SCE&G
A SCANA Company

South Carolina Electric & Gas Company
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Gary J. Taylor
Vice President
Nuclear Operations

August 2, 1996
RC-96-0182

Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Gentlemen:

Subject: VIRGIL C. SUMMER NUCLEAR STATION (VCSNS)
DOCKET NO. 50/395
OPERATING LICENSE NO. NPF-12
REQUEST FOR ADDITIONAL INFC ATION - GENERIC LETTER 95-07, "PRESSURE LOCKING AN .ERMAL BINDING OF SAFETY-RELATED POWER OPERAIED GATE VALVES" OF JULY 3, 1996

Pursuant to the NRC's request for additional information on the subject Generic Letter, South Carolina Electric & Gas Company (SCE&G) is submitting the attached documentation under oath of affirmation.

Should you have any questions, please call Mr. Jeffrey W. Pease, at (803) 345-4124.

Very truly yours,

for Gary J. Taylor

JWP/GJT/ews
Enclosures (5)

c: J. L. Skolds
W.F. Conway
R. R. Mahan (w/o enclosures)
R. J. White
A. R. Johnson
S. D. Ebneter
NRC Resident Inspector
J. B. Knotts, Jr.
NSRC
File (815.14)
RTS (LTR950007)
DMS (RC-96-0182)

1/1
A056

9608080036 960802
PDR ADOCK 05000395
P PDR

STATE OF SOUTH CAROLINA :

: **TO WIT** :

COUNTY OF FAIRFIELD :

I hereby certify that on the 2nd day of August 1996, before me, the subscriber, personally appeared Thomas H. Taylor, being duly sworn, states that he is acting for the Vice President, Nuclear Operations of the South Carolina Electric & Gas Company, a corporation of the State of South Carolina, that he provides the foregoing response for the purposes therein set forth, that the statements made are true and correct to the best of his knowledge, information, and belief, and that he was authorized to provide the response on behalf of said Corporation.

WITNESS my Hand and Notarial Seal

Jeffrey W. Pease
Notary Public for South Carolina

My Commission Expires

7-26-2005
Date

VCSNS RESPONSE TO THE REQUEST FOR ADDITIONAL INFORMATION CONCERNING THE STATIONS INITIAL GENERIC LETTER 95-07 "PRESSURE LOCKING AND THERMAL BINDING OF SAFETY-RELATED POWER-OPERATED GATE VALVES" SUBMITTAL.

PURPOSE:

This enclosure provides the additional information requested in part 1 of the enclosure to the NRC letter to Mr. Taylor, dated July 3, 1996 (REQUEST FOR ADDITIONAL INFORMATION - GENERIC LETTER 95-07, "PRESSURE LOCKING AND THERMAL BINDING OF SAFETY-RELATED POWER OPERATED GATE VALVES," VIRGIL C. SUMMER NUCLEAR STATION (TAC NO. M93525).

ADDITIONAL INFORMATION REQUESTED:

1. "Regarding the following valves:

8000 A/B/C	Pressurizer PORV Block
8801 A/B	High Head Injection to RCS Cold Legs
8884	High Head Safety Injection to RCS Hot Legs
8885	Alternate HHSI to RCS Cold Legs
8886	HHSI to RCS Hot Legs

the licensee's submittal states that a hydraulic pressure locking analysis consistent with the Commonwealth Edison methodology has shown that these valves have sufficient opening thrust capability to overcome the postulated pressure locking forces. Please provide these thrust requirement and actuator capability calculations for our review".

VCSNS ADDITIONAL INFORMATION:

The requested pressure locking (PL) thrust requirement and the applicable portions of the actuator capability calculations are attached as follows:

8000 A/B/C	Actuator capability calculation	- Attachment # I
8000 A/B/C	PL thrust requirement calculation	- Attachment # III
8801 A/B	Actuator capability calculation	- Attachment # II
8801 A/B	PL thrust requirement calculation	- Attachment # IV
8884	Actuator capability calculation	- Attachment # II

8884	PL thrust requirement calculation	- Attachment # V
8885	Actuator capability calculation	- Attachment # II
8885	PL thrust requirement calculation	- Attachment # VI
8886	Actuator capability calculation	- Attachment # II
8886	PL thrust requirement calculation	- Attachment # V

SUBJECT CODE 152	SOUTH CAROLINA ELECTRIC AND GAS COMPANY CALCULATION RECORD		PAGE 1 OF
CALC TITLE: Design, Review and Capability of Rising Stem MOVs in the CC, EF, FS, FW, MS, RC, SP & SW Sys.	CALC NO DC01520-065	REV 4	STATUS A
PARENT DOCUMENT N/A	SYSTEM VARIOUS	SAFETY CLASS ☐ NN ☐ QR ☑ SR	
ORIGINATOR Allen M. Edmond	DISC ME	ORGANIZATION SCE&G-DE	DATE 5-1-96 / XREF NO. N/A

A. CALCULATION INFORMATION

CONTENT DESCRIPTION: Rising Stem CC, EF, FS, FW, MS, RC, SP & SW Systems MOV Setup Windows

AFFECTED COMPONENTS/ANALYSIS: VARIOUS XVGs and XVKs/No analyses impacted.

CONTAINS PRELIMINARY DATA/ASSUMPTIONS:

☒ NO ☐ YES, PAGES

COMPUTER PROGRAM USED: ☒ NO

☐ YES, VALIDATION NOT REQ'D [REF. 3.5]
☐ YES, VALIDATED [ES-412]
☐ YES, VALIDATED [OTHERS]
☐ PROGRAM VALIDATION CALCULATION

B. VERIFICATION

☐ CONTINUED, ATTACHMENT

VERIFICATION SCOPE: Verify per ES-110 requirements and the administrative requirement of ES-412

VERIFIER: Waters, J.E.
ASSIGN BY: Estes, B.T.

