WESTINGHOUSE VALVE
PRESSURE LOCKING SPECIAL TEST PROCEDURE

Revision 0
September 12, 1995

ComEd Company

Corporate MOV Program Support

Prepared by: ______________________
John F. Kelly
MOV Program Support

Approved by: ______________________
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NES MOV Program Engineer

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A. PURPOSE

The purpose of this special test is to validate the proposed model and input assumptions for quantifying capability margin for valves susceptible to pressure locking. Specifically, testing will verify:

- the model for estimating MOV pressure lock pullout forces
- bonnet ability to retain pressure when upstream pressure source is removed
- bonnet pressure response to temperature changes

The MOV for this special test is a Westinghouse valve. This procedure provides the test requirements, procedures, and equipment to be used.

This special test procedure shall not be used on equipment installed in an operating Nuclear Station.

B. REFERENCES

1. Generic Letter 95-07, Pressure Locking and Thermal Binding
2. ComEd Quality Assurance Program Sections 9 and 11

C. TEST EQUIPMENT AND INSTRUMENTATION

1. All instrumentation, measuring, and test equipment used in the performance of this test program should be calibrated in accordance with ComEd's Quality Assurance Program
2. Measurement Equipment is listed in Table 1
3. Thrust, torque, motor power, and motor current shall be monitored.
4. Upstream, downstream, and bonnet pressure and temperature should be recorded as specified herein.
5. Westinghouse valve
6. Teledyne Quick Stem Sensor
7. Hydro-pump capable of generating 2500 psi
8. Miscellaneous valves and fittings

D. PRECAUTIONS

1. Standard safe work practices shall be followed when working around high pressure and electrical test equipment.
2. Do not exceed 2500 psig pressure.

E. REQUIREMENTS AND PROCEDURES

Table 2 specifies the testing to be performed and the test sequence. This test sequence may be modified during the special test. New or revised test sequences should be added to Table 2.

1. Pre-Test Preparation
   a. Record valve and actuator nameplate data into the test Data Sheet (Appendix A-7).
   b. The required measurements and associated instruments to be installed are listed in Table 1.
   c. The data acquisition system will consist of the VOTES computer, breakout box, motor power monitor, and associated cables.
   d. Pressures and temperatures will be recorded manually.
   e. Prior to any testing or stroking of the valve, actuator switches shall be set as follows:
      1) The open limit switch shall be set to prevent back-seating of the valve. 93%

      Signature 09-13-95
      Date

      2) The open torque switch should be bypassed a minimum of 25% of the open travel distance.

      Signature 09-13-95
      Date

   f. If necessary, calibration of the VOTES Force Sensor and Teledyne Quick Stem Sensor shall be documented on Attachment A-1

2. Static Break-in Test

Verify that the valve has been stroked a minimum of 15 strokes open and 15 strokes closed. If not, cycle valve until the specified strokes are achieved. Inrush power = 13.57 Kw

Signature 09-13-95
Date

3. LLRT Test

An LLRT Leakage Rate Test shall be performed at specified torque switch settings <u>in both directions</u> to verify seat leakage requirements in accordance with approved station procedures. Document results in Appendix A-2

4. Differential Pressure Test

   a. With the valve open fill the specimen with water .
   b. With the valve unpressurized, stroke test specimen open and then closed at the lower torque switch setting and record test data.
   c. Pressurize upstream disk side per Table 2.
   d. Vent downstream disk side to atmosphere.
   e. Open the valve , record diagnostic test data, and record upstream pressure.
   f. With the valve unpressurized, stroke test specimen closed and record test data.
   g. Perform valve factor calculation as described in Attachment A-3 and record results.

5. Bonnet Pressure Response

   a. With the valve open fill the specimen with water such that air pockets are vented and bonnet is filled with water.
   b. With the valve unpressurized and setup per Table 2, stroke test specimen open and then closed and record test data.
   c. Pressurize valve bonnet to the pressure indicated in Table 2 for this test.
   d. Vent upstream and downstream disk side to atmosphere and record bonnet pressure as a function of time.

6. Pressure Lock Test

   a. With the valve open fill the specimen with water such that air pockets are vented and bonnet is filled with water.
   b. With the valve unpressurized and setup per Table 2, stroke test specimen open and then closed and record test data.
   c. Pressurize bonnet to the pressure indicated in Table 2 for this test.
   d. Vent downstream and upstream disk side to atmosphere.
   e. Record bonnet pressure and open/close the valve while recording diagnostic test data.

7. Bonnet Pressure Response to Temperature Changes

   a. With the valve open fill the specimen with water such that air pockets are vented and bonnet is filled with water.
   b. With the valve unpressurized and setup per Table 2, stroke test specimen open and then closed and record test data.
   c. Heat bonnet to maximum achievable temperature.
   d. Monitor and record fluid temperature and bonnet pressure in Appendix A-6 until stable.

F. RESULTS/ACCEPTANCE CRITERIA

The results of this test will be used as technical input for evaluations and calculations to resolve/assess the pressure locking issue. This test has no acceptance criteria. Verify that calibrated equipment is within calibration dates at the completion of testing.

MPM cal out of date. will be calibrated subsequent to test.

______ / 9-13-95
Signature Date

G. RECORDS

The following information shall be retained as Quality Records:

- Diagnostic Test Data, VOTES and MPM (electronic format)
- Training Qualification Records for personnel operating test equipment
- Test results Data Sheets
- Test Procedure

H. PERSONNEL QUALIFICATIONS

Operation of diagnostic test equipment shall be performed by qualified individuals. This includes:

- Liberty Technologies Basic, Advanced, and Continuing VOTES System Training
- Liberty Technologies Advanced MPM Training

Personnel performing diagnostic testing shall sign and date the applicable Data Sheet(s)

I. SCHEDULE

A specific completion date is not required for this test.

