CALC. NO. IP3-CALC-RC-01718 REVISION 0

CALCULATION IS: PRELIMINARY X FINAL ____

	NAME	SIGNATURE	DATE
PREPARER:	F. Martsen	Fred W. Martsen	2/9/96
CHECKER:	L. Cerra	Lelane Cerra	2/9/96
(DESIGN) VERIFIED/NA	PHILIP C XIE	Philip C Xie	2/9/96
APPROVED:	K. Eslinger	Kelly Eslinger	2/~~9~~/96 13 KMC

ORIGINATOR: NYPA ☒ OR OTHER ☐

SYSTEM NO./NAME RC-MOV-536 Pressure Locking Analysis

FOR INFORMATION ONLY

QA CATEGORY: I DISCIPLINE: MOV STRUCTURE: N/A

MODIFICATION NO./TASK NO. GL-95-07 DBD REF. NO. N/A

PROBLEM / OBJECTIVE / METHOD

Assess actuator capability versus under pressure locking conditions.

DESIGN BASIS / ASSUMPTION

Valve Factor = .5, Degraded Voltage, Stem Friction Coefficient = .2

ALSO SEE PG 4

SUMMARY / CONCLUSIONS

Actuator is capable of operating under postulated conditions.

THIS CALC SUPERSEDES OR VOIDS CALC. NO. N/A

DISTRIBUTION: C = CONTROLLED I = INFO

NAME	DEPT	LOC	C	I
K. Eslinger	IDSE	IP3	X	
F. MARTSEN	PEP	WPO		X

SYSTEM: RC

QA CAT: CAT. I

FILE: 52-B-0199

COMP. PRINTOUT LOC: ____

COMPONENTS

MAJOR EQUIPMENT	PIPE NO.	VALVE NO.	SUPT. NO	INST. NO.	PENE. NO.
		RC-MOV-536			

RELATED DOCUMENTS

IP3-CALC-RC-01717
IP3-RPT-MULT-01763

RELATED DRAWINGS

IP3V-422-6.6-0031 REV. 1

SECURITY: (Y/N) N COMPUTER PRINTOUT: (Y/N) N

New York Power Authority			
	Calculation No. IP3-CALC-RC-01718	Revision No.	0
	Project: Generic Letter 95-07	Page	3 of 17
	Subject: Pressure Locking Eval. of RC-MOV-536	Computed by: F. Martsen	Date: 2/9/96
		Check by: L. Cerra	Date: 2/9/96

I. OBJECTIVES:

To determine the required thrust to open the flexible wedge gate valve, RC-MOV-536, under postulated pressure locking conditions and stem thermal growth, and the actuator capability margin for developing that thrust.

II. METHODOLOGY:

The methodology utilized to determine the pressure locking forces is that developed by Commonwealth Edison and presented in Reference 1. The method utilized to determine the stem thermal growth load is based on Commonwealth Edison methodology presented in Reference 2.

Under pressure locking conditions the internal valve pressure forces the two disk halves against the opposing seats resulting in an additional seat contact force. That contact force is a function of the stiffness parameters of the disk plates and central hub. In this methodology these stiffness parameters are approximated by treating the disk plates as uniform circular flat plates with a central hub using the equations from Reference 3 to account for disk plate bending and shear deformation and hub stretch. The stem force required to overcome this additional internal seat contact force is a function of the seat friction and seat angle.

Due to the seat angle, the internal pressure acting on the areas of the disk halves enclosed by the seat contact circumference projected normal to the stem results in a force component on the disk adding to the opening thrust requirement.

From the static condition closing thrust there is a residual seat force which together with the seat angle and seat friction results in a static unwedging force.

For valves that are stroked closed to isolate hot fluid, the portion of stem that is exposed to ambient conditions when open heats up when inserted and expands. For SMB type actuators with self-locking gearing and stem threads, this expansion is restrained. This results in an additional wedging load which must be overcome during unseating.

The stem ejection load assists opening and the packing friction load opposes it.

The above force components are summed to obtain the required opening thrust.

The standard Limitorque methodology with the conservative stem friction coefficient = 0.2 is used to determine the actuator capability.

III. ASSUMPTIONS:

1. The valve disk is assumed to act as two ideal disks connected by a hub. The equations in Reference 3 are assumed to conservatively model the actual load due to internal pressure. This assumption is considered conservative since the large fillets connecting the hub to the disks make the wedge stiffer than modeled, and expansion of the valve body along the pipe axis due to the internal pressure is neglected. These two effects would reduce the valve internal pressure induced seat contact force and associated required stem thrust.