Allen M. Edmond 5-1-96
LEAD ENGINEER (DESIGNEE)/DATE

VERIFIER/DATE	APPROVAL/DATE
JEWaters 5/1/96	D J L 5/1/96

C. RECORDS	REEL NUMBER:
	FRAME NUMBER:
TO PRS: ____________ INIT/DATE	ORIGINAL MAINTAINED BY: ☐ SCE&G DE ☐ SCE&G ________ ☐ VENDOR

DISTRIBUTION: CALC FILE (ORIGINAL)
PDE_____/SYSTEM ENG_____DE FILE 20.6602 ATTACH. 1 ONLY, COPY)

SOUTH CAROLINA ELECTRIC & GAS COMPANY
REVISION SUMMARY

PAGE 2 OF

CALCULATION NO.
DC01520-065

REV NO.
4

SUMMARY DESCRIPTION

This revision includes the following Changes:

1. Incoporates the 90% Open Torque Switch Bypass into the Configuration & Control Switch Requirements Section for the Valves identified by this revision.
2. Incorporates/changes the 90% OTS Bypass from "No" to "Yes" in the Valve Information Section for the Valves identified by this revision
3. Changed the actuator allowable for XVG03005A-SP from 14000 lb to 19600 lb. This is allowed per reference ~~7.3.1~~ 2.4 of DC01520-067 Rev. 4
mRH
5/1/96

☐ CONTINUES ON PAGE

1.0 PURPOSE

This calculation will determine the motor operator capability in both the open and close directions, provide torque bands, thrust bands and control switch setpoint recommendations for rising stem GL 89-10 MOVs as well as additional important to safety MOVs per ref. 2.32 in the following systems:

Component Cooling (CC)	Reactor Coolant (RC)
Emergency Feedwater (EF)	Reactor Building Spray (SP)
Fire Service (FS)	Service Water (SW)
Feedwater (FW)	
Main Steam (MS)	

Valves tag numbers in section 2.6 marked with an asterisk are not within the scope of GL-89-10.

Motor operator capability determination can serve several purposes:

1. Determine motor operator capability - Minimum operator capability is defined as the output torque and thrust the operator is capable of producing under design basis conditions independent of control switch setting.
2. Determine the limiting thrust and torque values for the MOV to protect it from overthrust, overtorque and locked rotor conditions.
3. To indicate overall MOV adequacy to operate at design basis conditions prior to diagnostic testing.
4. Recommend the configuration of control switches based on minimum required thrust calculations and most limiting stress and/or thrust value of the MOV in both the opening and closing directions without compromising MOV integrity.
5. Can be used as a basis for recommending motor operator reconfiguration where thrust/torque capability is determined to be less than adequate to overcome design basis thrust requirements.

2.0 REFERENCES

2.1 Limitorque correspondence:

2.1.1 Limitorque letter from Dominick Giangualano to Mr. H.N. Goldstein of Gilbert Commonwealth regarding P.O. 233617, including corrected Limitorque data sheets, dated 6/9/88

2.1.2 Limitorque letter from J.B. Drab to H.N. Goldstein of Gilbert Commonwealth regarding P.O. 230547, including Limitorque data sheets, dated 5/20/87

2.1.3 Limitorque letter from Mr. M. Bailey to Mr. Barry Norcutt of SCE&G regarding Limitorque Actuator Torque and Thrust Ratings, dated 10/2/91

2.2 Limitorque Documents

2.2.1 SEL-1, dated 5/21/79
2.2.2 SEL-2, dated 7/1/77
2.2.3 SEL-3, page 1 of 4, dated 5/21/79
SEL-3, page 2 of 4, dated 12/15/75
SEL-3, page 3 of 4, dated 2/26/79
SEL-3, page 4 of 4, dated 7/1/77
2.2.4 SEL-4, dated 7/1/77
2.2.5 SEI-5, dated 11/9/88
2.2.6 SEL-7, dated 11/89
2.2.7 SEL-9, dated 6/2/75
2.2.8 900-00003, dated 3/88
2.2.9 900-00004, dated 3/88
2.2.10 Technical Update 92-02, dated 10/9/92
2.2.11 Technical Update 93-01, dated 6/8/93
2.2.12 Potential 10CFR21 Condition Reliance 3 Phase Limitorque Corporation Actuator Motors, dated 5/13/93 and Technical Update 93-03, dated 11/93
2.2.13 Technical Update 92-01, dated 2/28/92
2.2.14 Maintenance Update 92-01, dated 2/27/92

2.3 EPRI Documents
2.3.1 EPRI Application Guide for Motor Operated Valves in Nuclear Power Plants NP-6660-d, Final Report, dated March 1990
2.3.2 EPRI MOV PPP MOV Margin Improvement Guide TR-100449, Dated February 1992

2.4 Letter CGE-91-1048 from J.C. Snelson to R.J. Waselus, Motor Operated Valve Data Sheets for V.C. Summer including attachment

2.5 Westinghouse E-Spec. 678852, Rev. 2, dated 3/14/77

2.6 Valve assembly drawings: Valve to drawing traceability confirmed through references 2.4 and 2.9.

Valve	Vendor Dwg.	VCSNS Dwg.	Elementary
XVG-9568-CC	3316-3, Rev. C	1MS-25-222-3	B-208-011 CC-18 R6A
XVG-9600-CC	3299-3, Rev. D	1MS-25-206-4	B-208-011 CC-24 R6B
XVG-9605-CC	3319-3, Rev. C	1MS-25-225-3	B-208-011 CC-25 R6A
XVG-9606-CC	3320-3, Rev. C	1MS-25-226-3	B-208-011 CC-26 R6
XVG-9625-CC	3318-3, Rev. C	1MS-25-224-3	B-208-011 CC-29 R3A
XVG-9626-CC	3318-3, Rev. C	1MS-25-224-3	B-208-011 CC-29 R3A
XVG-1001A-EF	3316-3, Rev. C	1MS-25-222-3	B-208-032 EF-03 R7
XVG-1001B-EF	3316-3, Rev. C	1MS-25-222-3	B-208-032 EF-04 R7
XVG-1002-EF	3318-3, Rev. C	1MS-25-224-3	B-208-032 EF-05 R7
XVG-1008-EF	3318-3, Rev. C	1MS-25-224-3	B-208-032 EF-06 R7
XVG-1037A-EF	3318-3, Rev. C	1MS-25-224-3	B-208-032 EF-07 R9
XVG-1037B-EF	3318-3, Rev. C	1MS-25-224-3	B-208-032 EF-08 R9A
XVG-6797-FS	3558-3, Rev. C	1MS-25-498-3	B-208-044 FS-01 R5
XVK-1633A-FW	ACD-31602315, R 1G	1MS-25-647-1	B-208-045 FW-41 R5
XVK-1633B-FW	ACD-31602315, R 1G	1MS-25-647-1	B-208-045 FW-42 R5
XVK-1633C-FW	ACD-31602315, R 1G	1MS-25-647-1	B-208-045 FW-43 R5

