (in valve)	1.500	1.500	1.500	1.50
@PI*R16*R16/4	R17	Stem Area (in valve)	< 1.767	< 1.767	< 1.767	< 1.76
R11*R17	R18	Stem End Load	< 3,093	< 1,847	< 1,847	< 1,04
	R19	Stuff Box Load	1,200	1,200	1,200	1,20
R15+R18+R19	R20	Total Stem Load	< 8,793	< 7,658	< 7,658	< 7,65
	R21	============================	================	================	================	================
	R22	Stem Dia. (thread)	1.2500	1.2500	1.2500	1.2500
	R23	Stem Pitch	0.250	0.250	0.250	0.250
	R24	Stem Lead	0.500	0.500	0.500	0.500
	R25	Stem Friction Coeff.	0.15	0.15	0.15	0.15
(R25*(R22-R23/2)+0.96815*R24/@PI)/(24*(0.96815-R25*R24/(@PI*(R22-R23/2))))	R26	Stem Factor	< 0.0142	< 0.0142	< 0.0142	< 0.0142
R20*R26	R27	Stem Torque	< 124.91	< 108.78	< 108.78	< 108.7
	R28	Stem Total Travel (in)	6.00	6.00	6.00	6.0
	R29	Design Stroke Time (sec)	18.0	18.0	18.0	18.
R28*60/R29	R30	Nominal Speed (in/min)	< 20.00	< 20.00	< 20.00	< 20.00
R30/R24	R31	Drive Sleeve RPM	< 40.00	< 40.00	< 40.00	< 40.00
	R32	Motor RPM	1,900	1,900	1,900	1,900
	R33	AC or DC	DC	DC	DC	DC
	R34	Overall Gear Ratio				
R32/R31	R35	Calculated	< 47.50	< 47.50	< 47.50	< 47.50
	R36	Actual	36.20	36.20	36.20	36.20
R32/R36	R37	Actual Drive Sleeve RPM	< 52.49	< 52.49	< 52.49	< 52.49
R37*R24	R38	Actual Stem Speed (in/min)	< 26.24	< 26.24	< 26.24	< 26.24
R28*60/R38	R39	Actual Stroke Time (sec)	< 13.72	< 13.72	< 13.72	< 13.72
	R40	Unit Pull-Out Eff.	0.40	0.40	0.40	0.40
	R41	Run Efficiency	0.50	0.50	0.50	0.50
	R42	Stall Efficiency	0.65	0.65	0.65	0.65
	R43	Application Factor	0.90	0.90	0.90	0.90

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MOV THRUST SIZING ANALYSIS FOR 12MOV-18 - CALC. NO. JAF-91-034
ANALYSIS OF HELB REQUIREMENTS FOR NRC GL 89-10 SUPP. 3

Formulas		Valve Number	C8 12MOV-18 Design Conditions	C9 12MOV-18 HELB w/ PO Eff	C10 12MOV-18 HELB w/ Run Eff	C11 12MOV-18 HELB w/ Stall Eff
R36*R40*R43	R44	Adj. Motor Torque Factor	< 13.03	< 13.03	< 13.03	< 13.03
R27/R44	R45	Mtr Calc Torque @ 100% V	< 9.58	< 8.35	< 8.35	< 8.35
	R46	Minimum Voltage %	84	84	84	84
	R47	Voltage Factor	0.84	0.84	0.84	0.84
R45/R47	R48	Mtr Calc Torque @ Min V	< 11.41	< 9.94	< 9.94	< 9.94
	R49	Rated Motor Torque	15	15	15	15
	R50	Selected Mtr, Unit & Type	SB 00-15	SB 00-15	SB 00-15	SB 00-15
	R51	Actuator Max. Thrust	14,000	14,000	14,000	14,000
	R52	==============================	================	================	================	================
R20-R19	R53	Available Thrust	< 7,593	< 6,458	< 6,458	< 6,458
R18+R19	R54	Running Load	< 4,293	< 3,047	< 3,047	< 3,047
100*R54/R20	R55	Running % of Total Load	< 48.8	< 39.8	< 39.8	< 39.8
(R26*R54)/(R36*R41)	R56	Motor Run Torque	< 3.37	< 2.39	< 2.39	< 2.39
100*R56/R49	R57	Motor Run Torque % Rated	< 22	< 16	< 16	< 16
R49*R36*R42*1.1	R58	Calculated Stall Torque	< 388.2	< 388.2	< 388.2	< 388.2
	R59	Max Act Stall Torque	500	500	500	500
R58/R26	R60	Stem Thrust at Stall	< 27,331	< 27,331	< 27,331	< 27,331
2.5*R51	R61	Max Act Stall Thrust	< 35,000	< 35,000	< 35,000	< 35,000
	R62	==============================	================	================	================	================
	R63	Cont. Duty Torque Limit	250	250	250	250
R51*R26	R64	Torque for Act Max Thrust	< 199	< 199	< 199	< 199
R27	R65	Stem Torque	< 125	< 109	< 109	< 109
R44*R49	R66	Max Pull-Out Torque @ 100% V	< 195	< 195	v 244	v 318
					N: F:R44*R49*R41/R40	N: F:R44*R49*R42/R40
R66*R47	R67	Max Pull-Out Torque @ Min V	< 164	< 164	< 205	< 267
	R68	Selected Spring Pack	0049	0049	0049	0049
	R69	New Spring Pack Number	0301-112	0301-112	0301-112	0301-112
	R70	Required TSS	1.50	1.00	1.00	1.00
	R71	Torque at TSS	130	115	115	115
R71/R26	R72	Thrust at TSS	< 9,151	< 8,096	< 8,096	< 8,096
	R73	Maximum TSS	2.50	3.00	3.00	3.00
	R74	Torque at Max TSS	166	185	185	185
R74/R26	R75	Thrust at Max TSS	< 11,656	< 13,023	< 13,023	< 13,023
	R76	Limiting Factor for Max TSS	Motor (Pull-Out)	Spring Pack	Spring Pack	Spring Pack
	R77	Effective Valve Disc Factor				
(R75-R19-R18)/R13	R78	at Maximum TSS	< 0.33	< 0.43	< 0.43	< 0.43

Preparer/Date [illegible] 4/10/91 Approval/Date [illegible] 4/10/91
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MOV THRUST SIZING ANALYSIS FOR 13MOV-15 - CALC. NO. JAF-91-035
ANALYSIS OF HELB REQUIREMENTS FOR NRC GL 89-10 SUPP. 3

Formulas -->

Formulas			C2	C3	C4	C5
			13MOV-15	13MOV-15	13MOV-15	13MOV-15
		Valve Number	Design Conditions	HELB w/ PO Eff	HELB w/ Run Eff	HELB w/ Stall E
	R1	Manufacturer	Anchor/Darling	Anchor/Darling	Anchor/Darling	Anchor/Darling
	R2	Mfg. ID No.	EA570-6	EA570-6	EA570-6	EA570-6
	R3	Valve Size,	3"	3"	3"	3"
	R4	Press. and Type	900 DD Gate	900 DD Gate	900 DD Gate	900 DD Gate
	R5	Ref Mfg. Dwg. No.	W8822740	W8822740	W8822740	W8822740
	R6	File No.	6.37-255	6.37-255	6.37-255	6.37-255
	R7	Limitorque Order No.	127173-03	127173-03	127173-03	127173-03
	R8	============================	================	================	================	==============
	R9	Seat Mean Dia.	2.80	2.80	2.80	2.
@PI*(R9*R9)/4	R10	Seat Area	< 6.16	< 6.16	< 6.16	< 6.
	R11	Line Design Press.	1,420	1,045	1,045	1,0
	R12	Design Diff. Press.	1,250	1,045	1,045	1,0
R10*R12	R13	Disc dP Load	< 7,697	< 6,435	< 6,435	< 6,4
	R14	Valve Disc Factor	0.20	0.20	0.20	0.
R13*R14	R15	Disc dP Thrust	< 1,539	< 1,287	< 1,287	< 1,2
	R16	Stem Dia (in valve)	0.750	0.750	0.750	0.7
@PI*R16*R16/4	R17	Stem Area (in valve)	< 0.442	< 0.442	< 0.442	< 0.4
R11*R17	R18	Stem End Load	< 627	< 462	< 462	< 4
	R19	Stuff Box Load	800	800	800	8
R15+R18+R19	R20	Total Stem Load	< 2,967	< 2,549	< 2,549	< 2,5
	R21	============================	================	================	================	==============
	R22	Stem Dia. (thread)	0.6250	0.6250	0.6250	0.62
	R23	Stem Pitch	0.200	0.200	0.200	0.2
	R24	Stem Lead	0.200	0.200	0.200	0.2
	R25	Stem Friction Coeff.	0.15	0.15	0.15	0.
(R25*(R22-R23/2)+0.96815*R24/@PI)/(24*(0.96815-R25*R24/(@PI*(R22-R23/2))))	R26	Stem Factor	< 0.0062	< 0.0062	< 0.0062	< 0.00
R20*R26	R27	Stem Torque	< 18.27	< 15.69	< 15.69	< 15.
	R28	Stem Total Travel (in)	3.00	3.00	3.00	3.
	R29	Design Stroke Time (sec)	10.0	10.0	10.0	10
R28*60/R29	R30	Nominal Speed (in/min)	< 18.00	< 18.00	< 18.00	< 18.
R30/R24	R31	Drive Sleeve RPM	< 90.00	< 90.00	< 90.00	< 90.
	R32	Motor RPM	3,400	3,400	3,400	3,4
	R33	AC or DC	AC	AC	AC	AC
	R34	Overall Gear Ratio				
R32/R31	R35	Calculated	< 37.78	< 37.78	< 37.78	< 37.
	R36	Actual	36.50	36.50	36.50	36.
R32/R36	R37	Actual Drive Sleeve RPM	< 93.15	< 93.15	< 93.15	< 93.
R37*R24	R38	Actual Stem Speed (in/min)	< 18.63	< 18.63	< 18.63	< 18.
R28*60/R38	R39	Actual Stroke Time (sec)	< 9.66	< 9.66	< 9.66	< 9.
	R40	Unit Pull-Out Eff.	0.40	0.40	0.40	0.
	R41	Run Efficiency	0.50	0.50	0.50	0.
	R42	Stall Efficiency	0.55	0.55	0.55	0.
	R43	Application Factor	0.90	0.90	0.90	0.