2. The coefficient of friction at the upstream and downstream seats are assumed to be equal and the same under pressure locking conditions and DP conditions. This assumption is considered to be justified based on ComEd's bench marking of the methodology against ComEd and EPRI pressure locking test data.

3. The Reference 2 methodology assumes that the stiffness of the valve/actuator assembly can be accurately determined from the static diagnostic thrust measurements. This is a reasonable assumption and is considered to be as accurate as the results of an extremely detailed finite element analysis. The stiffness determined in this fashion may be underestimated since it neglects the contribution from the spring pack. Based on preliminary Commonwealth Edison of this effect it is not expected to affect the stiffness more than 20 to 30%. To conservatively accommodate this uncertainty the valve assembly stiffness derived from the test will be increased 100%.

4. The Reference 2 methodology also assumes that the motor speed remains constant during seating. Based on Com. Ed and EPRI testing this is a reasonable assumption for AC motors. The motor RPM utilized in the calculation will be the Limitorque recommended value under load. For these 1800RPM motors that is 1700RPM. The lower number results in a higher stiffness which is conservative.

5. The Reference 2 method assumes that the only portion of stem that undergoes significant thermal growth is the portion inserted into the valve. This is a reasonable assumption as long as the differential temperature is based on the maximum bulk temperature of the fluid in the valve minus the normal ambient temperature.

The Reference 2 methodology is still under review by the Westinghouse Owner's Group (WOG) PLTB Task Team and has not yet been formally issued for utility use. Based on this this calculation will be considered preliminary pending WOG acceptance. The use of this methodology in the interim meets the NRC expectations for use of the "best available information".

New York Power Authority

Calculation No. IP3-CALC-RC-01718	Revision No. 0
Project: Generic Letter 95-07	Page ~~4~~ 5 of ~~10~~ 11
Subject: Pressure Locking Eval. of RC-MOV-536	Computed by: F. Martsen Date: 2/9/96
	Check by: L. Cerra Date: 2/9/96

IV. REFERENCES:

1. Westinghouse Letter ESBU/WOG-96-022, Attachment 2, "User's Guide For PRESLOCK, A Gate Valve Pressure Locking Analysis Program Using The Commonwealth Edison Model" Rev.0, January 2, 1996.

2. Westinghouse Letter ESBU/WOG-96-022, Attachment 4, "User's Guide For STEMGROW, A Gate Valve Thermal Binding Analysis Program Using The Commonwealth Edison Model" Rev.0, December 29, 1996.

3. Sixth Edition of Roark's Formulas for Stress and Strain.

4. B&W Doc. 32-1206515-02.

5. IP3 Emergency Operating Procedure E-3 Step 12

6. Velan Calculation Report DC-124, Rev. 0, June 22, 1993.

7. Velan FAX from M. Pang (Velan) to F. Martsen (NYPA), Nov. 29, 1995.

8. As-left static test per IP3 Work Request No. 94-03224-01

9. NYPA Calculation IP3-CALC-RCS-00978, Rev. 2.

10. EPRI/NMAC Report NP-6660-D, March 1990.

11. B&W Doc. 51-1224659-00

12. SA-1a Product Data Sheet for Armco A-286, Armco Steel Corp.

V. OPENING FORCE ANALYSIS:

V.1 INPUTS:

Bonnet Pressure	$P_{bonnet} := 2510 \cdot psi$	Reference 4.
Upstream Pressure	$P_{up} := 350 \cdot psi$	Reference 5(Min RCS for . bleed & feed
Downstream Pressure	$P_{down} := 0 \cdot psi$	Assumed (Conservative).
Disk Thickness	$t := 0.633 \cdot in$	Reference 6.
Seat Radius	$a := 1.249 \cdot in$	Reference 6.
Hub Radius	$b := 0.915 \cdot in$	Reference 6.
Half Hub Length	$L := 0.367 \cdot in$ (1.0 - 0.633)	Reference 7. (Attached)
Seat Angle	$theta := 5 \cdot deg$	Reference 6.
Poisson's Ratio (disk)	$v := .3$	Typical of Stainless Steel
Mod. of Elast. (disk)	$E := 29 \cdot 10^6 \cdot psi$	Typical of Stainless Steel
Static Pullout Force (Nominal Measured)	$F_{po} := 3277 \cdot lbf$	Reference 8.
Diagnostic Error % (SRSS of 10%&2%)	$e := 10.2$	Reference 9.
Open Valve Factor	$VF := .5$	Reference 9.
Stem Diameter	$D_{stem} := 1.125 \cdot in$	Reference 6.
Ambient Temp	$T_A := 120$	Assumed for Press. Doghouse Conserv since max normal is 140F
Max Vlv Temp	$T_V := 669$	Reference 11.
Stroke Length	$L_S := 2.6875 \cdot in$	Reference 6.
Motor Speed	$RPM := \frac{1700}{min}$	Reference 9. (Nominal is 1800) (Conservative)