Valve	Vendor Dwg.	VCSNS Dwg.	Elementary
XVG-2802A-MS	93-14372, Rev. 0	1MS-25-618-0	B-208-067 MS-01 R10A
XVG-2802B-MS	93-14372, Rev. 0	1MS-25-618-0	B-208-067 MS-02 R9A
XVT-2813-MS*	ACD-31602299, R.1	1MS-25-552-1	B-208-067 MS-04 R13
XVG-8000A-RC	115E075, Rev. 7	1MS-25-115-3	B-208-082 RC-10 R7A
XVG-8000B-RC	115E075, Rev. 7	1MS-25-115-3	B-208-082 RC-11 R7A
XVG-8000C-RC	115E075, Rev. 7	1MS-25-115-3	B-208-082 RC-12 R7A
XVT-8095A-RC*	E-191790, Rev. 3	1MS-25-793-2	B-208-082 RC-14 R4
XVT-8095B-RC*	E-191790, Rev. 3	1MS-25-793-2	B-208-082 RC-15 R4
XVT-8096A-RC*	E-191790, Rev. 3	1MS-25-793-2	B-208-082 RC-17 R3
XVT-8096B-RC*	E-191790, Rev. 3	1MS-25-793-2	B-208-082 RC-16 R4
XVG-3001A-SP	3329-3, Rev. D	1MS-25-233-2	B-208-097 SP-03 R8A
XVG-3001B-SP	3329-3, Rev. D	1MS-25-233-2	B-208-097 SP-04 R8A
XVG-3002A-SP	3304-3, Rev. E	1MS-25-211-3	B-208-097 SP-05 R9A
XVG-3002B-SP	3304-3, Rev. E	1MS-25-211-3	B-208-097 SP-06 R9A
XVG-3003A-SP	3336-3, Rev. C	1MS-25-237-3	B-208-097 SP-07 R9A
XVG-3003B-SP	3336-3, Rev. C	1MS-25-237-3	B-208-097 SP-08 R9A
XVG-3004A-SP	3328-3, Rev. E	1MS-25-232-5	B-208-097 SP-09 R8
XVG-3004B-SP	3328-3, Rev. E	1MS-25-232-5	B-208-097 SP-10 R8
XVG-3005A-SP	3330-3, Rev. D	1MS-25-233-2	B-208-097 SP-11 R9
XVG-3005B-SP	3330-3, Rev. D	1MS-25-233-2	B-208-097 SP-12 R7
XVG-3103A-SW	3331-3, Rev. B	1MS-25-291-2	B-208-101 SW-23 R6A
XVG-3103B-SW	3331-3, Rev. B	1MS-25-291-2	B-208-101 SW-24 R6A
XVG-3107A-SW	3332-3, Rev. B	1MS-25-292-2	B-208-101 SW-27 R7B
XVG-3107B-SW	3332-3, Rev. B	1MS-25-292-2	B-208-101 SW-28 R7C
XVG-3108A-SW	3325-3, Rev. D	1MS-25-230-4	B-208-101 SW-29 R4A
XVG-3108B-SW	3325-3, Rev. D	1MS-25-230-4	B-208-101 SW-30 R4A
XVG-3108C-SW	3325-3, Rev. D	1MS-25-230-4	B-208-101 SW-31 R4A
XVG-3108D-SW	3325-3, Rev. D	1MS-25-230-4	B-208-101 SW-32 R4A
XVG-3109A-SW	3325-3, Rev. D	1MS-25-230-4	B-208-101 SW-33 R5A
XVG-3109B-SW	3325-3, Rev. D	1MS-25-230-4	B-208-101 SW-34 R5A
XVG-3109C-SW	3325-3, Rev. D	1MS-25-230-4	B-208-101 SW-35 R5A
XVG-3109D-SW	3325-3, Rev. D	1MS-25-230-4	B-208-101 SW-36 R5A
XVG-3111A-SW	3327-3, Rev. B	1MS-25-290-2	B-208-101 SW-39 R5A
XVG-3111B-SW	3327-3, Rev. B	1MS-25-290-2	B-208-101 SW-40 R5A
XVG-3112A-SW	3327-3, Rev. B	1MS-25-290-2	B-208-101 SW-41 R6B
XVG-3112B-SW	3327-3, Rev. B	1MS-25-290-2	B-208-101 SW-42 R6A