Preparer/Date P. Swinburn 4/11/91 Approval/Date 4/16/91
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MOV THRUST SIZING ANALYSIS FOR 13MOV-15 - CALC. NO. JAF-91-035
ANALYSIS OF HELB REQUIREMENTS FOR NRC GL 89-10 SUPP. 3

Formulas		Valve Number		C2 13MOV-15 Design Conditions		C3 13MOV-15 HELB w/ PO Eff		C4 13MOV-15 HELB w/ Run Eff		C5 13MOV-15 HELB w/ Stall E
R36*R40*R43	R44	Adj. Motor Torque Factor	<	13.14	<	13.14	<	13.14	<	13.1
R27/R44	R45	Mtr Calc Torque @ 100% V	<	1.39	<	1.19	<	1.19	<	1.1
	R46	Minimum Voltage %		90		90		90		9
	R47	Voltage Factor		1.00		1.00		1.00		1.0
R45/R47	R48	Mtr Calc Torque @ Min V	<	1.39	<	1.19	<	1.19	<	1.1
	R49	Rated Motor Torque		2		2		2		
	R50	Selected Mtr, Unit & Type		SB 000-2		SB 000-2		SB 000-2		SB 000-2
	R51	Actuator Max. Thrust		8,000		8,000		8,000		8,00
	R52	==============================		================		================		================		================
R20-R19	R53	Available Thrust	<	2,167	<	1,749	<	1,749	<	1,74
R18+R19	R54	Running Load	<	1,427	<	1,262	<	1,262	<	1,26
100*R54/R20	R55	Running % of Total Load	<	48.1	<	49.5	<	49.5	<	49.
(R26*R54)/(R36*R41)	R56	Motor Run Torque	<	0.48	<	0.43	<	0.43	<	0.4
100*R56/R49	R57	Motor Run Torque % Rated	<	24.1	<	21.3	<	21.3	<	21.
R49*R36*R42*1.1	R58	Calculated Stall Torque	<	44.2	<	44.2	<	44.2	<	44.
	R59	Max Act Stall Torque		180		180		180		18
R58/R26	R60	Stem Thrust at Stall	<	7,173	<	7,173	<	7,173	<	7,17
2.5*R51	R61	Max Act Stall Thrust	<	20,000	<	20,000	<	20,000	<	20,00
	R62	==============================		================		================		================		================
	R63	Cont. Duty Torque Limit		90		90		90		9
R51*R26	R64	Torque for Act Max Thrust	<	49	<	49	<	49	<	4
R27	R65	Stem Torque	<	18	<	16	<	16	<	1
R44*R49	R66	Max Pull-Out Torque @ 100% V	<	26	<	26	v	33	v	3
							N: F:R44*R49*R41/R40		N: F:R44*R49*R42/R4	
R66*R47	R67	Max Pull-Out Torque @ Min V	<	26	<	26	<	33	<	3
	R68	Selected Spring Pack		0023		0023		0023		0023
	R69	New Spring Pack Number		0101-091		0101-091		0101-091		0101-091
	R70	Required TSS		1.00		1.00		1.00		1.0
	R71	Torque at TSS		23		23		23		2
R71/R26	R72	Thrust at TSS	<	3,735	<	3,735	<	3,735	<	3,73
	R73	Maximum TSS		1.25		1.25		1.75		2.0
	R74	Torque at Max TSS		27		27		33		3
R74/R26	R75	Thrust at Max TSS	<	4,385	<	4,385	<	5,359	<	5,84
	R76	Limiting Factor for Max TSS		Motor (Pull-Out)		Motor (Pull-Out)		Motor (Pull-Out)		Motor (Pull-Out)
	R77	Effective Valve Disc Factor								
(R75-R19-R18)/R13	R78	at Maximum TSS	<	0.38	<	0.49	<	0.64	<	0.71

Preparer/Date P. S[illegible] 4/11/91 Approval/Date [illegible] 4/16/91
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MOV THRUST SIZING ANALYSIS FOR 13MOV-16 - CALC. NO. JAF-91-036
ANALYSIS OF HELB REQUIREMENTS FOR NRC GL 89-10 SUPP. 3

Formulas------------------------------------>

Formulas		Valve Number	C8 13MOV-16 Design Conditions	C9 13MOV-16 HELB w/ PO Eff	C10 13MOV-16 HELB w/ Run Eff	C11 13MOV-16 HELB w/ Stall E
	R1	Manufacturer	Anchor/Darling	Anchor/Darling	Anchor/Darling	Anchor/Darling
	R2	Mfg. ID No.	EA570-7	EA570-7	EA570-7	EA570-7
	R3	Valve Size,	3"	3"	3"	3"
	R4	Press. and Type	900 DD Gate	900 DD Gate	900 DD Gate	900 DD Gate
	R5	Ref Mfg. Dwg. No.	W8822741	W8822741	W8822741	W8822741
	R6	File No.	6.37-260	6.37-260	6.37-260	6.37-260
	R7	Limitorque Order No.	127173-04	127173-04	127173-04	127173-04
	R8	==============================	=================	================	=================	==============
	R9	Seat Mean Dia.	2.80	2.80	2.80	2.8
@PI*(R9*R9)/4	R10	Seat Area	< 6.16	< 6.16	< 6.16	< 6.1
	R11	Line Design Press.	1,420	1,045	1,045	1,04
	R12	Design Diff. Press.	1,250	1,045	1,045	1,04
R10*R12	R13	Disc dP Load	< 7,697	< 6,435	< 6,435	< 6,43
	R14	Valve Disc Factor	0.20	0.20	0.20	0.2
R13*R14	R15	Disc dP Thrust	< 1,539	< 1,287	< 1,287	< 1,28
	R16	Stem Dia (in valve)	0.750	0.750	0.750	0.75
@PI*R16*R16/4	R17	Stem Area (in valve)	< 0.442	< 0.442	< 0.442	< 0.44
R11*R17	R18	Stem End Load	< 627	< 462	< 462	< 46
	R19	Stuff Box Load	800	800	800	80
R15+R18+R19	R20	Total Stem Load	< 2,967	< 2,549	< 2,549	< 2,54
	R21	==============================	=================	================	=================	==============
	R22	Stem Dia. (thread)	0.6250	0.6250	0.6250	0.625
	R23	Stem Pitch	0.250	0.250	0.250	0.25
	R24	Stem Lead	0.250	0.250	0.250	0.25
	R25	Stem Friction Coeff.	0.15	0.15	0.15	0.1
(R25*(R22-R23/2)+0.96815*R24/@PI)/(24*(0.96815-R25*R24/(@PI*(R22-R23/2))))	R26	Stem Factor	< 0.0067	< 0.0067	< 0.0067	< 0.006
R20*R26	R27	Stem Torque	< 19.90	< 17.10	< 17.10	< 17.1
	R28	Stem Total Travel (in)	3.00	3.00	3.00	3.0
	R29	Design Stroke Time (sec)	14.0	14.0	14.0	14.
R28*60/R29	R30	Nominal Speed (in/min)	< 12.86	< 12.86	< 12.86	< 12.8
R30/R24	R31	Drive Sleeve RPM	< 51.43	< 51.43	< 51.43	< 51.4
	R32	Motor RPM	1,900	1,900	1,900	1,90
	R33	AC or DC	DC	DC	DC	DC
	R34	Overall Gear Ratio				
R32/R31	R35	Calculated	< 36.94	< 36.94	< 36.94	< 36.9
	R36	Actual	33.50	33.50	33.50	33.5
R32/R36	R37	Actual Drive Sleeve RPM	< 56.72	< 56.72	< 56.72	< 56.7
R37*R24	R38	Actual Stem Speed (in/min)	< 14.18	< 14.18	< 14.18	< 14.1
R28*60/R38	R39	Actual Stroke Time (sec)	< 12.69	< 12.69	< 12.69	< 12.6
	R40	Unit Pull-Out Eff.	0.40	0.40	0.40	0.4
	R41	Run Efficiency	0.50	0.50	0.50	0.5
	R42	Stall Efficiency	0.55	0.55	0.55	0.5
	R43	Application Factor	0.90	0.90	0.90	0.9

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MOV THRUST SIZING ANALYSIS FOR 13MOV-16 - CALC. NO. JAF-91-036
ANALYSIS OF HELB REQUIREMENTS FOR NRC GL 89-10 SUPP. 3