Thrust at Seating	$F_{HSC} := 960 \cdot lbf$	Reference 8
Thrust at CST	$F_{CST} := 14322 \cdot lbf$	Reference 8
Unseating thrust	$F_{UW} := 2316 \cdot lbf$	Reference 8
Total Thrust(closing)	$F_{MAX} := 15226 \cdot lbf$	Reference 8
Stem Coeff. of Expans.	$\alpha := 9.8 \cdot 10^{-6}$	Reference 12
Acuator Overall Ratio	$OAR := 46.8$	Reference 9
Stem Lead	$S_L := 0.2 \cdot in$	Reference 9
Time at Seating	$t_{hsc} := 20.808 \cdot sec$	Reference 8
Time at CST	$t_{cst} := 21.618 \cdot sec$	Reference 8

V.2 PRESSURE FORCE CALCULATIONS

Coefficient of friction between disk and seat: (Reference 10)

$$mu := VF \cdot \frac{\cos(theta)}{1 - VF \cdot \sin(theta)} \qquad mu = 0.52079$$

Average DP across disks:

$$DPavg := P_{bonnet} - \frac{P_{up} + P_{down}}{2} \qquad DPavg = 2.335 \cdot 10^3 \cdot psi$$

Disk Stiffness Constant: (Reference 3, Table 24)

$$D := \frac{E \cdot (t)^3}{12 \cdot (1 - v^2)} \qquad D = 6.73576 \cdot 10^5 \cdot lbf \cdot in$$

$$G := \frac{E}{2 \cdot (1 + v)} \qquad G = 1.11538 \cdot 10^7 \cdot psi$$

Geometry Factors: (Reference 3, Table 24)

$$C_2 := \frac{1}{4}\cdot\left[1-\left(\frac{b}{a}\right)^2\cdot\left(1+2\cdot\ln\left(\frac{a}{b}\right)\right)\right] \qquad C_2 = 0.03233$$

$$C_3 := \frac{b}{4\cdot a}\cdot\left[\left[\left(\frac{b}{a}\right)^2+1\right]\cdot\ln\left(\frac{a}{b}\right)+\left(\frac{b}{a}\right)^2-1\right] \qquad C_3 = 0.00272$$

$$C_8 := \frac{1}{2}\cdot\left[1+\nu+(1-\nu)\cdot\left(\frac{b}{a}\right)^2\right] \qquad C_8 = 0.83784$$

$$C_9 := \frac{b}{a}\cdot\left[\frac{1+\nu}{2}\cdot\ln\left(\frac{a}{b}\right)+\frac{1-\nu}{4}\cdot\left[1-\left(\frac{b}{a}\right)^2\right]\right] \qquad C_9 = 0.20757$$

$$L_3 := \frac{a}{4\cdot a}\cdot\left[\left[\left(\frac{a}{a}\right)^2+1\right]\cdot\ln\left(\frac{a}{a}\right)+\left(\frac{a}{a}\right)^2-1\right] \qquad L_3 = 0$$

$$L_9 := \frac{a}{a}\cdot\left[\frac{1+\nu}{2}\cdot\ln\left(\frac{a}{a}\right)+\frac{1-\nu}{4}\cdot\left[1-\left(\frac{a}{a}\right)^2\right]\right] \qquad L_9 = 0$$

$$L_{11} := \frac{1}{64}\cdot\left[1+4\cdot\left(\frac{b}{a}\right)^2-5\cdot\left(\frac{b}{a}\right)^4-4\cdot\left(\frac{b}{a}\right)^2\cdot\left[2+\left(\frac{b}{a}\right)^2\right]\cdot\ln\left(\frac{a}{b}\right)\right] \qquad L_{11} = 1.88551\cdot10^{-4}$$

$$L_{17} := \frac{1}{4}\cdot\left[1-\frac{1-\nu}{4}\cdot\left[1-\left(\frac{b}{a}\right)^4\right]-\left(\frac{b}{a}\right)^2\cdot\left[1+(1+\nu)\cdot\ln\left(\frac{a}{b}\right)\right]\right] \qquad L_{17} = 0.03041$$