TABLE 1 / CALIBRATION LOG
MEASUREMENT EQUIPMENT ~~AND TOLERANCES~~

Measurement Parameter	Device Name	QA/Serial #	Calibration Date/Due Date
Pressure Gage Upstream Disk Side	GAGE	66295	9-7-95/Post Test
Pressure Gage Downstream Side	—	Not Used	—
Pressure Gage Bonnet	GAGE	60900	9-7-95/Post Test
Temperature Gage Bonnet	—	NOT USED	—
Stem Torque	Teledyne Quick Stem Sensor	—	—
Stem Torque	Liberty , VTC	—	—
Stem Thrust	Teledyne Quick Stem Sensor	—	—
Stem Thrust (Verification)	Liberty, C-Clamp	278973BR	07-95 /01-96
Motor Power Monitor System	Liberty, MPM	A1019/C1020	7-23-94/1-23-95
VOTES System ~~Computer~~	Liberty	—	
VOTES Breakout Box	Liberty	278951BR	07-95/ 01-96

mpm Computer A1019 / C1020 7-23-94/1-23-95

LLRT

Pressure LLRT 033200BR 8/95/2-96

Flow Meter LLRT 104945BR 12-94/12-95

MPM OPERATOR : JK 9/13/95 ~~Bill Cote~~/ John Kelly

VOTES OPERATOR : Chris Bedford

Prepared 09-13-95 Date

Reviewed 9/13/95 Date

TABLE 2
TESTING SEQUENCE AND NUMBERING

Procedure Section	Test Title
F.3	LLRT1
F.4	Differential pressure test to quantify friction factor at 500 psi
F.4	Differential pressure test to quantify friction factor at 1000 psi
F.4	Differential pressure test to quantify friction factor at 1500 psi
F.5	Bonnet Pressure Response at 1000 psi and lowest torque switch setting
F.5	Bonnet Pressure Response at 2000 psi and lowest torque switch setting
F.5	Bonnet Pressure Response at 1000 psi and highest torque switch setting
F.5	Bonnet Pressure Response at 2000 psi and highest torque switch setting
F.6	Pressure Lock Un-wedging at 500 psi and lower torque switch setting
F.6	Pressure Lock Un-wedging at 1000 psi and lower torque switch setting
F.6	Pressure Lock Un-wedging at 1500 psi and lower torque switch setting
F.6	Pressure Lock Un-wedging at 2000 psi and lower torque switch setting
F.6	Pressure Lock Un-wedging at 500 psi and higher torque switch setting
F.6	Pressure Lock Un-wedging at 1000 psi and higher torque switch setting
F.6	Pressure Lock Un-wedging at 1500 psi and higher torque switch setting
F.6	Pressure Lock Un-wedging at 2000 psi and higher torque switch setting
F.7	Bonnet pressure response to temperature at higher torque switch setting.

QSS ~~VFS~~ CALIBRATION FIELD DATA SHEET

Appendix A1

VALVE TAG NUMBER: TEST VALVE

VOTES SYSTEM SERIAL NO.: A 1068

VOTES SYSTEM QA NO.: 278951 BR

CAL DUE DATE: 1/96

CALIBRATOR LOCATION: THREADED [✓ UN-THREADED] SLOTTED TRANSITION

DESCRIPTION: VOTES SYSTEM WITH QSS LOCATED ON SOLID SECTION, EFFECTIVE DIA 1.229 CALIBRATOR USED TO CALIBRATE QSS.

NEW EFFECTIVE STEM DIA. 1.229

CB3-100 LENGTH: 30 ft

AMP PROBE SETTING: 2V 20A

ANTI-ROTATION DEVICE: [✓ yes] no

CALIBRATION TABLE

RUN #	Test Number/Date	~~VOTES SENS NO.~~ QSS	CAL DEV. NO.	CLAMP PRE-TENSION READING	TSS	MAX THRUST	RSQ	CFA	BFSL SENS	BFSL % CHG	STEM TEMP (F)	GAIN
1	9/13/95	3352	10023	2990	1.0	13,532	1,000	1.000	-2.437×10^{-2}		70°F	515
2	9/15/95	11	10023	2995	2.0	19,819	1.000	1.000	-2.447×10^{-2}	0.41	70°F	515
3												

Prepared: ________ Date: 9/13/95 Reviewed: RC Bed ________ Date: 9/13/95

LLRT RESULTS DATA SHEET

Appendix A2

VOTES Test #/Date	TSS	C14, lbf	C16, lbf	Pullout, lbf	Leakage, scfm	Comments, Note upstream or downstream test.
10/ 9-13	1.5	14,877	15,447	—	0 *	UPSTREAM SIDE TEST
	1.5				0 *	DOWNSTREAM SIDE TEST
11 / 9-13	1.0	13,183	13,820		0 *	oppisite flow direction - DOWNSTREAM
	1.0				0 *	UPSTREAM SIDE TEST.

Prepared: Date: 9-13-95 Reviewed: Date: 9/13/95

* VALUES ARE ACCURATE TO WITHIN 0.4 SCFH

DIFFERENTIAL PRESSURE TEST RESULTS DATA SHEET

VOTES Test #/ Date/ TSS	C14/C16/~~[illegible]~~ Thrust, lbf	Pullout Thrust, lbf	Upstream Disk Side Pressure, psi	Downstream Disk Side Pressure, psi	O10 Thrust, lbf	Open Run Thrust, lbf	Open Valve Factor[1]	Comments
6 /9/13 /~~1.0~~1.5	14929 15050lbs	3167 lbs	500/460	0	2430	1517	0.33	
7 / 9/13/ ~~1.0~~ 1.5	14810/ 15665	2904	500/ 480	0	2359	1508	0.314	
8/ 9-13-95/	15347/ 15597	3378	[illegible] 1040/ ~~1056~~/ 980	0	2640	1482	0.251	.258
9	15,012/ 15548	3501	1690/1590	0	2675	1541	0.208	
13	13079/ 13751	3500	1980/1880	0	2727	1581	0.194	

[1] Valve Factor =
$$\frac{\text{O10} - \text{Run Load} + \left[\text{Upstream Pressure} \times \frac{\pi}{4}(1.25)^2\right]}{\text{Upstream Pressure} \times \frac{\pi}{4}(3.445)^2}$$