				C8 13MOV-16 Design Conditions		C9 13MOV-16 HELB w/ PO Eff		C10 13MOV-16 HELB w/ Run Eff		C11 13MOV-16 HELB w/ Stall Ef
		Valve Number								
R36*R40*R43	R44	Adj. Motor Torque Factor	<	12.06	<	12.06	<	12.06	<	12.0
R27/R44	R45	Mtr Calc Torque @ 100% V	<	1.65	<	1.42	<	1.42	<	1.4
	R46	Minimum Voltage %		84		84		84		8
	R47	Voltage Factor		0.84		0.84		0.84		0.8
R45/R47	R48	Mtr Calc Torque @ Min V	<	1.96	<	1.69	<	1.69	<	1.6
	R49	Rated Motor Torque		5		5		5		
	R50	Selected Mtr, Unit & Type		SB 000-5		SB 000-5		SB 000-5		SB 000-5
	R51	Actuator Max. Thrust		8,000		8,000		8,000		8,00
	R52	==============================		==================		================		==================		================
R20-R19	R53	Available Thrust	<	2,167	<	1,749	<	1,749	<	1,74
R18+R19	R54	Running Load	<	1,427	<	1,262	<	1,262	<	1,26
100*R54/R20	R55	Running % of Total Load	<	48.1	<	49.5	<	49.5	<	49.
(R26*R54)/(R36*R41)	R56	Motor Run Torque	<	0.57	<	0.51	<	0.51	<	0.5
100*R56/R49	R57	Motor Run Torque % Rated	<	11.4	<	10.1	<	10.1	<	10.
R49*R36*R42*1.1	R58	Calculated Stall Torque	<	101.3	<	101.3	<	101.3	<	101.
	R59	Max Act Stall Torque		180		180		180		18
R58/R26	R60	Stem Thrust at Stall	<	15,105	<	15,105	<	15,105	<	15,10
2.5*R51	R61	Max Act Stall Thrust	<	20,000	<	20,000	<	20,000	<	20,00
	R62	==============================		==================		================		==================		================
	R63	Cont. Duty Torque Limit		90		90		90		9
R51*R26	R64	Torque for Act Max Thrust	<	54	<	54	<	54	<	5
R27	R65	Stem Torque	<	20	<	17	<	17	<	1
R44*R49	R66	Max Pull-Out Torque @ 100% V	<	60	<	60	v	75	v	8
							N: F:R44*R49*R41/R40		N: F:R44*R49*R42/R4	
R66*R47	R67	Max Pull-Out Torque @ Min V	<	51	<	51	<	63	<	7
	R68	Selected Spring Pack		0023		0023		0023		0023
	R69	New Spring Pack Number		0101-091		0101-091		0101-091		0101-091
	R70	Required TSS		1.00		1.00		1.00		1.0
	R71	Torque at TSS		23		23		23		2
R71/R26	R72	Thrust at TSS	<	3,428	<	3,428	<	3,428	<	3,42
	R73	Maximum TSS		2.50		3.00		3.00		3.0
	R74	Torque at Max TSS		43		50		50		5
R74/R26	R75	Thrust at Max TSS	<	6,609	<	7,453	<	7,453	<	7,45
	R76	Limiting Factor for Max TSS		Motor (Pull-Out)		Act Max Thrust		Act Max Thrust		Act Max Thrust
	R77	Effective Valve Disc Factor								
(R75-R19-R18)/R13	R78	at Maximum TSS	<	0.65	<	0.96	<	0.96	<	0.9

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MOV THRUST SIZING ANALYSIS FOR 23MOV-15 - CALC. NO. JAF-91-037
ANALYSIS OF HELB REQUIREMENTS FOR NRC GL 89-10 SUPP. 3

Formulas		Valve Number	C8 23MOV-15 Design Conditions	C9 23MOV-15 HELB w/ PO Eff	C10 23MOV-15 HELB w/ Run Eff	C11 23MOV-15 HELB w/ Stall Ef
	R1	Manufacturer	Anchor/Darling	Anchor/Darling	Anchor/Darling	Anchor/Darling
	R2	Mfg. ID No.	E6943-4	E6943-4	F6943-4	E6943-4
	R3	Valve Size,	10"	10"	10"	10"
	R4	Press. and Type	900 DD Gate	900 DD Gate	900 DD Gate	900 DD Gate
	R5	Ref Mfg. Dwg. No.	W8622457	W8622457	W8622457	W8622457
	R6	File No.	6.37-245	6.37-245	6.37-245	6.37-245
	R7	Limitorque Order No.	316938A	316938A	316938A	316938A
	R8	============================	================	================	================	================
	R9	Seat Mean Dia.	8.2000	8.2000	8.2000	8.2000
@PI*(R9*R9)/4	R10	Seat Area	< 52.8102	< 52.8102	< 52.8102	< 52.8102
	R11	Line Design Press.	1,250	1,045	1,045	1,045
	R12	Design Diff. Press.	1,250	1,045	1,045	1,045
R10*R12	R13	Disc dP Load	< 66,013	< 55,187	< 55,187	< 55,187
	R14	Valve Disc Factor	0.20	0.20	0.20	0.20
R13*R14	R15	Disc dP Thrust	< 13,203	< 11,037	< 11,037	< 11,037
	R16	Stem Dia (in valve)	2.0000	2.0000	2.0000	2.0000
@PI*R16*R16/4	R17	Stem Area (in valve)	< 3.1416	< 3.1416	< 3.1416	< 3.1416
R11*R17	R18	Stem End Load	< 3,927	< 3,283	< 3,283	< 3,283
	R19	Stuff Box Load	2,000	2,000	2,000	2,000
R15+R18+R19	R20	Total Stem Load	< 19,130	< 16,320	< 16,320	< 16,320
	R21	============================	================	================	================	================
	R22	Stem Dia. (thread)	2.0000	2.0000	2.0000	2.0000
	R23	Stem Pitch	0.200	0.200	0.200	0.200
	R24	Stem Lead	0.400	0.400	0.400	0.400
	R25	Stem Friction Coeff.	0.15	0.15	0.15	0.15
(R25*(R22-R23/2)+0.96815*R24/@PI)/(24*(0.96815-R25*R24/(@PI*(R22-R23/2))))	R26	Stem Factor	< 0.0178	< 0.0178	< 0.0178	< 0.0178
R20*R26	R27	Stem Torque	< 339.65	< 289.77	< 289.77	< 289.77
	R28	Stem Total Travel (in)	9.90	9.90	9.90	9.90
	R29	Design Stroke Time (sec)	13.5	13.5	13.5	13.5
R28*60/R29	R30	Speed (in/min)	44.00	44.00	44.00	44.00
R30/R24	R31	Drive Sleeve RPM	< 110.00	< 110.00	< 110.00	< 110.00
	R32	Motor RPM	3,400	3,400	3,400	3,400
	R33	AC or DC	AC	AC	AC	AC
	R34	Overall Gear Ratio				
R32/R31	R35	Calculated	< 30.91	< 30.91	< 30.91	< 30.91
	R36	Actual	30.46	30.46	30.46	30.46
R32/R36	R37	Actual Drive Sleeve RPM	< 111.62	< 111.62	< 111.62	< 111.62
R37*R24	R38	Actual Stem Speed (in/min)	< 44.65	< 44.65	< 44.65	< 44.65
R28*60/R38	R39	Actual Stroke Time (sec)	< 13.30	< 13.30	< 13.30	< 13.30

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MOV THRUST SIZING ANALYSIS FOR 23MOV-15 - CALC. NO. JAF-91-037
ANALYSIS OF HELB REQUIREMENTS FOR NRC GL 89-10 SUPP. 3

Formulas ---->		Valve Number	C8 23MOV-15 Design Conditions	C9 23MOV-15 HELB w/ PO Eff	C10 23MOV-15 HELB w/ Run Eff	C11 23MOV-15 HELB w/ Stall Ef
	R40	Unit Pull-Out Eff.	0.45	0.45	0.45	0.4
	R41	Run Efficiency	0.60	0.60	0.60	0.6
	R42	Stall Efficiency	0.60	0.60	0.60	0.6
	R43	Application Factor	0.90	0.90	0.90	0.9
R36*R40*R43	R44	Adj. Motor Torque Factor	< 12.34	< 12.34	< 12.34	< 12.3
R27/R46	R45	Mtr Calc Torque @ 100% V	< 27.53	< 23.49	< 23.49	< 23.4
	R46	Minimum Voltage %	90	90	90	9
	R47	Voltage Factor	1.00	1.00	1.00	1.0
R45/R47	R48	Mtr Calc Torque @ Min V	< 27.53	< 23.49	< 23.49	< 23.4
	R49	Rated Motor Torque	40	40	40	4
	R50	Selected Mtr, Unit & Type	SB 1-40	SB 1-40	SB 1-40	SB 1-40
	R51	Actuator Max. Thrust	45,000	45,000	45,000	45,00
	R52	==============================	================	================	================	================
R20-R19	R53	Available Thrust	< 17,130	< 14,320	< 14,320	< 14,32
R18+R19	R54	Running Load	< 5,927	< 5,283	< 5,283	< 5,28
100*R54/R20	R55	Running % of Total Load	< 31.0	< 32.4	< 32.4	< 32.
(R26*R54)/(R36*R41)	R56	Motor Run Torque	< 5.76	< 5.13	< 5.13	< 5.1
100*R56/R49	R57	Motor Run Torque % Rated	< 14	< 13	< 13	< 1
R49*R36*R42*1.1	R58	Calculated Stall Torque	< 804.1	< 804.1	< 804.1	< 804.
	R59	Max Act Stall Torque	1,700	1,700	1,700	1,70
R58/R26	R60	Stem Thrust at Stall	< 45,291	< 45,291	< 45,291	< 45,291
2.5*R51	R61	Max Act Stall Thrust	< 112,500	< 112,500	< 112,500	< 112,50
	R62	==============================	================	================	================	================
	R63	Cont. Duty Torque Limit	850	850	850	850
R51*R26	R64	Torque for Act Max Thrust	< 799	< 799	< 799	< 799
R27	R65	Stem Torque	< 340	< 290	< 290	< 290
R44*R49	R66	Max Pull-Out Torque @ 100% V	< 493	< 493	v 658 N: F:R44*R49*R41/R40	v 658 N: F:R44*R49*R42/R40
R66*R47	R67	Max Pull-Out Torque @ Min V	< 493	< 493	< 658	< 658
	R68	Spring Pack	0068	0068	0068	0068
	R69	New Spring Pack Number	0701-212	0701-212	0701-212	0701-212
	R70	Required TSS	1.50	1.50	1.50	1.50
	R71	Torque at TSS	350	350	350	350
R71/R26	R72	Thrust at TSS	< 19,713	< 19,713	< 19,713	< 19,713
	R73	Maximum TSS	1.75	1.75	2.25	2.25
	R74	Torque at Max TSS	438	438	638	638
R74/R26	R75	Thrust at Max TSS	< 24,669	< 24,669	< 35,933	< 35,933
	R76	Limiting Factor for Max TSS	Motor (Pull-Out)	Motor (Pull-Out)	Motor (Pull-Out)	Motor (Pull-Out)
	R77	Effective Valve Disc Factor				
(R75-R19-R18)/R13	R78	at Maximum TSS	< 0.28	< 0.35	< 0.56	< 0.56
	R79					
	R80					
	R81					

