ATTACHMENT 3

Design Analysis

Ginna Station

Pressure Lock Evaluation for
MOVs 852 A&B

Ginna Station

Rochester Gas and Electric Corporation
89 East Avenue
Rochester, New York 14649

DA-ME-96-076

Revision 2

September 20, 1996

Prepared by: D.R. [signature] — Design Engineer — 9/23/96 Date

Approved by: [signature] — Independent or Lead Reviewer — 9/23/96 Date

TECHNICAL INPUT FORM				
EIN	852A, 852B			
KEYWORDS	MOVs, Pressure Locking			
CROSS REF				
PSSL 03	EWR/ OTHER x PCR # 96-085	PROPRIETARY	YES	NO X
COMMENT				
SUPERSEDES	Rev. 1			

REVISION STATUS SHEET

Revision Number	Affected Sections	Description of Revision
2	3.0	Added Design Inputs 3.5 to 3.9.
	7.2	Added additional clarification to upstream and downstream pressure values.
	7.4.2	Added minor clarification.
	7.4.2.1	Revised calculated pressure locking force.
	7.4.2.2	Revised calculated total required force.
	7.4.3	Revised valve factor; added clarification.
	7.5	Completely revised to show calculation of available thrust. Stem factor and temp. effects justification added.
	7.6	Revised F_A, F_R and added minor clarification.
	7.7	Added Section 7.7.
	8.0	Revised results to reflect new press. locking force, force required and force available.
0	Att. A	No change.
2	Att. B	Revised to reflect new valve disc coefficient of friction of 0.621.
2	Att. C	New.

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1.0 Purpose

1.1 To perform a pressure locking evaluation for MOVs 852A and 852B based upon a maximum unseating thrust of 11,000 LBf.

2.0 Conclusions

Based upon the analysis performed in Section 7.0, the total calculated force required to overcome pressure locking is less than the available thrust. This conclusion is based upon a maximum unseating load of 11,000 LBf. Actual "as-left" unseating thrust values would provide additional margin.

3.0 Design Inputs

3.1 ALTRAN calculation No. 92129-C-01, Rev. 0, August 1992.

3.2 RG&E MOV calculation for 852A, dated 8/6/96.

3.3 RG&E MOV calculation for 852B, dated 8/6/96.

3.4 RG&E Design Analysis No. NSL-5080-0002, Rev. 6.

3.5 RG&E Design Analysis No. DA-ME-96-083, Rev. 1.

3.6 RG&E Design Analysis No. DA-ME-96-090, Rev. 0.

3.7 RG&E/MOVATS Testing Package M-64.1.2, dated 9/8/96, 852A.

3.8 RG&E/MOVATS Testing Package M-64.1.2, dated 9/8/96, 852B.

3.9 RG&E Design Analysis DA-EE-92-131-06, Revision 7.

4.0 Referenced Documents

4.1 NUREG/CR-5807, KEI No. 1721, "Improvements in Motor Operated Gate Valve Design and Prediction Models for Nuclear Power Plant Systems, SBIR Phase I Final Report Sept. 1990 - April 1991.

4.2 Westinghouse Calc. No. V-EC-1606, Rev. 0, Verification of Pressure Locking Analysis Program Preslock, WOG-220. (Attachment A).

4.3 Cameron Hydraulic Data, 17th Edition, 1st Printing.

4.4 Mechanics of Materials, Beer & Johnston, 1981.

4.5 Westinghouse Fax, I. Ezekoye (Westinghouse Owners Group) to D. Markowski, dated 8/8/96.

5.0 Assumptions

5.1 This evaluation is based upon an assumed maximum unseating thrust of 11,000 Lbf. This value will be confirmed via procedure M-64.1.2 during testing of 852 A/B.

6.0 Computer Codes

6.1 Microsoft Excel version 5.0 was used to develop the spread sheet for the pressure locking calculation based upon Ref. 4.2. Spreadsheet was verified as shown in Column "Verification", (Attachment B).