Prepared: Date: 9-13-95 Reviewed: Date: 9/13/95

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DIFFERENTIAL PRESSURE TEST RESULTS DATA SHEET

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mpm	VOTES Test #/ Date/ TSS	C16 Thrust, lbf	Pullout Thrust, lbf	Upstream Disk Side Pressure, psi	Downstream Disk Side Pressure, psi	O10 Thrust, lbf	Open Run Thrust, lbf	Open Valve Factor[1]	Comments
	18	STATIC	TEST	~~510/505~~	0	~~2734~~			
	19	19269/19717	2751	510/505	0 2292	~~1713~~ ~~2734~~ ECB 9/15/95	1582 RW 9/15/95	~~.160~~ .28	
	20	19250/19914	2870	1030/1020	0 2342	~~1764~~ ~~2764~~ ECB 9/15/95	1615	~~.248~~ .20	
	21	19252/19900	3091	1512/1496	0	2428 ~~1679~~ wme 9.15.95	1604	.19	
10:22	22	19351/19949	3125	1964/1944	0	2377 ~~2223~~ wme 9.15.95	1634	.17	
10:42	23	19435/20047	3108	1900/1880	0	2529	1694	.18	
10:54	24	19563/20112	2852	1596/1576	0	2359	1694	.18	Run 10 1000psid dP Test start from 24
11:00	25	19131/19946	2410	1078/1068	0	2070	1670	.17	

NOTE: Upstream pressures include Initial/Pressure while riding on seats

$$^{1}\text{Valve Factor} = \frac{\text{O10} - \text{Run Load} + \left[\text{Upstream Pressure} \times \frac{\pi}{4}(1.25)^2\right]}{\text{Upstream Pressure} \times \frac{\pi}{4}(3.445)^2}$$

Prepared: JKR Date: 9-13-95 Reviewed: RC Bd Date: 9/15/95

VOTES Test #/ Date/ TSS	C16 Thrust, lbf	Pullout Thrust, lbf	Upstream Disk Side Pressure, psi	Downstream Disk Side Pressure, psi	O10 Thrust, lbf	Open Run Thrust, lbf	Open Valve Factor[1]	Comments
46/09-15 2.0	14,477/20,058	2699	1532/1515	~~1522~~ 0 ~~1515~~ RCB 9/13/95	2009	1742	0.15	
47/9-15 2.0	19410/20291	3192	1561	0	2240	1754	0.16	Reverse flow DP test

$$^{1}\text{Valve Factor} = \frac{\text{O10} - \text{Run Load} + \left[\text{Upstream Pressure} \times \frac{\pi}{4}(1.25)^2\right]}{\text{Upstream Pressure} \times \frac{\pi}{4}(3.445)^2}$$

Prepared: _______ Date: 9-13-95 Reviewed: R.C. Bedy Date: 9/15/95

PRESSURE LOCK TEST RESULTS DATA SHEET

Test Description	VOTES Test #/ Date	MPM Title/ Date/ TSS	C14/C16 Thrust, lbf	09 Thrust, lbf	Bonnet Pressure, psi	Pullout Motor Power, kW	Pullout Torque, lbf	Comments
Static	15	—	19383/19835	1885	0	—	20.0	
Pressure Lock	16	4:23 ~~15~~ 9-12 1500 PresLock TSS = 2.0	19646/19616	5991	1650	1.8K	≈67.7	Inrush Power = 13.61KW
Static	17	—	19,147/19,784	1902	0	—	20.3	

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PRESSURE LOCKING SPECIAL TEST PROCEDURE
Revision 0
PRESSURE LOCK TEST RESULTS DATA SHEET

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Test Description	VOTES Test #/ Date	MPM Title/ Date/ TSS	C14/C16 Thrust, lbf	09 Thrust, lbf	Bonnet Pressure, psi	Pullout Motor Power, kW	Pullout Torque, lbf	Comments
Static Prior to DP	18	STATIC TSSMAX	20101	1952	0	1.1441 Kw	20.7	C14 19503
Static OLP	26	STATIC 11:07 TSSMAX	19433/ 20031	1900	0	1.17	21.3	
Static OLP	27	Static 11:13 TSSMAX	19481/ 20129	1866	0	1.165	21.5	
Static 500 LP	28	Static 11:19 TSSMAX	19481/ 20179	1441	500	NOT TAKEN	16.6	
Static 500 LP	29	Static 11:21 TSSMAX	19432/ 20080	1458	500	NOT TAKEN	17.3	
PL at 500 w/o bonnet	30	TSS MAX 11:26 PL 500	19,415/ 20,096	3005	~~500~~ 496	1.165 KW	36.1	Closed valve with 496 ~~500~~ psi LP
PL at 500/w bonnet	31	TSSMAX 11:36 PL 500	14,414/ 19,874	2988	514	1.194 Kw	35.8	〃
Static 1000 LP	32	TSS MAX 11:45 STATIC 1000 LP	19,351/ 19,962	896	998	.81K	10.4	
PL at 1000	33	TSS MAX 11:50 PL 1000	19,381/ 20,029	3907	978	0.967	47.5	Closed valve with 978 ~~1000~~ psi LP
Static 1000 LP	34	TSS MAX 11:56 STATIC 1000 LP	19,281/ 19,962	930	1008	0.789 Kw	10.7	LP 1008
PL at 1000	35	TSS MAX 12:01 PL 1000	19,380/ 19,994	3890	988	1.367 KW	46.8	
Static 1500 LP	36	TSSMAX 12:06 Static	18,801/ 19,249	522	1580	.692	2.2	See Test 45 for zero

Prepared: Date: 9-13-95 Reviewed: Date: 9/13/95

PRESSURE LOCKING SPECIAL TEST PROCEDURE
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PRESSURE LOCK TEST RESULTS DATA SHEET