2.7 Correspondence: Gilbert/Commonwealth letter CGGW-1896 to Westinghouse, dated 3/17/83

2.8 Correspondence: Westinghouse letter CGE-83-678 to G.J. Braddick of Gilbert/Commonwealth, dated 5/13/83

2.9 Minimum Required Thrust Calculations

2.9.1 DC01520-060 Rev. 3, Minimum Required Thrust For GL 89-10 MOVs in the CC System

2.9.2 DC01520-057 Rev. 3, Minimum Required Thrust For GL 89-10 MOVs in the EF System

2.9.3 DC01520-064 Rev. 2, Minimum Required Thrust For GL 89-10 MOVs in the FS System

2.9.4 DC01520-055 Rev. 2, Minimum Required Thrust For GL 89-10 MOVs in the FW System

2.9.5 DC01520-056 Rev. 4, Minimum Required Thrust For GL 89-10 MOVs in the MS System

2.9.6 DC01520-062 Rev. 4, Minimum Required Thrust For GL 89-10 MOVs in the RC System

2.9.7 DC01520-063 Rev. 3, Minimum Required Thrust For GL 89-10 MOVs in the SP System

2.9.8 DC01520-058 Rev. 4, Minimum Required Thrust For GL 89-10 MOVs in the SW System

2.10 Specification for Electric Motor Valve Actuators, V.C. Summer Nuclear Station, (SP-309-2261-00), dated 10/1/71

2.11 Correspondence: Westinghouse letter from R.J. Faix to Mr. C.A. Price of SCE&G, CGWS-1184, dated 5/7/81

2.12 USNRC IEB 81-02, dated 4/9/81 and IEB 81-02 Supplement 1, dated 8/18/81; "Failure of Gate Valves to Close Under Differential Pressure"

2.13 Correspondence: Westinghouse letter from R.J. Faix to Mr. C.A. Price of SCE&G, CGWS-2013, dated 6/11/81

2.14 Correspondence: Westinghouse letter from R.J. Faix to Mr. C.A. Price of SCE&G, CGWS-2125, dated 11/12/81

2.15 Correspondence: SCE&G letter from T.C. Nichols to NRC Director James P. Reilly, dated 7/7/81

2.16 Correspondence: Westinghouse letter to R.B. Clary of SCE&G, CGE-90-1061, dated 4/4/90. Valve allowables and new Limitorque thrust rating for SB-00 and SBD-00 actuators provided with Westinghouse valves

2.17 DC0820-003, Rev. 4, Class 1E 460V MOV Starting Voltages at Degraded Voltage Conditions

2.18 Correspondence: Westinghouse letter from R.J. Faix to Mr. C.A. Price of SCE&G, CGWS-2371, dated 12/15/82 Field Change Notice FCN-CGE-10634

2.19 V.C. Summer Nuclear Station Equipment Qualification Data Base

2.20 S-021-018, Environmental Zone Information

2.21 HELB/MSLB Evaluation, Report 2616, Rev. 7

2.22 V.C. Summer Nuclear Station Surveillance Test Procedures

2.23 MOV Weak Link Calculations

2.23.1 DC01520-050, Rev. 1, MOV Weak Link Analyses

2.23.2 DC01520-070, Rev. 0, Maximum Allowable Thrust Analysis Report B.O.M. RNn4 (XVG09605-CC)

2.23.3 DC01520-071, Rev. 0, Maximum Allowable Thrust Analysis Report B.O.M. RNn16 (XVG03003A,B-SP)

2.23.4 DC01520-072, Rev. 0, Maximum Allowable Thrust Analysis Report B.O.M. RNn17 (XVG03005A,B-SP)

2.23.5 DC01520-073, Rev. 0, Maximum Allowable Thrust Analysis Report B.O.M. RNn18 (XVG03001A,B-SP)

2.23.6 DC01520-074, Rev. 0, Maximum Allowable Thrust Analysis Report B.O.M. RNn30 (XVG09568-CC, XVG09606-CC)

2.23.7 DC01520-075, Rev. 0, Maximum Allowable Thrust Analysis Report B.O.M. RNg25 (XVG09625-CC, XVG09626-CC, XVG01002-EF, XVG01008-EF, XVG01037A-EF, XVG01037B-EF)

2.23.8 DC01520-076, Rev. 1, Maximum Allowable Thrust Analysis Report B.O.M. RNg19 (XVG03111A,B-SW, XVG03112A,B-SW)

2.23.9 DC01520-077, Rev. 0, Maximum Allowable Thrust Analysis Report B.O.M. RNn14 (XVG03103A,B-SW)

2.23.10 DC01520-078, Rev. 0, Maximum Allowable Thrust Analysis Report B.O.M. RNg20 (XVG03107A,B-SW)

2.23.11 DC01520-079, Rev. 0, Maximum Allowable Thrust Analysis Report B.O.M. RNg21 (XVG03002A,B-SP)

2.23.12 DC01520-080, Rev. 0, Maximum Allowable Thrust Analysis Report B.O.M. RNg24 (XVG01001A,B-EF)

2.23.13 DC01520-081, Rev. 1, Max. Allowable Thrust Analysis Report B.O.M. RNn13 (XVG03108A,B,C,D-SW, XVG03109A,B,C,D-SW) | 3

2.23.14 DC01520-082, Rev. 0, Maximum Allowable Thrust Analysis Report B.O.M. RNn5 (XVG09600-CC)

2.23.15 DC01520-083, Rev. 0, Maximum Allowable Thrust Analysis Report B.O.M. RNn21 (XVG03004A,B-SP)

2.23.16 DC01520-084, Rev. 0, Maximum Allowable Thrust Analysis Report B.O.M. RNn40 (XVG06797-FS)

2.23.17 DC01520-085, Rev. 1, Maximum Allowable Thrust Analysis Report B.O.M. RNn7 (XVG02802A,B-MS)

2.23.18 DC01520-087, Rev. 0, Maximum Allowable Thrust Analysis Report B.O.M. RNn8 & RNg10 (XVK01633A,B,C-FW, XVT02813-MS)

2.23.19 DC01520-088, Rev. 1, Maximum Allowable Thrust Analysis Report B.O.M. RNu1 (XVT08095A,B-RC, XVT08096A,B-RC)

2.24 VCSNS GL 89-10 Actuator Refurbishment Packages

2.25 MRF 21745 MCN C

2.26 MRF 21745 MCN G

2.27 Reactor Building Design Basis Document, Rev. 4

2.28 MRF 21745 MCN H

2.29 MRF 22362

2.30 MRF 21745 MCN I

2.31 Kalsi Engineering Inc. Documents
- 2.31.1 Thrust Rating Increase of Limitorque SB-00 Through SB-2 Spring Compensator Assemblies and SB-00 through SB-1 Actuators,Document No. 1707C, Rev. 0, dated 11-25-91
- 2.31.2 Thrust Rating Increase of Limitorque SMB-000, SMB-00, SMB-0 and SMB-1 Actuators, Document No. 1707C, Rev. 0, dated 11-25-91
- 2.31.3 Fastener Analysis: Limitorque Operator Mount and Housing Cover, Document No. 1759C, Rev. 0, dated 12-7-93