Preparer/Date P. Simbrunne 4/9/91 Approval/Date [illegible] 4/15/91
Reviewer/Date [illegible] Method [illegible] Page 2 of 4

MOV THRUST SIZING ANALYSIS FOR 23MOV-60 - CALC. NO. JAF-91-038
ANALYSIS OF HELB REQUIREMENTS FOR NRC GL 89-10 SUPP. 3

Formulas		Valve Number	C22 23MOV-60 Design Conditions	C23 23MOV-60 HELB w/ PO Eff	C24 23MOV-60 HELB w/ Run Eff	C25 23MOV-60 HELB w/ Stall Ef
	R1	Manufacturer	Conval	Conval	Conval	Conval
	R2	Mfg. ID No.	S.O. 9867	S.O. 9867	S.O. 9867	S.O. 9867
	R3	Valve Size,	1"	1"	1"	1"
	R4	Press. and Type	Globe	Globe	Globe	Globe
	R5	Ref Mfg. Dwg. No.	12G2PJ-105	12G2PJ-105	12G2PJ-105	12G2PJ-105
	R6	File No.	6.37-215	6.37-215	6.37-215	6.37-215
	R7	Limitorque Order No.	3K1204-B	3K1204-B	3K1204-B	3K1204-B
	R8					
	R9	Seat Mean Dia.	0.8125	0.8125	0.8125	0.812
@PI*(R9*R9)/4	R10	Seat Area	< 0.5185	< 0.5185	< 0.5185	< 0.518
	R11	Line Design Press.	1,300	1,045	1,045	1,04
	R12	Design Diff. Press.	1,300	1,045	1,045	1,04
R10*R12	R13	Disc dP Load	< 674	< 542	< 542	< 54
	R14	Valve Disc Factor	1.10	1.10	1.10	1.1
R13*R14	R15	Disc dP Thrust	< 741	< 596	< 596	< 59
	R16	Stem Dia (in valve)	0.6250	0.6250	0.6250	0.625
@PI*R16*R16/4	R17	Stem Area (in valve)	< 0.3068	< 0.3068	< 0.3068	< 0.306
R11*R17	R18	Stem End Load	< 399	< 321	< 321	< 32
	R19	Stuff Box Load	1,000	1,000	1,000	1,00
R15+R18+R19	R20	Total Stem Load	v 1,741	v 1,596	v 1,596	v 1,59
			N:	N:	N:	N:
			F:R15+R19	F:R15+R19	F:R15+R19	F:R15+R19
	R21					
	R22	Stem Dia. (thread)	0.6250	0.6250	0.6250	0.625
	R23	Stem Pitch	0.125	0.125	0.125	0.12
	R24	Stem Lead	0.125	0.125	0.125	0.12
	R25	Stem Friction Coeff.	0.20	0.20	0.20	0.2
(R25*(R22-R23/2)+0.96815*R24/@PI)/(24*(0.96815-R25*R24/(@PI*(R22-R23/2))))	R26	Stem Factor	< 0.0066	< 0.0066	< 0.0066	< 0.006
R20*R26	R27	Stem Torque	< 11.49	< 10.53	< 10.53	< 10.5
	R28	Stem Total Travel (in)	0.78	0.78	0.78	0.7
	R29	Design Stroke Time (sec)	7.5	7.5	7.5	7.
R28*60/R29	R30	Speed (in/min)	6.50	6.50	6.50	6.5
R30/R24	R31	Drive Sleeve RPM	< 52.00	< 52.00	< 52.00	< 52.0
	R32	Motor RPM	1,900	1,900	1,900	1,90
	R33	AC or DC	DC	DC	DC	DC
	R34	Overall Gear Ratio				
R32/R31	R35	Calculated	< 36.54	< 36.54	< 36.54	< 36.5
	R36	Actual	36.50	36.50	36.50	36.5
R32/R36	R37	Actual Drive Sleeve RPM	< 52.05	< 52.05	< 52.05	< 52.0
R37*R24	R38	Actual Stem Speed (in/min)	< 6.51	< 6.51	< 6.51	< 6.51
R28*60/R38	R39	Actual Stroke Time (sec)	< 7.20	< 7.20	< 7.20	< 7.2

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MOV THRUST SIZING ANALYSIS FOR 23MOV-60 - CALC. NO. JAF-91-038
ANALYSIS OF HELB REQUIREMENTS FOR NRC GL 89-10 SUPP. 3

Formulas ------------------------------------>

Formulas		Valve Number	C22 23MOV-60 Design Conditions	C23 23MOV-60 HELB w/ PO Eff	C24 23MOV-60 HELB w/ Run Eff	C25 23MOV-60 HELB w/ Stall E
	R40	Unit Pull-Out Eff.	0.40	0.40	0.40	0.
	R41	Run Efficiency	0.50	0.50	0.50	0.
	R42	Stall Efficiency	0.55	0.55	0.55	0.
	R43	Application Factor	0.90	0.90	0.90	0.
R36*R40*R43	R44	Adj. Motor Torque Factor	< 13.14	< 13.14	< 13.14	< 13.
R27/R44	R45	Mtr Calc Torque @ 100% V	< 0.87	< 0.80	< 0.80	< 0.
	R46	Minimum Voltage %	84	84	84	
	R47	Voltage Factor	0.84	0.84	0.84	0.
R45/R47	R48	Mtr Calc Torque @ Min V	< 1.04	< 0.95	< 0.95	< 0.
	R49	Rated Motor Torque	2	2	2	
	R50	Selected Mtr, Unit & Type	SMB 000-2	SMB 000-2	SMB 000-2	SMB 000-2
	R51	Actuator Max. Thrust	8,000	8,000	8,000	8,0
	R52	============================	=================	=================	=================	=================
R20-R19	R53	Available Thrust	< 741	< 596	< 596	< 5
R18+R19	R54	Running Load	< 1,399	< 1,321	< 1,321	< 1,3
100*R54/R20	R55	Running % of Total Load	< 80.3	< 82.7	< 82.7	< 82
(R26*R54)/(R36*R41)	R56	Motor Run Torque	< 0.51	< 0.48	< 0.48	< 0.
100*R56/R49	R57	Motor Run Torque % Rated	< 25	< 24	< 24	<
R49*R36*R42*1.1	R58	Calculated Stall Torque	< 44.2	< 44.2	< 44.2	< 44.
	R59	Max Act Stall Torque	180	180	180	1
R58/R26	R60	Stem Thrust at Stall	< 6,696	< 6,696	< 6,696	< 6,6
2.5*R51	R61	Max Act Stall Thrust	< 20,000	< 20,000	< 20,000	< 20,0
	R62	============================	=================	=================	=================	=================
	R63	Cont. Duty Torque Limit	90	90	90	
R51*R26	R64	Torque for Act Max Thrust	< 53	< 53	< 53	<
R27	R65	Stem Torque	< 11	< 11	< 11	<
R44*R49	R66	Max Pull-Out Torque @ 100% V	< 26	< 26	v 33 W: F:R44*R49*R41/R40	v W: F:R44*R49*R42/R4
R66*R47	R67	Max Pull-Out Torque @ Min V	< 22	< 22	< 28	<
	R68	Spring Pack	0023	0023	0023	0023
	R69	New Spring Pack Number	0101-091	0101-091	0101-091	0101-091
	R70	Required TSS	1.00	1.00	1.00	1.0
	R71	Torque at TSS	23	23	23	2
R71/R26	R72	Thrust at TSS	< 3,487	< 3,487	< 3,487	< 3,48
	R73	Maximum TSS	1.00	1.25	1.50	2.0
	R74	Torque at Max TSS	23	26	30	3
R74/R26	R75	Thrust at Max TSS	< 3,487	< 3,942	< 4,548	< 5,45
	R76	Limiting Factor for Max TSS	Motor (Pull-Out)	Motor (Pull-Out)	Motor (Pull-Out)	Motor (Pull-Out
	R77	Effective Valve Disc Factor				
(R75-R19-R18)/R13	R78	at Maximum TSS	< 3.10	< 4.84	< 5.96	< 7.6
	R79					
	R80					
	R81					

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MOV THRUST SIZING ANALYSIS FOR 23MOV-16 - CALC. NO. JAF-91-
ANALYSIS OF HELB REQUIREMENTS FOR NRC GL 89-10 SUPP. 3