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Test Description	VOTES Test #/ Date	MPM Title/ Date/ TSS	C14/C16 Thrust, lbf	09 Thrust, lbf	Bonnet Pressure, psi	Pullout Motor Power, kW	Pullout Torque, lbf	Comments
PL 1500 psi	37	PL1500 12:15 TSSMAX	19,379 20,077	4825 ~~4744~~	1525	1.541	57.6	
STATIC 1500 LP	38	STATIC 12:22 TSSMAX	18,916 19,629	505	1590	0.75	2.0	See Test 45 for Zero
PL 1500 psi	39	PL 1500 12:29 TSSMAX	19,411 20,059	4722	1536	1.52	55.7 ~~[illegible]~~	
STATIC 2000	40	Static TSSMAX	19,047	18381 296 19047	2004	0.679	NOT TAKEN	~~At Closing = 1862 = OPEN~~ ~~closed = 1980~~
STATC 2000 ~~PL 2000~~	41 ~~[illegible]~~	STATIC TSSMAX	~~19,047~~ 19,677	-346	OPEN=1862 CLOSE=1980	0.735	0.0	OP
PL 2000	42	PL2000 TSSMAX	14,576 20,323	5589	1902 2000	1.61 KW	65.3	
STATIC 2000	43	STATIC TSSMAX 2000 LP	19,345 19,976	-536	1920	NOT TAKEN	-0.2	
PL 2000	44	PL2000	19,544 20,158	5726	1950	1.575 Kw	66.5	
STA 1500 ~~2000~~	45	STATIC TSSMAX	19,343 20,041	17	Open=1500 close=1580	0.65	0.3	
~~PL 1500~~	~~46~~							

Prepared: Date: 9-13-95 Reviewed: R.C. Brady Date: 9/13/95

PRESSURE RESPONSE Bonnet ~~TO TEMPERATURE DATA SHEET~~ 9/15/95 Appendix A6

VOTES Test #/Date: 11/9-13 TSS: 1.0

O9 Thrust: N/A C14/C16 Thrust: 13,183 / 13,804

Time	Bonnet Pressure, psig	~~Bonnet Temperature, °F~~ Packing Load
0	~~1000~~ 900	
26	800	
58	700	
1:45	600	
2:57	500	
4:51	400	
8:40	300	Air bubbles from Packing Leak off line
0	2000 ~~1400~~	
13	1900	
25	1800	
38	1700	
51	1600	
1:05	1500	
1:19	1400	
1:35	1300	

Prepared: JJ Reilly Date: 9-13-95 Reviewed: K.C. Bell Date: 9/15/95

PRESSURE RESPONSE BONNET JCB 9/10/95 ~~TO TEMPERATURE DATA SHEET~~ Appendix A6

VOTES Test #/Date: 14/9-13 TSS: 1.0

O9 Thrust: N/A C14/C16 Thrust: 13,178 / 13,816

Time	Bonnet Pressure, psig	Bonnet Temperature, °F
1:52	1200	
2:11	1100	
2:34	1060	
3:01	900	
3:32	800	
4:14	700	
Closed / opened VOTES TEST # 14		
0	2000	
19	1900	
39	1800	
59	1700	
1:19	1600	
1:40	1500	
2:03	1400	
2:26	1300	

Prepared: Date: 9-13-95 Reviewed: Date: 9/13/95

PRESSURE RESPONSE BONNET ~~TO TEMPERATURE DATA SHEET~~ RCD 9/15/95 Appendix A6

VOTES Test #/Date: 15/9-13 TSS: 2.0

O9 Thrust: N/A C14 C16 Thrust: 19,383/ 19,869

Time	Bonnet Pressure, psig	~~Bonnet Temperature, °F~~
2:57	1200	
3:20	1100	
3:53	1000	
4:33	900	
4:36	890	
4:40	880	
4:45	870	
4:49	860	
4:53	850	
5:16	800	
Static Raise	TSS 2:00 ->	Test #15
0	1980	
58	1930	
1:40	1900	
2:10	1880	

Prepared: Date: 9-13-95 Reviewed: R.C. Date: 9/13/95

PRESSURE RESPONSE TO BONNET ~~TEMPERATURE DATA SHEET~~ RB 9/13/95 Appendix A6

VOTES Test #/Date: 15/9-13 TSS: 2.0

O9 Thrust: N/A C14/C16 Thrust: 19383/19869

Time	Bonnet Pressure, psig	~~Bonnet Temperature, °F~~
3:13	1840	
4:20	1800	
4:55	1780	
Close valve equalize pressure		
0	1730	
52	1720	
1:40	1710	

Prepared: Date: 9-13-95 Reviewed: Date: 9/13/95

PRESSURE RESPONSE TO TEMPERATURE DATA SHEET

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VOTES Test #/Date: 18,26,27,49

TSS: 2.0

O9 Thrust: 1952, 1900, 1866, 2239

C16 Thrust: 20101, 20031, 20129, 20648

Time	Bonnet Pressure, psig	Bonnet Temperature, °F
N/A	102	75.8
	106.5	91
	93.7	105
	105.7	120
	124.5	185
	128.2	195
	131.2	206
	135.0	216.2
	139.5	226
	153.7	230
	161.3	236
	173.3	245
	182.2	250
	192.7	257
↓	201.7	263

Prepared: RCB for JFK Date: 9/15/95 Reviewed: R. C. Bedf Date: 9/15/95

VALVE DATA SHEET Appendix A7

Valve		Source
Type	Gate	
Vendor / ID	Westinghouse/4-GM88FND	Nameplate
Size	4" 2500 psi/650°F	Nameplate
Model No./Serial No.	04002GM88FNH0B00 0W750007	Nameplate
Mean Seat Diameter		
Stem Diameter		
Stem Threads per Inch		
Stem Thread Starts	2	
Stem Material		
YR Built	1978	
ASME	CLASS I	
Actuator		
Type	—	
Vendor	Limitorque	Nameplate/Datasheet
Size	SB-00	"
Model No.	—	
Serial No	265405	"
OAR	38.6	"
Spring Pack No.	047	"
Shop Order No	3B3749A	"
Motor		
Type		
Vendor	Reliance	Nameplate
~~Model No~~. ID No	716244-VC	"
RPM	1700	"
Voltage (AC/DC)	AC	"
Start Torque	15 ft.lb	"
Run Torque	3 ft.lb	"
Locked Rotor Amps		
Full Load Amps		
Frame Size	M-56	Name plate
Run Amps	2.8	"
Insulation Class	RH	"

Prepared: Date: 9-13-95 Reviewed: R.C. B Date: 9/13/95

Weak Link 24,000 lbs, Telecon Steve Zrma open and close
Actuator 100% = 14,000 lbs 200% = 28,000 lbs,

Westinghouse Valve
Pressure Locking Thermal Binding Test Notes

09/13/95 Test Setup

The Westinghouse valve was received from the stand fabricator and was setup such that the valve could be rotated about the pipe centerline from vertical to 90 degrees from vertical. The valve leakoff line was machined and fitted with a cap which could be removed. The instrument maintenance department calibrated and installed the test equipment. Two holes were drilled and tapped into the bonnet to accept a thermowell/temperature meter and a pressure transducer/indicator. Due to the small size of the valve and the bonnet area and the length of the thermowell it could not be used for testing.