2.32 DC01520-089, Rev. 2, GL 89-10 MOV Scope, Grouping and Engineering Justifications

3.0 ASSUMPTIONS

3.1 Spring pack limitations will not be considered as an operator limiting component.

3.2 The maximum ambient temperature for which operation of XVG08000A,B,C-RC is required is the Reactor Building design temperature of 283°F(140°C)(ref. 2.27). This is considered reasonable as the design function of these MOVs is to isolate a stuck open pressurizer PORV. From a Reactor Building peak temperature perspective, the most limiting high energy line break for which PORV actuation is reasonable (i.e., RCS pressure increase) is a Feedwater Line Break Inside Containment (FWLBIC). The RB pressure and temperature analysis do not specifically address the FWLBIC as it results in less energy input to the RB than a Main Steam Line Break (i.e., the feedwater is subcooled). As there are no post-FWLBIC RB temperature profiles, the design temperature of 283°F will be used. Please note that these MOVs' EQ protective category of C1,C2 indicates that their operation in a steam environment is not required.

3.3 The maximum stem to stem nut coefficient of friction during maximum MOV DP loads is less than or equal to 0.15 based on VCSNS experience, unless otherwise specified.

4.0 METHODOLOGY

This calculation will determine the minimum MOV capability. These limitations can be based on degraded voltage actuator capability, actuator thrust ratings, actuator torque ratings and/or valve structural limitations(reference 2.23).

4.1 The basic actuator degraded voltage capability equation and methodology are given below.

ACTUATOR OPEN TORQUE = NOM. MOTOR TORQUE * MTF * OGR * PULLOUT EFF. * APP. FACTOR * (%OF FULL VOLTAGE/100)^2

ACTUATOR OPEN THRUST = ACTUATOR OPEN TORQUE/STEM FACTOR @ 0.15 (Unless otherwise specified)

ACTUATOR CLOSE TORQUE = NOM. MOTOR TORQUE * MTF * OGR * RUN EFF. * APP. FACTOR * (% OF FULL VOLTAGE/100)^2

ACTUATOR CLOSE THRUST = ACTUATOR CLOSE TORQUE/STEM FACTOR @ 0.15 (Unless otherwise specified)

ACTUATOR STALL TORQUE = NOM. MOTOR TORQUE * OGR * STALL EFF. * 1.1

Both the motor torque factor and undervoltage factor are affected by temperature as discussed in reference 2.2.12. The maximum allowable stroke time (MAX S.T.) for each MOV was determined by a review of reference 2.22. This information is then used to determine the temperature increase internal to the motor per the guidance of ref. 2.2.12. The maximum ambient temperature for which MOV operation is required is determined by a review of references 2.19, 2.20 and 2.21. Once this data has been acquired, the internal temperature rise due to MOV operation is added to the worst case ambient temp. (MAOT) for which MOV operation is required. Note that for position changeable MOVs, the motor torque loss from internal heat generation due to two MOV strokes (mispositioning and recovery) is used rather than the heat generation for one stroke. This total temperature is then used in determination of the overall temperature effect on motor torque reduction and motor locked rotor current reduction per Ref. 2.2.12. The locked rotor current reduction (MCF) is an input to ref. 2.17. The motor torque reduction (MTF) is used in the overall actuator capability calculation as shown above. The general equations for MCF and MTF are given below (ref. 2.2.12). Note that the % Current Loss (MCM) and % Torque Loss (MTM) from 25°C to 180°C are motor size and speed specific per reference 2.2.12.

MTF = 1 - (MAOT + 2 * (0.1 sec. * 75°C/10 sec. + MAX S.T. * 75°C/900 sec.) - 40°C) * MTM/155

MCF = 1 - (MAOT + 0.1 sec. * 75°C/10 sec. + MAX S.T. * 75°C/900 sec. - 40°C) * MCM/155

The Unit Efficiency is a function of actuator size, actuator overall ratio, closure control method, and stroke direction. Pullout efficiency is used for the valve opening per references 2.2.6 and 2.2.10. MOV closure control method is based on a review of reference 2.6 elementary diagrams. Running efficiency is used for the closing stroke per ref. 2.3.2. Running efficiency is justified in the closing direction as the initial loads are small enough to allow the entire drive train to reach rated speed per ref. 2.3.2. Stall efficiency is from reference 2.2.6.

The Application Factor (AF) is a function of minimum motor terminal voltage per ref. 2.2.12. For minimum motor terminal voltage of less than 90%, the AF is 1.0. For cases where the minimum motor terminal voltage is greater than or equal to 90%, the AF is 0.9.

Note that all MOV applications are for temperatures considerably less than 900°F and per ref. 2.2.5 do not require an AF of 0.8.
The Undervoltage Factor is also a function of minimum motor terminal voltage as stated in references 2.2.10 and 2.2.12. For minimum motor terminal voltage of less than 90%, the Undervoltage Factor is the actual percentage of rated motor voltage (460VAC) squared. For cases where the minimum motor terminal voltage is greater than or equal to 90%, the Undervoltage Factor is 1.0. The motor terminal voltage values are from reference 2.17.

Stem factors are from reference 2.2.9 based on reference 2.6 data.

An MOV is considered position changeable unless it cannot be mispositioned from the Main Control Board, has a power lockout switch which allows MOV electrical operation for specific operations only or has its circuit breaker locked in the open position.