7.0 Analysis

7.1 The methodology for calculating the total force required to overcome pressure locking is based upon Reference 4.2 (Attachment A). This document includes definition of terms and applicable equations.

7.2 Input Data:

- Bonnet Pressure (P_{BONNET}) = 2250 psi (Based on Design Input 3.4)
- Upstream Pressure (P_{up}) = 30 psi (Based upon Design Input 3.6, slightly conservative, actual calculated value approx. 31 psi).
- Downstream Pressure (P_{down}) = 0 psi (conservative, worst case Rx completely blowdown)
- Disk thickness (t) = 1.536 in. (Design Input 3.1)
- Seat radius (a) = 2.789 in, (Design Input 3.1)
- Hub radius (b) = 1.500 in. (Design Input 3.1)
- Seat Angle (θ) = 5° (Design Input 3.1)
- Poisson's Ratio (v) = 0.3 (Ref. 4.2 - typical)

- Modulus of Elasticity (E) = 2.9 x 10^7 psi (Ref. 4.4, App. B, Steel Typical)

- Unseating Thrust (F_{po}) = 11,000#
(Assumed maximum, to be verified by testing, Section 5.1)

- Open Valve Factor (V_F) = 0.66
(Based upon Design Input 3.5)

- Stem Diameter (D_{stem}) = 1.75 in.
(Based upon Design Inputs 3.2 and 3.3)

- Hub Length (Hub Length) = 0.4375 in.
(Based upon field measurement of spare disc in stock)

7.3 Spreadsheet Verification

7.3.1 Attachment B, Column "Verification" provides the verification of the correctness of the spreadsheet for calculating the total force.

7.3.2 The equations from Ref. 4.2 were used to develop the spreadsheet.

7.3.3 The example from Ref. 4.2, App. A, Pages 22-25 was used to verify the spreadsheet.

7.3.3.1 The inputs were used in the spreadsheet and a line-by-line verification of the results was performed.

7.4 Calculation of Total Force Required

7.4.1 The applicable data for valves 852 A/B, from Section 7.2, was inputted to the spreadsheet.

7.4.2 The input and results are shown in Column "V852A" and "V852B" of Attachment B.

7.4.2.1 The calculated pressure locking force was determined to be 23,681#.

7.4.2.2 The total required force was calculated to be 38,790#, (F_R).

7.4.3 Discussion of calculation of Coefficient of Friction (μ)

The methodology of Design Input 4.2 is based upon calculation for the coefficient of friction (μ) as follows:

$$\mu = V_F \cdot \frac{\cos \theta}{1 + V_F \cdot \sin \theta}$$

where:

V_F = the closing valve factor (0.66 for both the closing and opening direction per Design Input 3.5).

θ = Seat Angle (5 degrees)

If a valve factor of 0.66 is used with the methodology of Design Input 4.2, the appropriate coefficient of friction of 0.621 will be applied to the Total Required force calculation for the open direction.

As indicated in App. A, Pg. 13 of Ref. 4.2, μ is calculated using the closing valve factor.

As indicated in Ref. 4.5, the decision/recommendation to base μ on the closing valve factor (in Ref. 4.2) was that test results generally indicated more stable data was obtained for the closing direction than for the opening direction.

The coefficient of friction (μ) is dependent upon the materials in contact involved. μ is independent of the direction the valve is operating and therefore would be the same for both the opening and closing directions.

The equation for μ in Ref. 4.2 is based upon equation 2.1a of Ref. 4.1 (algebraically manipulated).

$$V_F = \frac{\mu}{\cos \theta - \mu \sin \theta}$$

$$V_F = \frac{.621}{\cos(5) - (.621)(\sin 5)} = .66$$

This discussion reflects the results of Design Input 3.5, in that a disc coefficient of friction of 0.621 will be utilized in the calculation.