A high pressure air/water accumulator was used to pump high pressure water into either the upstream or downstream side of the valve. The accumulator would supply a constant water pressure during unseating of the valve.

Data Acquisition

The VOTES and MPM systems were used as data acquisition devices for the test. The VOTES system was used to monitor stem thrust, switch actuation, and motor current. The MPM system was used to monitor motor voltage and current parameters. The Westinghouse valve has a solid unthreaded section of stem just above the antirotation device. In this area a Teledyne QSS was mounted and connected to the VOTES system. This QSS was then calibrated using a Liberty C-Clamp located just below the QSS 1" below the stem undercut. In this area the liberty effective diameter is 1.229 inches. A calibration was performed at a high valve torque switch setting of 2.0 and a low torque switch setting of 1.0. These two calibrations were within 0.41 percent of each other.

Local leak rate testing

A Local Leak Rate Test (LLRT) was performed in accordance with procedural step E.3 after initial differential pressure testing. This LLRT testing was performed in accordance with plant procedures with a test pressure of approximately 45.6 psig. The valve was tested on the upstream and downstream side at both a TSS of 1.0 and 2.0. Results of this testing indicated zero leakage in both directions. The test equipment has an accuracy 0.4 scfh.

09/13/95 Differential pressure testing

Differential pressure tests were performed on the upstream side of the valve at a TSS of 1.0. Tests 6 through 13 were performed at differential pressures of between 460 and 1880 psig with valve factors ranging from 0.33 to 0.19. Valve factors appeared to decrease with increasing differential pressure. Another round of differential pressure tests were performed during tests 19 through 25 which were performed at differential pressures between 505 and 1944 psig. These tests were performed at a TSS of 2.0. Valve factors again ranged between 0.28 and 0.17 with valve factors decreasing with increasing differential pressure. Appendix A3 lists two disk side pressures used for calculating valve factors. The reason for this is that the pressure decreased from its initial value 5-20 psig during unseating. This is believed to be due to the stem being withdrawn from the valve prior to the disk moving. The pressure just before unseating was utilized for calculation of valve factors. Differential pressure tests 46 and 47 were performed by pressurizing the downstream sides of the valve. Both these tests were performed at approximately 1500 psid. Valve factors of 0.15 and 0.16 were obtained.

09/13/95 Bonnet Pressure Response

In accordance with test section E.5 a bonnet depressurization test was performed. The valve was initially set at a TSS of 1.0 to run this test. The bonnet was pressurized by pressurizing the valve with it open. The valve was then closed and the upstream and downstream sides were vented to 0 psig. This first test was started from 900 psig in the bonnet and pressure decreased from approximately 900 to 300 psig over 9 minutes. The next test was performed with a similar setup at a starting pressure of 2000 psig. During this test the pressure decreased from 2000 to 700 psig over 4.25 minutes. Static VOTES test #14 at the same TSS was performed prior to the next depressurization test. Test pressure started at 2000 psig and decreased to 800 psig over 5.25 minutes. The rate is greater at the higher pressure and decreases as pressure decreases. Static VOTES test #15 was performed at a TSS of 2.0 prior to the next depressurization test. Test pressure started at 1980 psig and decreased to 1780 over 5 minutes. During this testing water could be heard wheezing from the valve seats as pressure decreased. In an effort to ensure that water was leaking past the seats a similar test was performed, however, when the valve was closed to pressurize the bonnet the upstream and downstream sides of the valve were left pressurized such that the upstream and downstream pressures were at bonnet pressure. During this test pressure decreased from 1730 to 1710 psig over 1.75 minutes. This test indicated that a substantial amount of pressure loss was from leakage past the valve seats. Appendix A6 was modified slightly and used to document this testing.

09/13/95
09/15/95 Pressure locking testing

Pressure locking data acquisition started with static test 26 at a TSS of 2.0. Each of these pressure lock tests were performed by pressurizing the entire valve with the disk off its seat and then closing the valve and depressurizing the upstream and downstream sides. The bonnet pressure was then recorded with an initial value and an unseating value. Prior to each pressure lock test a static test was performed at the specified test pressure. These were performed because the valve bonnet was pressurized by closing the valve against pressure and then bleeding off the upstream and downstream sides of the valve. VOTES tests 26 through 45 were performed at bonnet pressures between 500 and 2000 psig.

09/15/95 Pressure response to temperature

During this test the valve was closed at a TSS of 2.0. High temperature heat guns were used to heat the valve body and bonnet from the outside. During this test heat guns were directed at both the valve body area and the bonnet area. Temperature of the bonnet water was measured with a contact temperature meter placed on the outside of the bonnet away from the heat guns. The bonnet water temperature is assumed to be approximately equal to the outside bonnet temperature. The test was started at a bonnet pressure of 102 psig and a temperature of 75.8 F. During this test, stem strain was also monitored to verify if stem growth was contributing to the seating force. Time was not monitored for this testing. Appendix A6 was slightly modified and used to document this testing. During this test bonnet pressure initially increased with temperature, then decreased for a short time after which it continued to increase. This test indicated a pressure increase of approximately 2 psig per degree F.