4.2 Standard actuator thrust ratings are from reference 2.2.7 with the exception of Westinghouse supplied SB-00 and SBD-00 actuators which have a maximum thrust rating of 16,000 lbf. (ref. 2.16). The standard thrust rating for SMB-000, SMB-00, SMB-0 and SMB-1 actuators may be increased to 140% of the standard thrust rating per reference 2.2.13 with the number of cycles at this increased thrust rating not to exceed 2000. *Thrust values greater than 140% of the standard rating are allowed per Ref. 2.31 testing only as stated throughout this calculation.*

4.3 Standard actuator torque ratings are from reference 2.2.7 and are dependent on OGR for a given size actuator. The standard torque ratings may be exceeded by as much as 20% for a limited number of cycles (100) per reference 2.1.3. The standard actuator torque ratings may be exceeded by 100% for one cycle per reference 2.2.14.

4.4 Valve open and close thrust limitations are from reference 2.23.

4.5 Valve minimum required thrust values are from reference 2.9.

4.6 The limiting torque and thrust values in this calculation do not include diagnostic test equipment accuracy allowances.

4.7 This calculation does not evaluate torque switch/spring pack capabilities and/or limitations. Full spring pack compression must be avoided for torque controlled MOVs. Torque switch settings must be below the lesser of the actuator torque rating, actuator degraded voltage capability, and spring pack limitations.

4.8 Results of the minimum actuator torque and thrust capabilities are compared to the actuator torque and thrust ratings to determine which is more limiting.

4.9 The most limiting of the minimum actuator capabilities and ratings are then compared to the valve allowables to verify that the valve will not be damaged due to improper actuator configuration.

4.10 Thrust and torque bands are then developed as follows;

Minimum Required Thrust = Min. Required Thrust per ref. 2.9.

Maximum Thrust at CST = Minimum of the actuator capability determination. Total thrust cannot exceed valve allowable or actuator rating (including inertia).

Maximum Torque at CST = Minimum of the actuator capability determination. Total torque cannot exceed actuator rating (including inertia).

NOTE: Diagnostic equipment error is not factored into the torque and thrust band values above.

4.11 Where it is determined that actuator capability is less than the minimum required thrust or if the minimum required thrust is greater than the actuator rating, recommendations are made to reconfigure the actuator to overcome limitations and provide an adequate margin to overcome minimum required thrust without compromising the MOV integrity.

4.12 Control Switch Recommendations

Control switch configuration is determined only when an acceptable torque and thrust band is available. Minimum torque and thrust capabilities should be greater than minimum required torque and thrust with diagnostic equipment error included. Recommendations are based on calculated results.

Control Switch Trip (CST) is considered to be the torque switch actuation in the open direction with the open limit providing primary valve control.

CST for the closing stroke is either close limit or close torque switch actuation depending on the design of the individual MOV.

4.13 Limit Switch Control Open

The open limit switch will be adjusted to prevent backseating. Typically, this setting approximates 90 to 95% of stroke from the fully closed position but may be varied due to inertia of the MOV, motor design, and contactor drop-out time.

4.14 Limit Switch Control Close

In cases where minimum required thrust is very close to maximum rating or allowable, and/or high inertia is present, the MOV may be set for limit closure. Actuator will be configured to trip the motor on limit and coast the disk into the seat to achieve an acceptable thrust.

4.15 Torque Switch Control Open

Primary torque switch control in the opening direction is not recommended. Backup torque switch protection is provided in case of limit failure.

4.16 Torque Switch Control Close

Recommendation for torque switch control in the closing direction is based on the torque and thrust bands established in the body of the calculation. Torque switch trip must be set at a value greater than the minimum required torque and thrust (including equipment error) and less than the lesser of the actuator rating, valve allowable or actuator degraded voltage capability. This will assure the disk is properly seated and that the torque developed is great enough to trip the motor prior to overthrust conditions.

4.17 Close to Open Torque Switch Bypass

Close to Open (C/O) torque switch bypass will be set to bypass a minimum of 20 to 25% of disk travel time with the torque switch in the open circuit. This will ensure the open torque switch is bypassed for the highest MOV loads in the open direction.

4.18 Open to Close Torque Switch Bypass

Open to Close (O/C) torque switch bypass will be set to bypass the close torque switch sufficiently to assure flow cutoff (i.e., disc over seat rings) while having the close torque switch in the control circuit prior to hard seat contact. This will ensure the valve cuts off flow while limiting the total seating thrust, including inertial effects. This setup is not recommended for valves which are required to be leak tight.

4.19 The use of the tested stem factor, tested packing load and 200% actuator torque rating is required only to address recovery from inadvertent mispositioning which is expected to no longer be an issue for PWRs with the issue of Supplement 7 to GL 89-10. This applies to valves XVG03103A-SW and XVG03103B-SW.

VALVE MFG.	WESTINGHOUSE	STEM DIA.	1.250 in.
VALVE TYPE	FLEX WEDGE GATE	STEM PITCH	0.333 in.
VALVE SIZE	3.00 in.	STEM LEAD	0.333 in.
STEM FACTOR @ 0.20	0.0140'	DWG. NO.	1MS-25-115-3
STEM FACTOR @ 0.15	0.0116'	MAX. S.T.	10 sec.
VALVE OPEN ALL.	23995 lbf.	VALVE ID	3GM88FNH
VALVE CLOSE ALL.	24922 lbf.	MAOT	140°C
POSITION CHANGEABLE	YES	90° OTS BYPASS	YES

ACTUATOR INFORMATION

MODEL	SB-00	SERIAL NO.	188642
ORDER NO.	370315B	OGR	34.1
NOM. MOTOR TORQUE	15 ft-lbf	APP. FACTOR	1.0
MOTOR RPM	3400	MOTOR VOLTAGE	460 VAC
DEGRADED VOLTAGE	407 (88.48%)	CLOSE CONTROL	LIMIT
ALLOWABLE THRUST	16000 lbf.	PULLOUT EFF.	0.40
MOTOR TORQUE MULT.	0.214	RUN EFF.	0.60
MOTOR CURRENT MULT.	0.192	STALL EFF.	0.65
ALLOWABLE TORQUE	250 ft-lbf.	STALL TORQUE	365.7 ft-lbf