Moment (Reference 3, Table 24, Case 2L)

$$M_{rb} := \frac{-DPavg\cdot a^2}{C_8}\cdot\left[\frac{C_9}{2\cdot a\cdot b}\cdot(a^2-b^2)-L_{17}\right] \qquad M_{rb} = -153.18434\cdot lbf$$

$$Q_b := \frac{DPavg}{2\cdot b}\cdot(a^2-b^2) \qquad Q_b = 922.23058\cdot\frac{lbf}{in}$$

Deflection due to pressure and bending: (Reference 3, Table 24, Case 2L)

$$y_{bq} := M_{rb}\cdot\frac{a^2}{D}\cdot C_2 + Q_b\cdot\frac{a^3}{D}\cdot C_3 - \frac{DPavg\cdot a^4}{D}\cdot L_{11} \qquad y_{bq} = -5.80032\cdot 10^{-6}\cdot in$$

Deflection due to pressure and shear stress: (Reference 3, Table 25, Case 2L)

$$K_{sa} := -0.3\cdot\left[2\cdot\ln\left(\frac{a}{b}\right) - 1 + \left(\frac{b}{a}\right)^2\right] \qquad K_{sa} = -0.04771$$

$$y_{sq} := \frac{K_{sa}\cdot DPavg\cdot a^2}{t\cdot G} \qquad y_{sq} = -2.46143\cdot 10^{-5}\cdot in$$

Deflection due to hub stretch (from center of hub to disk):

$$P_{force} := 3.1416\cdot(a^2 - b^2)\cdot DPavg \qquad P_{force} = 5.30202\cdot 10^3\cdot lbf$$

$$y_{stretch} := \frac{P_{force}}{3.1416\cdot b^2}\cdot\frac{L}{(1\cdot E)} \qquad y_{stretch} = 2.55104\cdot 10^{-5}\cdot in$$

Total Deflection due to pressure forces:

$$y_q := y_{bq} + y_{sq} - y_{stretch} \qquad y_q = -5.5925\cdot 10^{-5}\cdot in$$

Deflection due to seat contact force and shear stress (per lbf/in.): (Reference 3, Table 25, Case 1L)

$$y_{sw} := -\left[\frac{1.2\cdot\left(\frac{a}{a}\right)\cdot\ln\left(\frac{a}{b}\right)\cdot a}{t\cdot G}\right] \qquad y_{sw} = -6.60571\cdot 10^{-8}\cdot\frac{in}{\left(\frac{lbf}{in}\right)}$$

(per lbf/in)

Deflection due to seat contact force and bending (per lbf/in.): (Reference 3, Table 24, Case 1L)

$$y_{bw} := -\left(\frac{a^3}{D}\right)\cdot\left[\left(\frac{C_2}{C_8}\right)\cdot\left[\left(\frac{a\cdot C_9}{b}\right) - L_9\right] - \left[\left(\frac{a}{b}\right)\cdot C_3\right] + L_3\right] \qquad y_{bw} = -2.08804\cdot10^{-8}\cdot\frac{in}{\left(\frac{lbf}{in}\right)}$$

(per lbf/in)

Deflection due to hub compression (per lbf/in), (from center of hub to disk):

$$y_{compr} := \frac{2\cdot a\cdot\pi}{3.1416\cdot b^2}\cdot\frac{L}{(1\cdot E)} \qquad y_{compr} = 3.77587\cdot10^{-8}\cdot\frac{in}{\left(\frac{lbf}{in}\right)}$$

(per lbf/in)

Total deflection due to seat contact force (per lbf//in.):

$$y_w := y_{bw} + y_{sw} - y_{compr} \qquad y_w = -1.24696\cdot10^{-7}\cdot\frac{in}{\left(\frac{lbf}{in}\right)}$$

(per lbf/in)

Seat Contact Force for which deflection is equal previously calculated deflection from pressure forces:

$$F_s := 2\cdot\pi\cdot a\cdot\frac{y_q}{y_w} \qquad F_s = 3.51961\cdot10^3\cdot lbf$$

V.3 UNSEATING FORCES

$F_{packing}$ is included in measured static pullout Force

$$F_{pomax} := \frac{F_{po}}{1 - \frac{e}{100}} \qquad F_{pomax} = 3.64922\cdot10^3\cdot lbf$$

$$Speed := RPM\cdot\frac{1}{60\cdot\frac{sec}{min}}\cdot\frac{S_L}{OAR} \qquad Speed = 0.12108\cdot sec^{-1}\cdot in$$

$$Rate := \frac{F_{CST} - F_{HSC}}{t_{cst} - t_{hsc}} \qquad Rate = 1.64963\cdot10^4\cdot sec^{-1}\cdot lbf$$