Thermal binding test

The thermal binding test was performed after the valve was heated in accordance with the previous pressure response to temperature test. After heating of the valve, it was opened and closed during VOTES test #48 performed at a TSS of 2.0. Thrust numbers from this test indicated that the sensor had heated and was not providing accurate thrusts. The valve was cooled to ambient conditions and another static test #49 was performed. This test indicated a pullout thrust of 2239 lbs. The increase in pullout was compared to static tests #18, 26 and 27 which were performed at the same TSS. An average pullout value was taken from these three tests of 1906 lbs which yields an increase of 333 lbs. The valve bonnet temperature measured 263 F and the body temperature measured approximately 172 F around the bottom half centerline. The starting valve body and bonnet temperature was 76 F.

Test Summary and Conclusions

Local Leak Rate Testing

Local leak rate testing was performed in accordance with station local leak rate testing methods. The valve was tested from both the upstream and downstream side with each side being tested at two final closing thrusts (TSS of 1.0 and 2.0). This testing indicated zero leakage from both sides of the valve at both torque switch settings. Therefore, the valve was leaktight to within the accuracy of the flow meter or 0.4 scfh.

Differential Pressure Test

The first set of differential pressure tests were performed from the upstream side of the valve at differential pressures of between 460 and 1880 psid. During analysis of the pressure locking data it was discovered that the seat diameter which was used for calculating open valve factor was the inner seat ring diameter and not the mean seat ring diameter as is used for input into the pressure locking calculations. The actual mean seat diameter was 2.001 inches rather than 3.445. Therefore, using this diameter the valve factors range from 0.13 to 0.21. The second set of differential pressure tests were performed from the upstream side of the valve yielding corrected valve factors in the 0.12 range.

Pressure Locking Test

Pressure locking tests were performed by initially pressurizing the entire valve with the disk off the closed seat. The valve was then closed to trap the pressure in the bonnet and the upstream and downstream seats were vented. Prior to each pressure locking test a static stroke was performed with the entire valve pressurized to the test pressure. The bonnet pressure was then recorded with an initial value and an unseating value. These were performed because the valve bonnet was pressurized by closing the valve against pressure and then bleeding off the upstream and downstream sides of the valve. These static test values were used as input into the pressure locking model. Comparison of the predicted pressure locking forces to the actual tested values are summarized in DOC ID#DG96-000078.

Bonnet Pressure Response Test

The valve was initially closed with a static seating thrust of approximately 13800 lbs. The valve was pressurized to a pressure of approximately 1000 psig and closed and both the upstream and downstream sides of the valve were vented. When the valve depressurized to 900 psig the test was started. The bonnet depressurized to 300 psig at a decreasing rate over 8.6 minutes. The next test was performed at the same TSS, however, the starting pressure was 2000 psig. During this test the valve depressurized to 700 psig at a decreasing rate over 4.25 minutes. A repeat test was performed starting from 2000 psig. During this test the valve depressurized to 800 psig at a decreasing rate over 5.25 minutes. The valve was then set to a TSS of 2.0 and a measured final thrust of 19870 lbs. The bonnet was pressurized to 1980 psig for an initial pressure. During this test the valve depressurized to 1780 psig at a relatively constant rate over 5.0 minutes. The next test was performed to verify where the leakage was occurring. The valve was pressurized and closed at the same TSS, however, the upstream and downstream sides of the valve were not vented. The depressurization rate was substantially slower starting from 1730 psig depressurizing to 1710 psig over 1.6 minutes. This test indicated that some packing leakage was occurring but this was a small amount of the total. Leakage was not visible through the upper packing but may have been occurring through the capped packing leakoff line. It should be noted that the packing load on this valve was higher than the design value of 1000 lbs per inch of stem diameter. This testing indicates that under bonnet pressurization/depressurization scenarios the seats and packing do leak at a substantial rate even with a valve that measures zero leakage via a LLRT.

Bonnet Pressure Response to Temperature

During this test the bonnet was initially pressurized to 102 psig and the upstream and downstream sides of the valve were depressurized. Heat guns were used to heat the valve and bonnet and a temperature probe was used to measure the bonnet temperature externally. The external bonnet temperature was assumed to approximate the internal fluid temperature. During this test time was not monitored with temperature and pressure due to the length of time to heat the valve. Bonnet pressure started at 102 psig (arbitrary point) and bonnet temperature started at ambient 75.8 F. Initially pressure increased then decreased for a short time with constantly increasing temperature. From this point bonnet pressure increased at an average rate of approximately 2 psig/degree F to a pressure of 201 psig and temperature 263 F. The initial pressure decrease is believed to be due to expansion of the metal and bonnet area due to heating.

Thermal Binding Test

This test was conducted subsequent to heating the valve from the bonnet pressure response to temperature test. Although this test was not part of the procedure it was done to gather additional information. While the valve was at 263 F it was opened and closed and then allowed to cool. A VOTES test was performed during this stroke, however, the thrust values were found to be invalid due to heating of the thrust/torque sensor. After cooling of the valve to ambient temperature a VOTES test was performed with a pullout thrust of 2239 lbs. This final test was compared with static tests performed earlier in the testing sequence. The average pullout from three static tests performed at a similar TSS were 1906 lbs with final thrust values from each of these static tests being within 0.48 percent of one another. This is an increase in pullout thrust of 333 lbs or 17.4 percent with a differential temperature of approximately 100 F using the lower valve body temperature as a valve temperature. This increase is much less if the valve bonnet temperature is used.