MOTOR CAPABILITY @ DEGRADED VOLTAGE

MTF = 1 - (MAOT - 2 * (0.1 sec. * 75°C/10 sec. + MAX S.T. * 75°C/900 sec.) - 40°C) * MTM/155
MTF = 1 - (140°C - 2 * (0.1 sec. * 75°C/10 sec. + 10 sec. * 75°C/900 sec.) - 40°C) * 0.214/155
MTF = 0.8576

MCF = 1 - (MAOT + 0.1 sec. * 75°C/10 sec. + MAX S.T. * 75°C/900 sec. - 40°C) * MCM/155
MCF = 1 - (140°C + 0.1 sec. * 75°C/10 sec. + 10 sec. * 75°C/900 sec. - 40°C) * 0.192/155
MCF = 0.8742

ACTUATOR OPEN TORQUE = NOM. MOTOR TORQUE * MTF * OGR * PULLOUT EFF. * APP. FACTOR * (% OF FULL VOLTAGE/100)²

ACTUATOR OPEN TORQUE = 15 ft-lbf * 0.8576 * 34.1 * 0.40 * 1.0 * (0.8848)² = 137.4 ft-lbf.

ACTUATOR OPEN THRUST = ACTUATOR OPEN TORQUE/STEM FACTOR @ 0.15 = 137.4/0.0116 = 11845 lbf.

ACTUATOR CLOSE TORQUE = NOM. MOTOR TORQUE * MTF * OGR * RUN EFF. * APP. FACTOR * (% OF FULL VOLTAGE/100)²

ACTUATOR CLOSE TORQUE = 15 ft-lbf * 0.8576 * 34.1 * 0.60 * 1.0 * (0.8848)² = 206.0 ft-lbf.

ACTUATOR CLOSE THRUST = ACTUATOR CLOSE TORQUE/STEM FACTOR @ 0.15 = 206.0/0.0116 = 17767 lbf.

XVG-8000B-RC

VALVE MFG.	WESTINGHOUSE	STEM DIA.	1.250 in.
VALVE TYPE	FLEX WEDGE GATE	STEM PITCH	0.333 in.
VALVE SIZE	3.00 in.	STEM LEAD	0.333 in.
STEM FACTOR @ 0.20	0.0140'	DWG. NO.	1MS-25-115-3
STEM FACTOR @ 0.15	0.0116'	MAX. S.T.	10 sec.
VALVE OPEN ALL.	23995 lbf.	VALVE ID	3GM88FNH
VALVE CLOSE ALL.	24922 lbf.	MAOT	140°C
POSITION CHANGEABLE	YES	90% OTS BYPASS	YES

ACTUATOR INFORMATION

MODEL	SB-00	SERIAL NO.	188645
ORDER NO.	370317B	OGR	34.1
NOM. MOTOR TORQUE	15 ft-lbf	APP. FACTOR	0.9
MOTOR RPM	3400	MOTOR VOLTAGE	460 VAC
DEGRADED VOLTAGE	411 (89.35%)	CLOSE CONTROL	LIMIT
ALLOWABLE THRUST	16000 lbf.	PULLOUT EFF.	0.40
MOTOR TORQUE MULT.	0.214	RUN EFF.	0.60
MOTOR CURRENT MULT.	0.192	STALL EFF.	0.65
ALLOWABLE TORQUE	250 ft-lbf.	STALL TORQUE	365.7 ft-lbf

MOTOR CAPABILITY @ DEGRADED VOLTAGE

MTF = 1 - (MAOT + 2 * (0.1 sec. * 75°C/10 sec. + MAX S.T. * 75°C/900 sec.) - 40°C) * MTM/155
MTF = 1 - (140°C + 2 * (0.1 sec. * 75°C/10 sec. + 10 sec. * 75°C/900 sec.) - 40°C) * 0.214/155
MTF = 0.8576

MCF = 1 - (MAOT + 0.1 sec. * 75°C/10 sec. + MAX S.T. * 75°C/900 sec. - 40°C) * MCM/155
MCF = 1 - (140°C + 0.1 sec. * 75°C/10 sec. + 10 sec. * 75°C/900 sec. - 40°C) * 0.192/155
MCF = 0.8742

ACTUATOR OPEN TORQUE = NOM. MOTOR TORQUE * MTF * OGR * PULLOUT EFF. * APP. FACTOR * (% OF FULL VOLTAGE/100)^2

ACTUATOR OPEN TORQUE = 15 ft-lbf * 0.8576 * 34.1 * 0.40 * 1.0 * (0.8935)^2 = 140.1 ft-lbf.

ACTUATOR OPEN THRUST = ACTUATOR OPEN TORQUE/STEM FACTOR @ 0.15 = 140.1/0.0116 = 12078 lbf.

ACTUATOR CLOSE TORQUE = NOM. MOTOR TORQUE * MTF * OGR * RUN EFF. * APP. FACTOR * (% OF FULL VOLTAGE/100)^2

ACTUATOR CLOSE TORQUE = 15 ft-lbf * 0.8576 * 34.1 * 0.60 * 1.0 * (0.8935)^2 = 210.1 ft-lbf.

ACTUATOR CLOSE THRUST = ACTUATOR CLOSE TORQUE/STEM FACTOR @ 0.15 = 210.1/0.0116 = 18116 lbf.