Formulas		Valve No.	C2 23MOV-16 Design Conditions	C3 23MOV-16 HELB w/ PO Eff	C4 23MOV-16 HELB w/ Run Eff
	R1	Manufacturer	Anchor/Darling	Anchor/Darling	Anchor/Darling
	R2	Mfg. ID No.	E6943-3	E6943-3	E6943-3
	R3	Valve Size,	10"	10"	10"
	R4	Press. and Type	900 DD Gate	900 DD Gate	900 DD Gate
	R5	Ref Mfg. Dwg. No.	WB622456	WB622456	WB622456
	R6	File No.	6.37-244	6.37-244	6.37-244
	R7	Limitorque Order No.	3T69388	3T69388	3T69388
	R8				
	R9	Seat Mean Dia.	8.2000	8.2000	8.2000
@PI*(R9*R9)/4	R10	Seat Area	< 52.8102	< 52.8102	< 52.8102
	R11	Line Design Press.	1,250	1,045	1,045
	R12	Design Diff. Press.	1,250	1,045	1,045
R10*R12	R13	Disc dP Load	< 66,013	< 55,187	< 55,187
	R14	Valve Disc Factor	0.20	0.20	0.20
R13*R14	R15	Disc dP Thrust	< 13,203	< 11,037	< 11,037
	R16	Stem Dia (in valve)	2.0000	2.0000	2.0000
@PI*R16*R16/4	R17	Stem Area (in valve)	< 3.1416	< 3.1416	< 3.1416
R11*R17	R18	Stem End Load	< 3,927	< 3,283	< 3,283
	R19	Stuff Box Load	2,000	2,000	2,000
R15+R18+R19	R20	Total Stem Load	< 19,130	< 16,320	< 16,320
	R21				
	R22	Stem Dia. (thread)	2.0000	2.0000	2.0000
	R23	Stem Pitch	0.250	0.250	0.250
	R24	Stem Lead	0.750	0.750	0.750
	R25	Stem Friction Coeff.	0.15	0.15	0.15
(R25*(R22-R23/2)+0.96815*R24/@PI)/(24*(0.96815-R25*R24/(@PI*(R22-R23/2))))	R26	Stem Factor	< 0.0225	< 0.0225	< 0.0225
R20*R26	R27	Stem Torque	< 430.32	< 367.13	< 367.13
	R28	Stem Total Travel (in)	9.90	9.90	9.90
	R29	Design Stroke Time (sec)	13.5	13.5	13.5
R28*60/R29	R30	Speed (in/min)	44.00	44.00	44.00
R30/R24	R31	Drive Sleeve RPM	< 58.67	< 58.67	< 58.67
	R32	Motor RPM	1,900	1,900	1,900
	R33	AC or DC	DC	DC	DC
	R34	Overall Gear Ratio			
R32/R31	R35	Calculated	< 32.39	< 32.39	< 32.39
	R36	Actual	27.20	27.20	27.20
R32/R36	R37	Actual Drive Sleeve RPM	< 69.85	< 69.85	< 69.85
R37*R24	R38	Actual Stem Speed (in/min)	< 52.39	< 52.39	< 52.39
R28*60/R38	R39	Actual Stroke Time (sec)	< 11.34	< 11.34	< 11.34

Preparer/Date __Information Only___ Approval/Date ______________

Reviewer/Date ____________________ Method ________ Page 1 of 6

MOV THRUST SIZING ANALYSIS FOR 23MOV-16 - CALC. NO. JAF-91-___
ANALYSIS OF HELB REQUIREMENTS FOR NRC GL 89-10 SUPP. 3

Formulas --->		Valve Number	C2 23MOV-16 Design Conditions	C3 23MOV-16 HELB w/ PO Eff	C4 23MOV-16 HELB w/ Run Eff
	R40	Unit Pull-Out Eff.	0.40	0.40	0.40
	R41	Run Efficiency	0.50	0.50	0.50
	R42	Stall Efficiency	0.60	0.60	0.60
	R43	Application Factor	0.90	0.90	0.90
R36*R40*R43	R44	Adj. Motor Torque Factor	< 9.79	< 9.79	< 9.79
R27/R44	R45	Mtr Calc Torque @ 100% V	< 43.95	< 37.49	< 37.49
	R46	Minimum Voltage %	84	84	84
	R47	Voltage Factor	0.84	0.84	0.84
R45/R47	R48	Mtr Calc Torque @ Min V	< 52.32	< 44.63	< 44.63
	R49	Rated Motor Torque	60	60	60
	R50	Selected Mtr, Unit & Type	SB 1-60	SB 1-60	SB 1-60
	R51	Actuator Max. Thrust	45,000	45,000	45,000
	R52	==========================	================	================	================
R20-R19	R53	Available Thrust	< 17,130	< 14,320	< 14,320
R18+R19	R54	Running Load	< 5,927	< 5,283	< 5,283
100*R54/R20	R55	Running % of Total Load	< 31.0	< 32.4	< 32.4
(R26*R54)/(R36*R41)	R56	Motor Run Torque	< 9.80	< 8.74	< 8.74
100*R56/R49	R57	Motor Run Torque % Rated	< 16	< 15	< 15
R49*R36*R42*1.1	R58	Calculated Stall Torque	< 1077.1	< 1077.1	< 1077.1
	R59	Max Act Stall Torque	1,700	1,700	1,700
R58/R26	R60	Stem Thrust at Stall	< 47,882	< 47,882	< 47,882
2.5*R51	R61	Max Act Stall Thrust	< 112,500	< 112,500	< 112,500
	R62	==========================	================	================	================
	R63	Cont. Duty Torque Limit	850	850	850
R51*R26	R64	Torque for Act Max Thrust	< 1,012	< 1,012	< 1,012
R27	R65	Stem Torque	< 430	< 367	< 367
R44*R49	R66	Max Pull-Out Torque @ 100% V	< 588	< 588	v 734 N: F:R44*R49*R41/R40
R66*R47	R67	Max Pull-Out Torque @ Min V	< 494	< 494	< 617
	R68	Spring Pack	0068	0068	0068
	R69	New Spring Pack Number	0701-212	0701-212	0701-212
	R70	Required TSS	1.75	1.75	1.75
	R71	Torque at TSS	438	438	438
R71/R26	R72	Thrust at TSS	< 19,471	< 19,471	< 19,471
	R73	Maximum TSS	1.75	2.00	2.25
	R74	Torque at Max TSS	438	550	638
R74/R26	R75	Thrust at Max TSS	< 19,471	< 24,450	< 28,362
	R76	Limiting Factor for Max TSS	Motor (Pull-Out)	Motor (Pull-Out)	Motor (Pull-Out)
	R77	Effective Valve Disc Factor			
(R75-R19-R18)/R13	R78	at Maximum TSS	< 0.21	< 0.35	< 0.42
	R79				
	R80				
	R81				

ATTACHMENT 3 TO JPN-91-039

GENERIC LETTER 89-10, SUPPLEMENT 3
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

ANCHOR/DARLING TESTING PROGRAM

New York Power Authority

JAMES A. FITZPATRICK NUCLEAR POWER PLANT
Docket No. 50-333

Attachment 3 to JPN-91-039

Anchor/Darling Valve Co.

Gate Valve Blowdown Test Program Summary

This test program is set up to evaluate the high flow valve closure effects on A/DV Double Disc Gate valves and A/DV Flex Wedge Gate valves.

Test Valves

1. 6" 900# A/DV Double Disc Gate Valve
2. 6" 900# A/DV Flex Wedge Gate Valve

Both valves are equipped with an SMB-1-40 Limitorque motor operator.

Test Description

Each test valve will be subjected to the following two sets of tests:

1. Three valve blowdown (closing) cycles using water at ambient temperature,
2. Three valve blowdown (closing) cycles using water at 580 degrees Fahrenheit.

The blowdown tests shall subject the gate valves to a 1400 psi differential pressure during valve closure from 50% closed to 100% closed. Seat leakage tests shall be performed at the start of each test set and after each valve test cycle. The test valves shall be disassembled and inspected after each valve test cycle

Schedule

The current schedule is as follows:

Task	Planned Completion	
	6" 900# FW	6" 900# DD
Test valve preparation	10/25/91	9/27/91
Test procedure preparation	8/16/91	8/16/91
Start testing at Wyle	1/6/92	10/28/91
Completes ambient temp. testing	1/24/92	11/15/91
Complete hot cycle tests	2/21/92	12/13/91
Finalize test report	4/24/92	2/21/92

This schedule is tentative and subject to change as the test program progresses.

ATTACHMENT 4 TO JPN-91-039

GENERIC LETTER 89-10, SUPPLEMENT 3
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

PLANT SPECIFIC SAFETY ASSESSMENT

New York Power Authority

JAMES A. FITZPATRICK NUCLEAR POWER PLANT
Docket No. 50-333

Attachment 4

New York Power Authority

JAMES A. FITZPATRICK
NUCLEAR POWER PLANT

PLANT - SPECIFIC
SAFETY ASSESSMENT

FOR THE

ISOLATION FUNCTION OF MOVs FOR HPCI AND RCIC STEAM SUPPLY LINE AND RWCU WATER SUPPLY LINE

Based on the Generic Safety Assessment prepared by:

GE NUCLEAR ENERGY
FOR
BWR OWNER'S GROUP

Prepared by ______ Date 12/12/90

Reviewed by Victor M Walz Date 12/12/90

Approved by ______ Date 12/12/90

Reviewed by Plant Operations Review Committee

Meeting No. # 90-110 Date 12/12/90

1.0 Introduction

On June 7, 1990 the NRC by letter to the BWR Owners' Group (BWROG) requested data concerning certain safety-related BWR Motor Operated Valve (MOV) capabilities. Data was requested for the primary containment isolation valves in the High Pressure Coolant Injection (HPCI) and Reactor Core Isolation Cooling (RCIC) steam supply lines, and the Reactor Water Clean-Up (RWCU) suction lines. This request was the result of a BWROG and NRC May 23, 1990 meeting which concerned the applicability of the Idaho National Engineering Laboratory (INEL) test data obtained to resolve Generic Issue 87. The NRC interpretation of this data is in NRC Information Notice 90-40 "Results of NRC-Sponsored Testing of Motor-Operated Valves" dated June 5, 1990.

The NRC interpretation of the test results appeared to indicate that a 0.2 or 0.3 disc factor, normally used to calculate valve seating forces, is not conservative. The calculated valve seating force is used to size the valve actuator and motor, and to establish the torque switch setpoint. Therefore, the actuator size or torque switch setting may be marginal or may not fully close the valve against postulated maximum design basis event flow and differential pressure (dp). This document demonstrates that a significant safety concern does not exist, even if the HPCI, RCIC and RWCU isolation MOVs are not optimally sized.

2.0 Summary

In summary this document explains that,

1. The need for these isolation valves to perform their intended design function of isolating a line break against a maximum differential pressure condition resulting from a postulated double-ended guillotine pipe break is unlikely because of leak before break characteristics and the availability of leak detection instrumentation.

2. The consequences of postulated leaks in these lines have been evaluated from a radiological, Environmental Qualification, and equipment flooding point of view and are bounded by other analyzed plant events.