Source Document: ______ ______
Revision: ______ ______
Date: ______ ______

BwIP 2000-T0
Revision 2

MULTIPLE USE

CALIBRATION TEST REPORT FORM

Instr. No/Type: CMM - 66295
Location:
Instrument Name:
Tolerance:
Instr. Model Mfr.: Heise
References:
Instr. Serial No.: 66295
Procedure No.: BwIP 2400-026 Rev 2.1
Head Correction: N/A
Setpoint: N/A
Technician: Minarich
Date Calibrated: 9-7-95
Range: 2000 PSI

INPUT TEST POINT		OUTPUT TEST POINT		
INPUT		REQUIRED	AS FOUND	AS LEFT
%	PSI	PSI	PSI	PSI
0	0	0	0	0
25	500	500	500	500
50	1000	1000	1000	1000
75	1500	1500	1499	1499
100	2000	2000	1999	1999
75	1500	1500	1500	1500
50	1000	1000	1001	1001
25	500	500	501	501
0	0	0	0	0

SWITCH OPERATION			ACTUATION
	AS FOUND	AS LEFT	INC/DEC
SETPOINT			
RESET	N		
SETPOINT			A
RESET			

REMARKS:

TEST EQUIPMENT

ID#	AF/AL	MODEL#	RANGE	RATE	CERT DUE
BC 017	AF/AL	DM-TQ50	10 000 PSI	N/A	10-95

DOCUMENT REVIEW
SUPERVISOR: P. [illegible]
DATE REVIEWED: 9-7-95
DATE ENTRY:
SYS ID:
NWR#: 95003824-03

(Final)

92(082092)
BWIP

APPROVED
AUG 27 1992
BRAIDWOOD
ONSITE REVIEW

Source Document:
Revision:
Date:

BwIP 2000-T0
Revision 2

MULTIPLE USE

CALIBRATION TEST REPORT FORM

Instr. No/Type	cmm - 60900	Location	
Instrument Name		Tolerance	
Instr.Model Mfr.	Heise	References	N/A
Instr.Serial No.	60900	Procedure No.	BwIP 2400-026 Rev 2.1
Head Correction	N/A	Setpoint	N/A
Technician	Minarich		
Date Calibrated	PM ~~9-5~~ 9-7-95 9-7-95	Range	2000 PSI

INPUT TEST POINT		OUTPUT TEST POINT		
INPUT		REQUIRED	AS FOUND	AS LEFT
%	PSI	PSI	PSI	PSI
0	0	0	0	0
25	500	500	500	500
50	1000	1000	1001	1001
75	1500	1500	1500	1500
100	2000	2000	1998	1998
75	1500	1500	1500	1500
50	1000	1000	1002	1002
25	500	500	500	500
0	0	0	0	0

SWITCH OPERATION			ACTUATION
	AS FOUND	AS LEFT	INC/DEC
SETPOINT	N		
RESET			
SETPOINT			A
RESET			

REMARKS:

TEST EQUIPMENT

ID#	AF/AL	MODEL#	RANGE	RATE	CERT DUE
DR017	AF/AL	DM-TQ50	10000 PSI	N/A	10-95

DOCUMENT REVIEW

SUPERVISOR: P.
DATE REVIEWED: 9-7-95
DATE ENTRY:
SYS ID:
NWR#: 95003824-03

(Final)

92(082092)
HBWIP

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Source Document: ______ ______
Revision: ______ ______
Date: ______ ______

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Revision 2

MULTIPLE USE

CALIBRATION TEST REPORT FORM

Instr. No/Type	CMM-78538	Location	
Instrument Name		Tolerance	
Instr.Model Mfr.	Heise	References	
Instr.Serial No.	98538	Procedure No.	BWIP 2400-026 Rev. 21
Head Correction	N/A	Setpoint	N/A
Technician	Minarich		
Date Calibrated	9-7-95	Range	2000 PSI

INPUT TEST POINT		OUTPUT TEST POINT		
INPUT		REQUIRED	AS FOUND	AS LEFT
%	PSI	PSI	PSI	PSI
0	0	0	0	0
25	500	500	499	499
50	1000	1000	998	998
75	1500	1500	1497	1497
100	2000	2000	1998	1998
75	1500	1500	1498	1498
50	1000	1000	999	999
25	500	500	500	500
0	0	0	0	0

SWITCH OPERATION			ACTUATION
	AS FOUND	AS LEFT	INC/DEC
SETPOINT			
RESET	N		
SETPOINT			A
RESET			

REMARKS:

TEST EQUIPMENT

ID#	AF/AL	MODEL#	RANGE	RATE	CERT DUE
BR017	AF/AL	DM-TQ50	10000 PSI	N/A	10-95

DOCUMENT REVIEW
SUPERVISOR:
DATE REVIEWED: 9-7-95
DATE ENTRY:
SYS ID:
NWR#: 950003824-03

(Final)