7.5 Available Thrust

7.5.1 From Design Inputs 3.2 and 3.3 the stall thrust can be determined as follows:

7.5.1.1 Stall Thrust = (MT) (UR) (PE) (AE) /FS

where:

MT = Name Plate Motor Torque (60 ft-lbs)
UR = Unit Ration (60.15:1)
PE = Pullout Efficiency = (0.40)
AF = Application Factor (1.0)
FS = Stem Factor (0.019 ft) [see below]

Stem Factor:

The Stem Factor of 0.019 was the result of actual valve testing, Per Design Inputs 3.7 and 3.8. Valve 852A results indicate a Stem Factor of 0.018, Valve 852B results indicate a Stem Factor of 0.019. Three (3) tests for each valve in the open direction were performed. The 0.019 maximum value will be used for this analysis.

$$\text{Stall Thrust} = \frac{(60)(60.15)(0.40)(1.0)}{0.019}$$

Stall Thrust = 75,979 lbs.

7.5.1.2 Reduction for Reduced Voltage

Per Design Input 3.9 the applicable reduced voltage factor for the 852's is 75%.

7.5.1.3 Available Thrust

$$F_A = 75{,}979\ (R.V.)^2$$

$$= 75{,}979\ (.75)^2$$

$$F_A = 42{,}738 \text{ lbs.}$$

7.5.1.4 Temperature Effects

Since the 852's are required to open within seconds of an accident, this is not sufficient time for the valve actuator to heat up. Therefore, a reduction for Temperature Effects will not be applied for this analysis.

7.6 Acceptability

∴ Since F_A (42,738#) is > F_R (38,790#) the 852 A/B MOVs would be able to overcome the calculated pressure locking forces and perform it's safety-related opening function.

7.7 Margin Discussion

From Design Inputs 3.7 and 3.8, the actual "as-left" unseating thrust values are as follows:

852A: 7816 lbs.

852B: 7386 lbs.

If these values are inputted to the total force calculation the required total force decreases as follows:

852A: 35,606 lbs.

852B: 35,176 lbs.

These results are shown on Attachment "C".

8.0 <u>Results</u>

8.1 The force due to pressure locking was calculated to be 23,681#.

8.2 The total required force was calculated to be 38,790#.

8.3 The available thrust was determined to be 42,738#, since this exceeds the required force (38,790#), the 852 A/B MOVs would be operable under all expected loads, including pressure locking considerations. This result is based upon a maximum unseating thrust of 11,000#. An actual measured unseating thrust of less than 11,000# would provide additional margin, as discussed in Section 7.7.

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ATTACHMENT A

DA-ME-96-076 Rev 0

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ESBU/WOG-96-050

February 13, 1996

To: WOG S&EE Subcommittee Representatives (1L, 1A)
PLTB Task Team (1L, 1A)

Subject: Westinghouse Owners Group
<u>Verification of Pressure Locking Analysis Program - Preslok (MUHP-6050)</u>

Attached for your information in completion of Action Item 2 from the January 4 & 5, 1996 PLTB Task Team meeting is Verification Of Pressure Locking Analysis Program - Preslok. The verification included:

a. a review of the ComEd model and the associated equations for applicability.

b. a review of the assumptions to assure that they are reasonable.

c. a comparison of the MathCad sample problem solution with a hand calculation solution.

d. an update of the Preslok Users Manual to reflect comments obtained during the January 5, 1996 WOG PLTB Task Team meeting.

The verification confirms that the Preslok MathCad model correctly performs the ComEd pressure locking open load calculation, however, it does not compare the calculated results with the test results. This aspect will be covered by ComEd.

Please direct questions or comments to Ike Ezekoye, W, at (412) 374-6643.

Regards,

S.A. Binger, Jr
Project Engineer
Westinghouse Owners Group

SAB/ygs
attachment

cc: Steering Committee (1L, 1A)
WOG Primary Representatives (1L, 1A)
Licensing Subcommittee (1L, 1A)
Operations Subcommittee (1L, 1A)