3. The INEL tests represent extreme and worst case conditions. When breaks are postulated given expected system response and accident scenarios, successful isolation of the break is more likely.

This assessment concludes that existing FitzPatrick MOVs for the HPCI and RCIC steam supply line and RWCU suction line isolation have a high probability of full isolation under realistic conditions. In addition, HPCI and RCIC steam supply lines and the RWCU suction line MOVs have demonstrated proper operation under conditions mimicing the likely demand event, a pipe leak. System isolation will occur before the postulated design basis event high flow dp condition. Based on this the presently installed and maintained equipment does not represent an undue risk to the health and safety of the public.

3.0 Safety Assessment - HPCI/RCIC/RWCU Pipe Leaks

3.1 Leakage Considerations

It is industry experience that high energy piping experiences leaks long before a pipe break condition develops. Industry has referred to this as Leak-Before-Break (LBB). The FitzPatrick plant has multiple channel, and redundant leak detection monitoring of the high energy system lines external to the primary containment. This monitoring is sensitive to small leaks (~7 gpm) and causes both an alarm in the control room and automatic isolation signals to the leaking system's isolation MOVs. Isolation signals would initiate MOV closure long before the leakage could cause any significant flow change, fluid loss or radiation release, and before a significant long term environmental challenge to the MOVs. The MOVs have been environmentally qualified to the more extreme double-ended guillotine break environmental conditions. The MOVs are periodically inspected and tested to demonstrate operability during plant operation. In addition, these valves have occasionally been inadvertently closed during system operations. This has demonstrated unscheduled demand operability against the significant dp resulting from normal system flow rates.

3.2 Leak-Before-Break Justification

Although the design basis for the FitzPatrick plant as discussed in the FSAR, includes the evaluation of a loss of coolant accident resulting from a postulated pipe break, considerable effort goes into designing piping and vessel nozzle safe-end systems to assure that such a break will not occur. Piping systems are analyzed using appropriate codes and standards to limit applied stresses and materials are selected to provide adequate ductility and toughness. Piping design also provides implicit margins concerning fatigue failure. Extreme environmental effects are not considered significant. Piping materials (carbon steel) and steady state temperatures preclude environmentally-assisted cracking. Thus, while cracking may be postulated, the probability is low. Furthermore, leak detection systems are designed to assure that, even if a pipe cr safe-end (nozzle-pipe transition piece) should experience cracking, the crack would grow to a through-wall leak and the leak would be detected long before it reaches critical crack size which could cause a pipe rupture. This concept is called the 'Leak-Before-Break' concept or approach. This critical crack basis already exists in Section 4.10.3 of the FitzPatrick FSAR as part of the plant design basis discussion for the Reactor Coclant System.

In general terms, the LBB concept is based on the fact that reactor piping and vessel safe-ends are fabricated from tough ductile materials which can tolerate large through-wall cracks without complete fracture under service loadings. By monitoring the leak rate from the through-wall cracks and setting a conservative leakage limit of 7 gpm, cracks in piping can be detected well before the margin to rupture is challenged.

In NUREG 1061, Volume 3[1], the NRC Piping Review Committee outlined the limitations and general technical guidance on LBB analyses to justify mechanistically that breaks in high energy fluid system piping need not be postulated. In a recent modification to General Design Criterion 4[2], the NRC has formalized the use of the LBB approach to justify the elimination of pipe whip restraints and jet impingement barriers as design requirements for a hypothetical double-ended guillotine break in high energy reactor piping systems. Thus there is NRC recognition that the LBB concept provides realistic margin over and above the ASME Code piping design structural margins.

A key parameter in the LBB evaluation is the critical crack length at which pipe rupture is predicted. The focus in the LBB evaluation is on the through-wall circumferential cracks because such cracks could lead to a double-ended guillotine break.

The LBB approach is not being applied in this assessment to eliminate pipe whip restraints or jet impingement barriers or reduce inspections. Therefore, explicit LBB margins are not calculated nor are they necessary. Instead, the LBB concept is used in this assessment to demonstrate that the leakage from a through-wall crack with a length up to but less than the critical crack length, would be large enough to be readily detected such that isolation actions can be taken well before the critical crack length is achieved and long before maximum design basis event flows and pressures are established which could challenge the isolation motor-operated valves.

3.3 Critical Crack Length and Leak Rate Calculations

Critical crack length and leak rate calculations for FitzPatrick piping geometries is documented in Section 4.10.3.2 of the FitzPatrick FSAR. Reference [3] is an example of such calculations. The calculations presented here use methods [4,5,6] more recent than that used in the FitzPatrick FSAR calculations.

Table 1 lists the values of parameters used in the critical crack length and leak rate calculations which are typical for the FitzPatrick applications of interest. The results of the calculations for representative pipe sizes are summarized in Table 2. A limit load approach with a conservative value of stress equal to 2.4 S_m (where S_m is the value of material design stress intensity given in the ASME Code), was used in calculating the critical crack lengths. When based on test data, the stress for four inch diameter pipes was assumed to be 2.7 S_m. The leak rate calculation methods used for both the water and the steam lines are outlined in Reference [5].

An inspection of Table 2 shows that the calculated leak rate at critical crack length is a strong function of pipe diameter. Nevertheless, even for a 4-inch diameter water line, the predicted leak rate is 25 gpm at the critical crack length. A 25 gpm leak rate is larger than the leak detection rate sensitivity identified in the following section of this evaluation on leak detection with the exception of the RWCU cold water lines. These calculations conservatively ignore leak rate increases due to steam cutting, that can occur for a given crack length. Once leakage starts due to steam cutting it increases with time and the Table 2 leak rates can occur before reaching critical crack length. Full design basis MOV dp corresponding to a double ended guillotine break will not occur at these limits due to the downstream flow restriction (crack). Complete MOV closure will occur under these conditions. The RWCU cold lines have a much lower potential for cracking because of their constant cold condition.

Of significance is that the LBB margin increases with increasing pipe size. Thus, larger pipes where failure could be more significant have inherent LBB advantages. While the LBB margin is somewhat lower for smaller pipes, there is still a large BWR experience database supporting the integrity of such piping.

Inspection programs (e.g., In Service Inspections (ISI) per ASME Section XI), Generic Letter 89-08 [8] related commitments and other periodic inspections on system piping outside the isolation valves provide additional assurance of continuing piping integrity and low probability of pipe leak and break conditions. As indicated in the NRC's Staff Safety Assessment (Enclosure 1 of Generic Letter 89-10 Supplement 3), the HPCI and RCIC ferritic steel steam supply lines have low erosion/corrosion susceptibility. This is due to only intermittent operation during HPCI/RCIC pump testing. Unlike most BWR's no austenitic stainless steel is utilized for the FitzPatrick RWCU system piping. Therefore the concerns of Generic Letter 88-01 with respect to intergranular stress corrosion cracking (IGSCC) do not apply. The RWCU system has been modeled using the EPRI CHEC analysis program for erosion/corrosion potential. This system model accounts for the possible effects of Hydrogen Water Chemistry (HWC) on the corrosion layer within the carbon steel RWCU piping. The generally low flow velocities which exist in the RWCU system cause few areas of significant erosion/corrosion potential. These areas were inspected during the FitzPatrick 1990 refueling outage with no erosion/corrosion degradation noted. Additional inspections are planned for the 1991 refueling outage.

Based on the results of this and the following evaluation, it is concluded that the subject piping systems (HPCI, RCIC Steam Supply Line and RWCU Suction Line) are expected to develop a detectable leak before reaching the point of incipient rupture. A double-ended guillotine break in these lines with the resulting high break flows is highly unlikely.

3.4 Leak Detection Monitoring and Isolation

These systems at FitzPatrick have been designed for compliance to General Design Criterion (GDC) 54 [7] - "Piping system penetrating containment. Piping systems penetrating primary reactor containment shall be provided with leak detection, isolation, and containment capabilities ..." This GDC was satisfied with a defense-in-depth combination of pipe break, high flow monitoring and isolation sensors for large leaks for each high energy piping system. RCIC and HPCI use high flow and temperature monitoring and RWCU uses only temperature monitoring for isolation sensing. These same high energy piping systems also have sensitive, small leak (~7 gpm), temperature monitoring and isolation sensors.

At FitzPatrick redundant, safety grade temperature monitoring equipment continuously monitors areas outside primary containment where high energy lines are routed. The temperature sensors for this monitoring are grouped with the piping of each system and will alarm and isolate that system when a leak condition is detected. At FitzPatrick the sensors and logic are applied in a redundant design configuration to be single failure tolerant.

For the HPCI, RCIC and RWCU Systems the alarm and isolation limit is based on detecting leaks of less than 7 gpm [12]. This isolation is converted to a temperature value and is expressed in terms of a temperature rise of 40°F above maximum ambient temperature as listed in Technical Specification Table 3.2-1. The sensitivity of the temperature sensors provides a fast response to a developing leak. Even though a temperature limit may relate to a specific leak rate, these same temperature limits can be attained with much lower leak rates. A smaller leak for a longer time period can reach the temperature limit and allows recognition of smaller cracks.

In addition to the temperature monitoring system, the operator can detect small leakage flow into the reactor building floor and equipment drain sumps. There are also area radiation monitoring system gamma detectors that alarm during small leak conditions. These additional sources of leak detection provide data to the operator which call for further assessment including a visual inspection of the area.

Operating experience has shown relatively quick operator response to leaking conditions in safety systems and other monitored systems upon leak identification by routine inspection activities or by monitoring equipment isolations and alarms.

The leak detection temperature monitoring capability installed at FitzPatrick can detect the small leakage condition and initiate isolation long before a pipe break condition would develop. Therefore, the combination of the leak-before-break approach in conjunction with the leak detection capability provides early isolation at less than design basis conditions for a potential pipe break that might challenge the MOVs isolation capability at maximum flow-induced dp.