$K := \frac{2 \cdot Rate}{Speed}$ $\quad K = 3.26976 \cdot 10^{6} \cdot ft^{-1} \cdot lbf$ (Doubled for conservatism

$F_{thermal} := K \cdot \alpha \cdot L_{S} \cdot \left(T_{V} - T_{A}\right)$ $\quad F_{thermal} = 3.93987 \cdot 10^{3} \cdot lbf$

$F_{thermunwdg} := \frac{F_{UW}}{F_{MAX} - F_{HSC}} \cdot F_{thermal}$ $\quad F_{thermunwdg} = 639.61385 \cdot lbf$

$F_{piston} := \frac{\pi}{4} \cdot D_{stem}^{2} \cdot P_{bonnet}$ $\quad F_{piston} = 2.49499 \cdot 10^{3} \cdot lbf$

$F_{vert} := \pi \cdot a^{2} \cdot \sin(theta) \cdot \left(2 \cdot P_{bonnet} - P_{up} - P_{down}\right)$ $\quad F_{vert} = 1.99475 \cdot 10^{3} \cdot lbf$

$F_{preslock} := 2 \cdot F_{s} \cdot (mu \cdot \cos(theta) - \sin(theta))$ $\quad F_{preslock} = 3.03852 \cdot 10^{3} \cdot lbf$

$F_{total} := -F_{piston} + F_{vert} + F_{preslock} + F_{pomax} + F_{thermunwdg}$

$F_{total} = 6.82711 \cdot 10^{3} \cdot lbf$

VI. CONCLUSION

Per Reference 9 the calculated actuator thrust capability at degraded voltage and elevated temperature and with a conservative stem friction coefficient of 0.2 is: MCUVo = 8828lbf. Since this is greater than the above calculated force, F_{total} = 6827 lbf, the capability of this MOV to open under the postulated pressure locking conditions combined with the stem thermal growth load is demonstrated. The margin is ((8828 - 6827)/(6827))x100% = 29.3%.

Verification of:

Document Title: Pressure Locking Evaluation of RC-MOV-536

Document Number: IP3-CALC-RC-01718

Subject: Pressure Locking Evaluation of RC-MOV-536

Modification/Task Number (if applicable):

QA Category: CAT I

Review Required	Discipline	Review Complete (initial of reviewer)
	ELECTRICAL	
	MECHANICAL	
	INSTRUMENT & CONTROL	
	CIVIL/ STRUCTURAL	
	FIRE PROTECTION	
	SIMULATOR	

New York Power Authority

☒ - IP3
☐ - JAF

DESIGN VERIFICATION CHECKLIST

IDENTIFICATION:

Document Title: (print title) Pressure Locking Evaluation of RC-MOV-536

Doc. Number: IP3-CALC-RC-01718 Doc. Revision: 0

QA Category: CAT 1

DISCIPLINE:

[] ELEC [] I&C
[] MECH [] Fire Protect
[] C/S [] Simulator
[] Other (specify)

METHOD OF VERIFICATION:

☒ Design Review [] Alternate Calculations [] Qualification Test

Selected Verifier: PHILIP C XIE, SYSTEM ENGINEER. -6017
print name_department_phone ext.

#	Design Verification Questionnaire All questions shall be explained in the space provided.
1.	Were the inputs correct and incorporated into the design?

Explanation: Yes, All data have been confirmed by existing reference.

2.	Are the physical and functional characteristics of the proposed design within the approved design basis of the system(s) structure(s) or component(s)?

Explanation: N/A

3.	Does the proposed design incorporate license Commitments?

Explanation: N/A

4.	Are assumptions necessary to perform the design activity adequately described and reasonable: Where necessary, are the assumptions identified for subsequent reverifications when the detailed design activities are completed?

Explanation: Yes, Assumptions listed in Calculation.

5.	Are the appropriate quality and quality assurance requirements specified? e.g., safety classification?

Explanation: Yes. This MOV is safety-ralated (CAT I)

6.	Are the applicable codes, standards and regulatory requirements including issue and addenda properly identified and are their requirements for design met?