92(082092)
WBWIP

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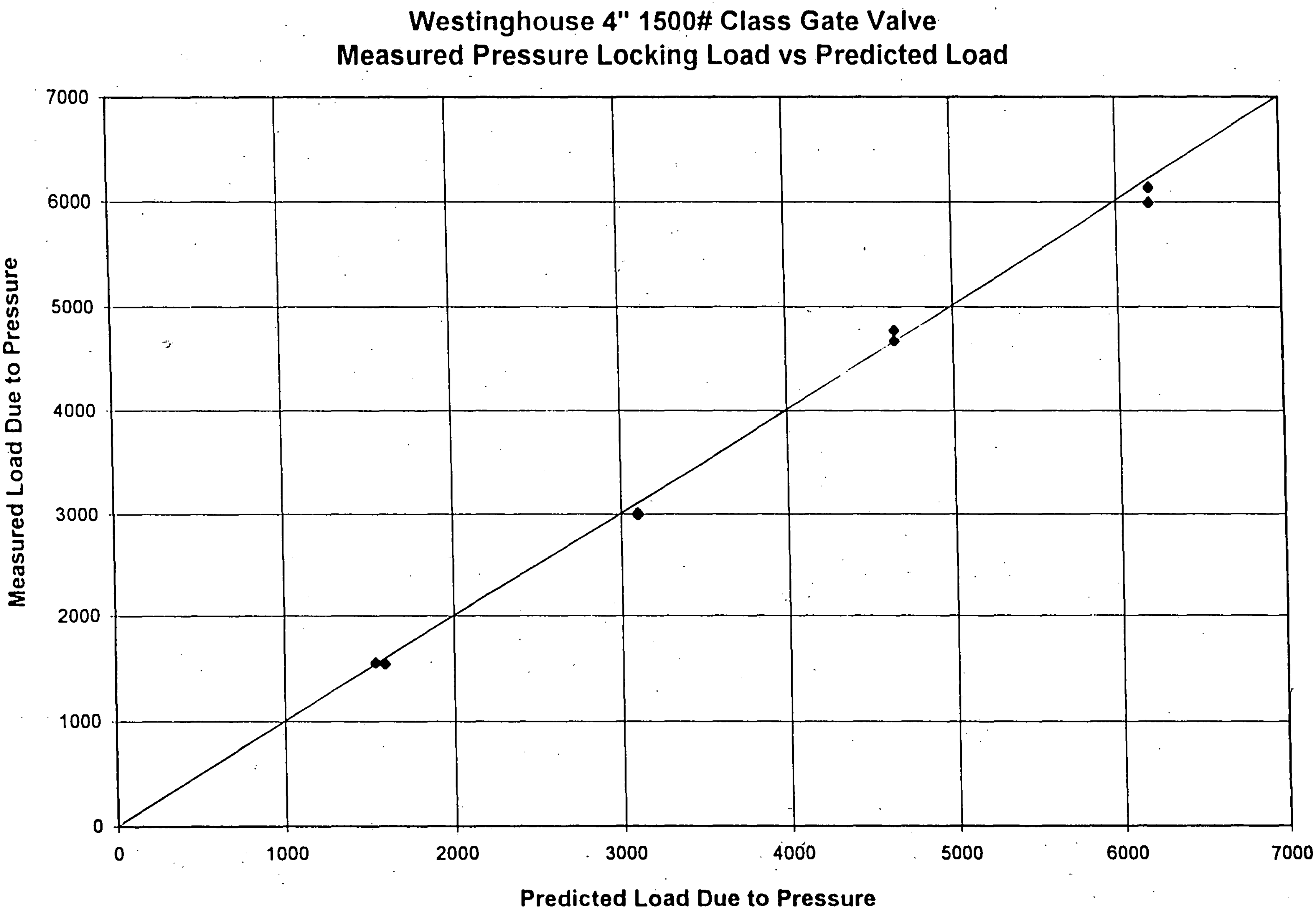
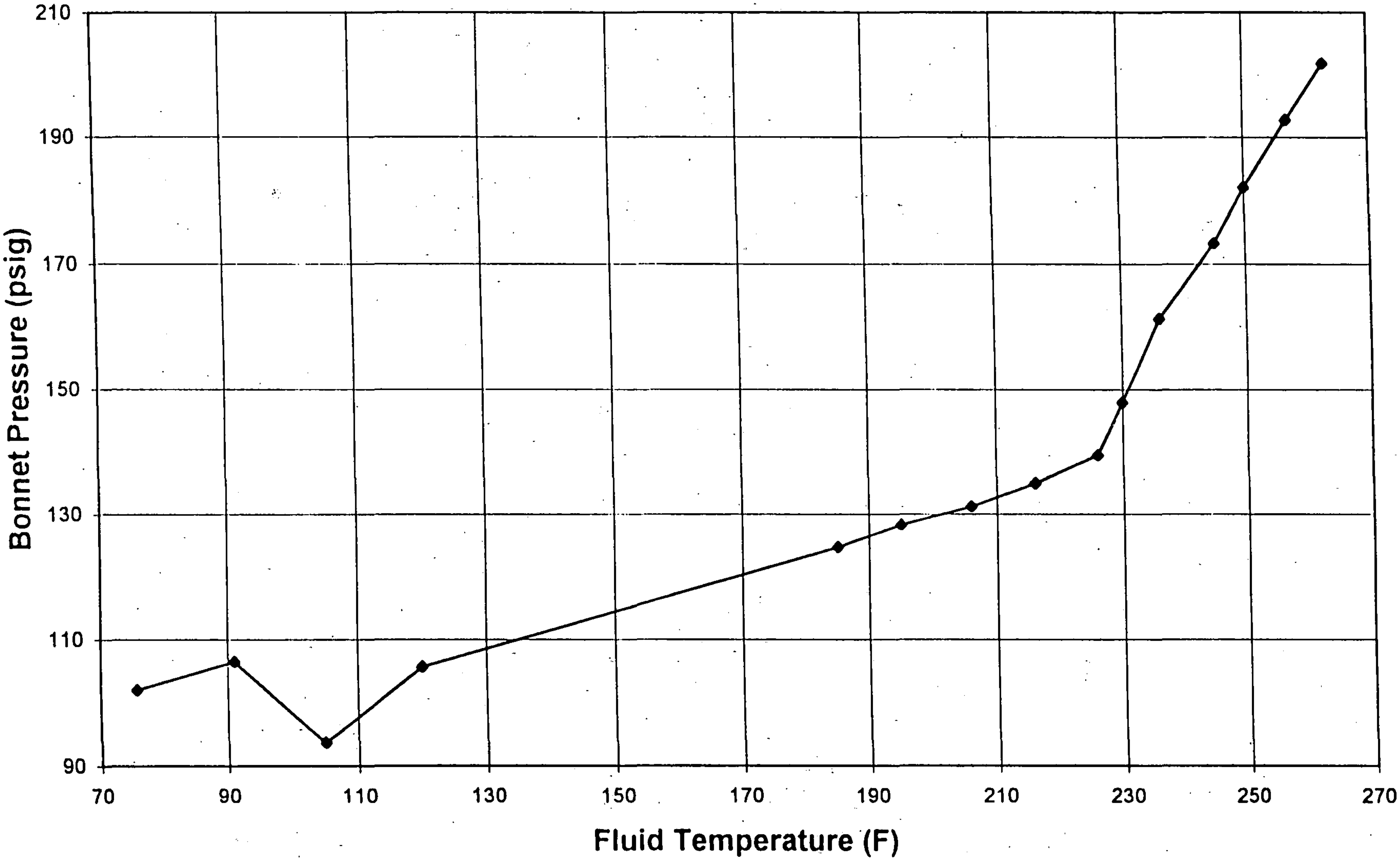


Westinghouse 4" 1500# Class Gate Valve
Measured Pressure Locking Load vs Predicted Load



Westinghouse 4" 1500# Class Gate Valve
Bonnet Pressure vs. Temperature

Attachment 4

ComEd Response to NRC Request for Additional Information on ComEd Pressure Locking Testing