3.5 Radiological Consequences of Leakage Flow

The radiological consequences of the leakage flow from the HPCI, RCIC or

RWCU lines are bounded by plant design basis radiological release evaluations. The FitzPatrick design basis event for offsite release is the double-ended guillotine break of the main steam line. The evaluation of the offsite release results for this break assumes a large amount of reactor inventory loss prior to break isolation. The liquid phase of the reactor inventory contains most of the radioactive material which is released into the turbine building during the postulated break event. However, the resulting dose from the main steam line break is still only a fraction of the 10CFR100 limits. Furthermore, the total inventory loss for the small leakage associated with the HPCI, RCIC or RWCU line is only a small fraction of that from a main steam line double ended guillotine break and is contained inside secondary containment. For example, a 25 gpm hot water leak from RWCU typically can be detected within 10 seconds. This means that the total inventory release before detection is less than 30 lbs. This is a small fraction compared to the main steam line break liquid inventory loss which is approximately 140,000 lbs. total, of which 120,000 lbs. is liquid. Therefore, even if the leak detection requires 4000 times longer to isolate the detected leak, the radiological release from the leakage flow will be a very small fraction of the 10CFR100 limit. This radiological release would further be reduced by operator action in accordance with Emergency Operative Procedures and by the capabilities of secondary containment.

3.6 Environmental Qualification and Flooding Potential

The FitzPatrick Equipment Qualification (EQ) program has established the capability of the plant safety related electrical equipment to perform their design basis safety functions under the limiting environmental conditions postulated for that equipment. Equipment is qualified based on analysis and type testing at bounding environmental conditions that envelope a broad range of applications. The HPCI, RCIC and RWCU isolation MOVs are qualified to environmental envelopes that bound HELB conditions as well as containment LOCA conditions. Other required equipment is qualified to the analyzed HELB conditions which are much worse than the small leak environmental conditions that would be postulated due to the leak before break scenario. The existing HELB analysis assumes 100% relative humidity for 48 hours post-LOCA. Therefore, the Leak-Before-Break scenario cannot result in a worse relative humidity condition. Since mass and energy release is much less, the overall severity of the accident in the terms of temperature and pressure condition will be much less. Therefore, the Leak-Before-Break scenario is enveloped by the design basis HELB analysis. Since essentially atmospheric pressure would exist in the reactor building the maximum achievable temperature (i.e., 212°F) would be the same with or without prompt isolations. The worst case localized superheated expansion temperature to atmospheric pressure would be approximately 325°F. Time duration at maximum conditions would increase without prompt isolation. The motor operators installed on the HPCI/RCIC/RWCU isolation MOVs are qualified to primary containment accident conditions which exceed these temperature values.

For noncompartmentalized arrangements such as FitzPatrick, the bulk building conditions could be postulated to reach saturated steam conditions at atmospheric pressure if the pipe break is not isolated. These conditions would exceed existing qualification limits for some equipment. However, the FitzPatrick Emergency Operating Procedures provide low administrative temperature limits for several reactor building areas. If a primary system is discharging into the reactor building and the maximum safe temperature is exceeded in two or more areas, then emergency RPV depressurization is required. This action would successfully minimize the exposure of sensitive reactor building equipment from harsh conditions.

The final potential area of concern that has been considered is equipment submergence due to flooding resulting from a postulated pipe break without isolation. At FitzPatrick existing flood control measures such as curbs and drains and equipment elevations above floor level are adequate to control the volume of condensed water released from such breaks. The fluid released in such a postulated break would be steam or hot water which would quickly flash to steam and condense on various heat sink surfaces throughout the reactor building. EQ program controls, such as requirements for orientation, weep holes and conduit seals would effectively protect vital equipment from such conditions. Flooding and submergence potential is a result of the collection of this condensate. Therefore any flooding effects would be widely distributed within the reactor building and delayed after the postulated break. Additionally, since the reactor building cannot withstand any significant pressure, evaporation and venting of water vapor may occur further reducing the potential for any flooding problems. Flooding expected under these conditions may be similar to that which would occur with activation of the fire protection system water curtains.

Therefore, no EQ concern exists for MOV isolation or the functioning of other safety systems equipment due to small pipe leaks postulated under the leak before break criteria. In evaluating the consequences of a postulated double-ended guillotine break without prompt isolation it is expected that existing EQ enveloping environmental conditions would not be significantly exceeded as the result of emergency RPV depressurization.

3.7 Leakage Flow and Inadvertent Closure

From leak-before-break considerations, with the capabilities of detection and isolation of a small leak, the leakage flow from a postulated leaking piping system would be small. Such small leakage, when compared with normal and standby flow capabilities of the systems, would not establish any appreciable dp across a closing isolation MOV until fully closed.

Further, there have been inadvertent isolation events of these MOVs since they were installed. Some of these isolations have occurred at or near 100% system flow rates. This demonstrates isolation capability well in excess of small pipe leak flow conditions. It should be further noted that as the HPCI/RCIC valves close they are subjected to the full reactor pressure (1000 psi) across the valve seat. This dp will be equivalent to the isolation MOV end-of-stroke dp conditions for a double-ended guillotine break. Therefore, in-situ valve closure capability has been demonstrated. MOV isolation operability for small pipe leaks has been demonstrated for all three systems.

4.0 Safety Assessment - Design Basis Pipe Break

4.1 Realistic Analysis Conditions

An analytical assessment of a postulated design basis pipe break condition in one of the three BWR systems of concern can be looked at from a realistic perspective, just like the postulated small leak condition. A realistic review without all of the design basis assumptions was conducted because of the low probability (4 x 10^{-4}/yr) of a high energy line break in one of these systems. Any MOV at FitzPatrick which might be considered marginal or inadequate, when comparing the actuator size and deliverable stem force against expected required thrust, may still be helpful in achieving full or partial system isolation. Table 3 provides design thrust requirements and valve functional test results as provided to the BWROG in response to the NRC's request [13].

Some beneficial conclusions can be drawn from the system design, equipment design, and physical attributes of the systems and equipment. There are MOV design considerations which have been included during the design process which make MOV actuators more capable than their ratings state [11].

The actual flow during a postulated leak would probably be closer to the 100% system flow rate rather than that attributable to the double-ended guillotine break. This is because ductile pipe lines do not physically guillotine rupture and there would be a flow interference from the remaining piping. Some of these valves have already demonstrated the ability to close under comparable full flow conditions when inadvertent system initiation and isolations have occurred.

There are two MOV isolation valves in series on each of the subject lines. These valves are mounted in the supply lines very close together and separated only by the primary containment wall. Upon receipt of isolation signals they will not close at exactly the same time. This is because of realistic, but small physical differences, as well as the fact that inboard units are driven by high speed AC motors while outboard units are driven by DC motors. Therefore, each valve may be subjected to instantaneously different dp levels as they are closing. The alternate sharing of the break flow high pressure conditions and any cycling of this sharing between the two valves would probably allow at least one of the isolation valves to continue its closure motion until it becomes fully closed with the possibility of the second valve following thereafter. This possibility might better be described as a sharing or splitting of the high pressure condition between the valves. As the valves reach the end of stroke, they will be subjected to the full dp condition. However, as discussed in Section 3.7, this is equivalent to the conditions that these valves would experience at the end of travel during an inadvertent isolation.

4.2 Nuclear System Impact

Assuming the high energy line break occurs external to the primary containment in one of the three subject systems the impact on the nuclear system would be less severe than a Design Basis Accident (DBA). The high energy lines are small lines (compared to the DBA) and would require less Emergency Core Cooling System (ECCS) flow for core cooling and maintain reactor vessel inventory. Any one of the six low pressure injection pumps (Core Spray or Low Pressure Coolant Injection) would be sufficient to provide core cooling and handle the consequences of a postulated line break. The FitzPatrick loss of coolant accident analyses for the same line breaks inside the containment (which cannot be isolated) show that there will not be any resulting core or fuel damage for the smaller line break events.

ECCS components have spatial separation such that the impact of the postulated high energy line break should affect only one division of equipment. The remaining division will be more than sufficient to handle even the maximum line break considered in this analysis (as opposed to a more likely small leak in the line).

Therefore, the FitzPatrick plant has adequate safety margin to protect the reactor core and provide adequate leak detection and isolation capability using the presently designed isolation MOVs and other mitigating measures.

4.3 Offsite Dose Release Impact

The radiological release from the postulated double-ended guillotine break of the HPCI and RCIC steam line is bounded by that of the main steam line break. These smaller lines do not depressurize the reactor vessel as fast as the main steam line. The reactor inventory release for these breaks is mostly steam. The dose from steam loss through an outside line break is small. Therefore, the offsite release from the HPCI and RCIC steam line break will still meet requirements of 10CFR100. The reactor inventory loss from the double-ended guillotine break of the RWCU line will be mostly liquid. However, the radiological consequences of the RWCU line is bounded by that of the main steam line, based on the significantly smaller line size and valve closure times for the RWCU isolation valves assuming prompt isolation occurs. The radiological release from the main steam line is only a small fraction of that of 10CFR100. Therefore, any slightly longer valve stroke time for the RWCU isolation valves will not result in exceeding the requirements of 10CFR100.

5.0 Applicability of the NRC Sponsored INEL Tests to FitzPatrick

A significant difference exists between the gate valves tested in the NRC sponsored testing program and the gate valves installed in these systems at the FitzPatrick plant. The valves tested by the NRC were representative of several different manufacturers but all were the flexible wedge gate valve design. When the NRC planned and initiated their testing program the flexible wedge gate valve was the predominant design used by BWR's for these applications. During the 1988 and 1990 FitzPatrick refueling outages Anchor Darling parallel double disc gate valves were installed at the FitzPatrick plant for all lines of concern. The parallel double disc gate valve is considered a better design than the flexible wedge gate valve for flow isolation purposes. Many PWR's use parallel double disc gate valves as main steam isolation valves (MSIV's). Because of this fundamental difference in valve design, the Authority does not believe that NRC sponsored test results are directly applicable to these particular MOV's at the FitzPatrick plant.