Explanation: N/A

#	Design Verification Questionnaire All questions shall be explained in the space provided
7.	Have applicable construction and operating experience been considered?
	Explanation: Yes This calculation supports the review for PLTB under GL 95-07. that review includes consideration of operating experience.
8.	Have the design interface requirements for mechanical, electrical/I&C, and civil/structural engineering been satisfied?
	Explanation: N/A
9.	Was the appropriate design method used?
	Explanation: Yes, this calculation uses the standard industry methods for determining opening thrust requirment under pressurized conditions for double-disc gate valve.
10.	Is the output reasonable compared to inputs?
	Explanation: Yes.
11.	Are the specified parts, equipment and processes properly suited for the fire protection Appendix R, QA, and EQ classifications required for the application?
	Explanation: N/A
12.	Are the specified materials compatible with each other and the design environmental conditions to which the material will be exposed?
	Explanation: N/A
13.	Have personnel requirements and limitations for maintenance, testing, and inspection been satisfied?
	Explanation: N/A
14.	Are accessibility, maintenance, repair, and inservice inspection requirements for the plant including the plant conditions under which these will be performed been considered?
	Explanation: N/A
15.	Has adequate accessibility been provided to perform the in-service inspection expected to be required during the plant life?
	Explanation: N/A

#	Design Verification Questionnaire All questions shall be explained in the space provided
16.	Has the design properly considered radiation exposure to the public and plant personnel? (ALARA/cobalt reduction)
	Explanation: N/A
17.	Are the acceptance criteria incorporated in the design documents sufficient to allow verification that design requirements have satisfactorily accomplished?
	Explanation: Yes, the conclusion is reached by directly comparing requirements to capability.
18.	Have adequate pre-operational and subsequent periodic test requirements been appropriately specified?
	Explanation: N/A
19.	Are adequate handling, storage, cleaning and shipping requirements specified?
	Explanation: N/A
20.	Are adequate identification requirements specified?
	Explanation: N/A
21.	Are the conclusions drawn in the Safety Evaluation fully supported by adequate discussion in the test or Safety Evaluation itself?
	Explanation: N/A
22.	Are necessary procedural changes specified, and are responsibilities for such changes clearly delineated?
	Explanation: N/A
23.	Are requirements for record preparation, review, approval, retention, etc., adequately specified?
	Explanation: Yes, this is CAT I calculation Documents control process
24.	Have supplemental reviews by other engineering disciplines (seismic, electrical, etc.) been performed on the integrated design package?
	Explanation: Yes, System engineer, WPO engineer have reviewed this calculation.
25.	Have the drawings, sketches, calculations, etc., included in the integrated design package been reviewed?
	Explanation: Yes.

#	Design Verification Questionnaire All questions shall be explained in the space provided
26.	Have reviews been performed to identify any effect on the Check Valve Maintenance Program?
Explanation:	N/A
27.	Does the design for check valves meet the intents of INPO SOER 86-03?
Explanation:	N/A
28.	Is the plant reference simulator physical and functional fidelity affected and it's design change been factored into the cost?
Explanation:	N/A
29.	Are all references listed (including design calculation/analysis) that were used as part of the design review?
Explanation:	Yes.

REMARKS/COMMENTS:

Design Verification Complete: [signature] 2/10/96

VELAN

VIA FAX

Number of pages including this page: ______

Please reply by FAX to:	
☐ Head Office and Plant No. 1	(514) 748-8635
☐ Marketing	(514) 748-7592
☐ Plant No. 2	(514) 341-3032
☐ Spare Parts	(514) 342-2311
☐ Plant No. 3	(802) 862-4014
☐ Plant No. 4	(514) 378-6865

Message No.: ______

Date: Nov. 29, 1995

From: M. L. PANG

To: New York Power Authority (914) 736-5402

Attention: Mr. Martsen

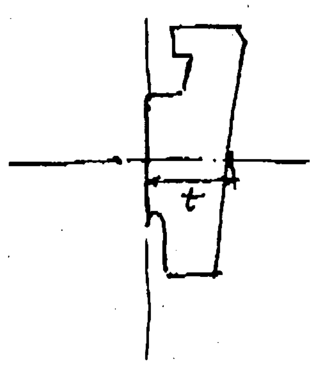
Copies to: ______

Subject / Reference: Wedge dimension for pressure locking calculation (P9-76938-K)

Fred:

Please find the following dimension you requested and sketch per our telephone conversation today.

t = 1.0 inch.



Should you have any question, please call at (514) 748-7743 ext 264

Regards,

Michael L. Pang

VELAN INC.

ATTACHMENT TO CALC No. IP3-CALC-RC-01718 Page 1 of 1