The Anchor Darling Valve Co. designed and sized the actuators for these MOV's using a valve disc friction coefficient or valve factor of 0.2. Choice of this valve factor was based on Anchor Darling's considerable experience with parallel double disc gate valve applications. Reference 10 describes tests performed in Germany on a KSB parallel disc gate valve. These flow interruption tests were similar to the NRC sponsored tests except they were performed at somewhat higher pressures (approximately 1300 to 1750 psia). The results of these tests were maximum valve friction coefficients of 0.33 to 0.41 for high pressure and temperature tests. While these friction coefficients are greater than the 0.2 used by Anchor Darling they are considerably less than the 0.5 to 0.7 disc friction factor suggested by the NRC sponsored test results on flexible wedge gate valves. The Authority does not know how similar are the KSB and Anchor Darling parallel double disc gate valve designs. The Authority understands that the Anchor Darling Valve Co. plans to perform flow interruption tests on their design of parallel double disc gate valve during the second quarter of 1991. These tests will provide data that will be directly applicable to the isolation MOV's of concern at the FitzPatrick plant.

6.0 Other Mitigating Factors

6.1 Training and Emergency Operating Procedures

The FitzPatrick Emergency Operating Procedures (EOP's) will quickly lead to reactor depressurization for the case of a primary system discharging into the reactor building, such as a double ended guillotine break of the HPCI/RCIC/RWCU lines without isolation. Emergency Operating Procedure EOP 5 (Secondary Containment Control) leads to emergency reactor depressurization if the maximum safe temperature is exceeded in two or more reactor building areas. The maximum safe temperatures are as low as 113 to 133 degrees F for several reactor building areas where the most sensitive reactor building equipment is located. A double ended guillotine break without isolation will result in saturated conditions at atmospheric pressure with a resulting temperature of 212 degrees F. Therefore these conditions would direct emergency RPV depressurization before significant damage to reactor building equipment could occur. In addition, Emergency Operating Procedure EOP 2 (Reactor Pressure Vessel Control) applied together with EOP 5 provides for rapid depressurization using the bypass valves if it is anticipated that any reactor building maximum safe temperature will be exceeded.

Thorough training on the requirements and the use of the FitzPatrick EOP's is included as part of the initial and requalification licensed operator training programs. Simulator training includes an exercise which simulates a HPCI line DEGB without isolation (Simulator Exercise Guide 81930). This tests the control room operator's response, using the guidance of EOP 2 and 5, to successfully protect the reactor fuel and reactor building equipment by means of RPV depressurization. The failure of the isolation function is readily apparent from the light indication for the MOV's. From the reactor building area temperature rise and the isolation valve position light indications, the operator will be able to determine when reactor depressurization is required.

6.2 Waterhammer Prevention Practices

The HPCI and RCIC steam supply lines are kept pressurized and drained of condensate. This draining practice generally prevents the possibility of water hammer and turbine water induction due to prompt demand operation. There have been some water hammer problems with one of the two steam condensing lines to the RHR heat exchangers. This water hammer may be the result of flashing of undrained condensate during HPCI initiation. This problem is under evaluation and may be corrected with modifications to the piping system.

The RWCU system is a normally and continuously operating system which has not experienced water hammer events during isolations. This is because that with an isolation, the RWCU pump trips and flow rate decays as pump speed coasts down. Thus there is little flow velocity when the isolation valves approach the closed position.

As a general practice, operating procedures require that water systems be filled and vented prior to start-up This operating practice, together with "keep full" systems has reduced the likelihood of water hammer events at the FitzPatrick plant.

6.3 Probabilistic Risk Considerations

The Authority has developed a Probabilistic Risk Assessment (PRA) model for the FitzPatrick plant in accordance with Generic Letter 88-20 guidelines. The probability of failure of the ECCS systems combined with the probability of a line break is sufficiently low as to preclude consideration of this event as a practical concern.

6.4 Current Torque Switch Bypass Settings

At the FitzPatrick plant, the close torque switch is not bypassed for any significant portion of the valve stroke. Since the torque switch is in the circuit, it will tend to protect the actuator motor from overload failure if excessive loads are encountered during the closing stroke. This will permit repeated attempts to close the valve as the differential pressure and required thrust is reduced. Reduced differential pressure may be the result of emergency RPV depressurization or depressurization through the break.

6.5 HPCI Warming (Bypass) Valve

At FitzPatrick the steam supply line for the HPCI turbine is kept warm and pressurized through a 1 (one) inch bypass globe valve (23MOV-60) and the main supply outboard isolation valve (23MOV-16) is normally closed. Therefore design basis flow thru any break of the HPCI steam line downstream of the outboard containment isolations valves, while 23MOV-16 is closed (normal standby line-up), would be limited to choked flow through the bypass valve. This greatly reduces the closing flow requirement on the inboard isolation valve.

7.0 Conclusions

Because of the leak-before-break considerations for the HPCI/RCIC/RWCU piping and the installed leak detection and isolation systems, it is not expected that system isolation MOVs would ever be challenged at high flow design basis accident conditions. With these effective isolation systems leaks should be isolated early at low or zero flow conditions. Additionally, realistic consideration of expected plant and system response to postulated accident conditions leads to the conclusion that there is a significantly high probability of successful valve closure. Even without successful full valve closure for a postulated rupture in these lines, there is adequate safety margin in the ECCS to handle the reactor coolant inventory losses. The ECCS systems are designed for a much larger break than these small line ruptures. Delayed isolation responses for these three systems is expected to keep offsite dose releases within 10CFR100 requirements.

8.0 References

[1] Report of the U.S. Nuclear Regulatory Commission Piping Review Committee, NUREG-1061, Volumes 1 through 5, 1984.

[2] Federal Register, Volume 52, p. 41288, final rule modifying General Design Criterion 4 in 10 CFR Part 50, Appendix A.

[3] GESSAR II, 238 Nuclear Island, Section 5.2.5, GE Document No. 22A7007, Rev. 0.

[4] S. Ranganath and H.S. Mehta, "Engineering Methods for the Assessment of Ductile Fracture Margin in Nuclear Power Plant Piping," ASTM STP 803, 1983, pp. II-309 to II330.

[5] A. Zahoor, R.M. Gamble, H.S. Mehta, S. Yukawa and S. Ranganath, "Evaluation of Flaws in Carbon Steel Piping: Appendixes A and B, "EPRI Report No. NP-4824SP, October 1986.

[6] Mehta, H.S., "Determination of Crack Leakage Rates in BWRs", Attachment 2 in Letter dated April 22, 1985, from Jack Fox, Chairman, ANS-58.2 Working Group to K. Wichman of NRC.

[7] 10 Code of Federal Regulations 50 Appendix A General Design Criteria

[8] NRC Generic Letter 89-08 Erosion/Corrosion-Induced Pipe Wall Thinning, dated June 25, 1989.

[9] NRC IE Bulletin 85-03 Motor-Operated Valve Common Mode Failures During Plant Transients Due to Improper Switch Settings, dated November 15, 1985.

[10] U. Simon, N. Rauffmann and H. Schafer, "Testing of Safety-Related Valves of PWR and BWR Power Plants," AMSE paper from PVP - Vol. 180, Pipeline Dynamics and Valves, Book No. H00495 - 1989.

[11] Limitorque Corp. letter, "Limitorque Type SMB Actuator Thrust Ratings," dated April 30, 1987, from D. S. Waring to G. Levy, Duane Arnold Energy Center.

[12] General Electric Co. APED Design Specification No. 22A2931, Rev. 1, "Nuclear Boiler Leak Detection," dated April 4, 1972.

[13] NRC letter, "Performance of the Motor-Operated Valves Within the Scope of Generic Safety Issue 87," dated June 7, 1990, from J. E. Richardson to S. D. Floyd, Chairman BWR Owners Group.

TABLE 1

VALUES OF PARAMETERS USED IN CRITICAL CRACK LENGTH AND LEAK RATE CALCULATIONS

Pipe Thickness : Schedule 80

Pipe Internal Pressure : 1050 psi

Temperature : 528°F

Normal Operation Bending Stresses : 4 ksi

Material : Stainless Steel or Carbon Steel

TABLE 2

CRITICAL CRACK LENGTHS AND LEAK RATES FOR VARIOUS DIAMETER PIPES

Pipe Diameter (in.)	Critical Crack Length (in.)	Leak Rate at Critical Crack Length (gpm)	
		Water	Steam
4	7.1	25	15
6	9.8	41	27
12	18.5	166	108
16	23.1	262	170

TABLE 3

FUNCTIONAL VALVE TEST RESULTS

	VALVE/SIZE (IN.)	OPER/MOTOR MFG	MTR SZ (FT-LBS)	OPTR	D/P(1) (PSIG)	TEMP(1) (F)	TORQUE SWITCH THRUST DESIGN	TEST	BASIS TEST D/P	BASIS CALCS
HPCI VLVS										
23MOV-15	A/D DD 10	LIM/REL	40	SB-1	1,250	545	19130	26271	N/A	VOTES
23MOV-16	A/D DD 10	LIM/PEER	60	SB-1	1,250	545	19125	20326	N/A	VOTES
RWCU VLVS										
12MOV-15	A/D DD 6	LIM/REL	10	SB-00	1,020	545	8793	9354	N/A	VOTES
12MOV-18	A/D DD 6	LIM/PEER	15	SB-00	1,020	545	8793	11465	N/A	VOTES
RCIC VLVS										
13MOV-15	A/D DD 3	LIM/REL	2	SB-000	1,250	545	2967	3300	N/A	VOTES
13MOV-16	A/D DD 3	LIM/PEER	5	SB-000	1,250	545	2967	2606(2)	N/A	VOTES

(1) A/E supplied design values, [illegible] opening/closing parameters not specified.

(2) Acceptable because measured packing load was considerably less than the design assumed 800 Lbs.