XVG-8000C-RC

VALVE MFG.	WESTINGHOUSE	STEM DIA.	1.250 in.
VALVE TYPE	FLEX WEDGE GATE	STEM PITCH	0.333 in.
VALVE SIZE	3.00 in.	STEM LEAD	0.333 in.
STEM FACTOR @ 0.20	0.0140'	DWG. NO.	1MS-25-115-3
STEM FACTOR @ 0.15	0.0116'	MAX. S.T.	10 sec.
VALVE OPEN ALL.	23995 lbf.	VALVE ID	3GM88FNH
VALVE CLOSE ALL.	24922 lbf.	MAOT	140°C
POSITION CHANGEABLE	YES	90% OTS BYPASS	YES

ACTUATOR INFORMATION

MODEL	SB-00	SERIAL NO.	188644
ORDER NO.	370315B	OGR	34.1
NOM. MOTOR TORQUE	15 ft-lbf	APP. FACTOR	1.0
MOTOR RPM	3400	MOTOR VOLTAGE	460 VAC
DEGRADED VOLTAGE	415 (90.2%)	CLOSE CONTROL	LIMIT
ALLOWABLE THRUST	16000 lbf.	PULLOUT EFF.	0.40
MOTOR TORQUE MULT.	0.214	RUN EFF.	0.60
MOTOR CURRENT MULT.	0.192	STALL EFF.	0.65
ALLOWABLE TORQUE	250 ft-lbf.	STALL TORQUE	365.7 ft-lbf

MOTOR CAPABILITY @ DEGRADED VOLTAGE

MTF = 1 - (MAOT - 2 * (0.1 sec. * 75°C/10 sec. - MAX S.T. * 75°C/900 sec.) - 40°C) * MTM/155
MTF = 1 - (140°C - 2 * (0.1 sec. * 75°C/10 sec. + 10 sec. * 75°C/900 sec.) - 40°C) * 0.214/155
MTF = 0.8576

MCF = 1 - (MAOT - 0.1 sec. * 75°C/10 sec. - MAX S.T. * 75°C/900 sec. - 40°C) * MCM/155
MCF = 1 - (140°C - 0.1 sec. * 75°C/10 sec. + 10 sec. * 75°C/900 sec. - 40°C) * 0.192/155
MCF = 0.8742

ACTUATOR OPEN TORQUE = NOM. MOTOR TORQUE * MTF * OGR * PULLOUT EFF. * APP. FACTOR * $(\text{\% OF FULL VOLTAGE}/100)^2$

ACTUATOR OPEN TORQUE = 15 ft-lbf * 0.8576 * 34.1 * 0.40 * 0.9 * $(1)^2$ = 157.9 ft-lbf.

ACTUATOR OPEN THRUST = ACTUATOR OPEN TORQUE/STEM FACTOR @ 0.15 = 157.9/0.0116 = 13612 lbf.

ACTUATOR CLOSE TORQUE = NOM. MOTOR TORQUE * MTF * OGR * RUN EFF. * APP. FACTOR * $(\text{\% OF FULL VOLTAGE}/100)^2$

ACTUATOR CLOSE TORQUE = 15 ft-lbf * 0.8576 * 34.1 * 0.60 * 0.9 * $(1)^2$ = 236.9 ft-lbf.

ACTUATOR CLOSE THRUST = ACTUATOR CLOSE TORQUE/STEM FACTOR @ 0.15 = 236.9/0.0116 = 20418 lbf.

SUBJECT CODE 152	SOUTH CAROLINA ELECTRIC AND GAS COMPANY CALCULATION RECORD			PAGE 1 OF
CALC TITLE Design, Review and Capability For Rising Stem Movs in the CS, RH and SI System		CALC NO DC01520-067	REV 5	STATUS A
PARENT DOCUMENT N/A	SYSTEM VARIOUS	SAFETY CLASS ☐NN ☐QR ☒SR		
ORIGINATOR Allen M. Edmond	DISC ME	ORGANIZATION SCE&G-DE	DATE 5-1-96	XREF NO. N/A

A. CALCULATION INFORMATION

CONTENT DESCRIPTION: Rising Stem CS, RH and SI Systems MOV Setup Windows

AFFECTED COMPONENTS/ANALYSIS: Various, XVGs, XVTs and LCVs / No analyses impacted. See Reference 2.6 for a list of affected valves.

CONTAINS PRELIMINARY DATA/ASSUMPTIONS:

☒ NO ☐ YES, PAGES

COMPUTER PROGRAM USED: ☒ NO

☐ YES, VALIDATION NOT REQ'D [REF. 3.5] ☐ YES, VALIDATED [OTHERS]
☐ YES, VALIDATED [ES-412] ☐ PROGRAM VALIDATION CALCULATION
☐ CONTINUED, ATTACHMENT

B. VERIFICATION

VERIFICATION SCOPE: Verify per ES-110 requirements and the ~~administrative~~ AME 5/1/96 administrative requirements of ES-412.

VERIFIER: Waters, J.E.
ASSIGN BY: Estes, B.T.

Allen M Edmond 5/1/96
LEAD ENGINEER (DESIGNEE)/DATE

VERIFIER/DATE	APPROVAL/DATE
[signature] 5/1/96	[signature] 5/2/96

C. RECORDS

TO PRS: ______________
INIT/DATE

REEL NUMBER:

FRAME NUMBER:

ORIGINAL MAINTAINED BY:

☐ SCE&G DE
☐ SCE&G __________
☐ VENDOR __________

DISTRIBUTION: CALC FILE (ORIGINAL)
PDE_____/SYSTEM ENG_____DE FILE 20.6602 ATTACH. 1 ONLY, COPY)

SOUTH CAROLINA ELECTRIC & GAS COMPANY REVISION SUMMARY	PAGE 2 OF
CALCULATION NO. DC01520-067	

REV NO.	SUMMARY DESCRIPTION
5	This revision includes the following Changes:

1. Incorporates the 90% Open Torque Switch Bypass into the Configuration & Control Switch Requirements Section for the values identified by this revision.

2. Incorporates/Changes the 90% OTS Bypass from "NO" to "YES" in the Valve Information Section for the values identified by this revision.

3. Extracted the closing torque capability from the Motor Capability at Degraded Voltage Section and incorporated it into the Torque Band and Configuration ~~&~~ and Control Switch Requirement Section for XVG08702A-RH. This is allowed per reference 2.4.

☐ CONTINUES ON PAGE

1.0 PURPOSE

This calculation will determine the motor operator capability in both the open and close directions, provide thrust bands and control switch setpoint recommendations for GL 89-10 MOVs as well as other safety-related MOVs in the Chemical Volume and Control System, Residual Heat Removal System, and Safety Injection System. Valve tag numbers in section 2.6 marked with an asterisk are not within the GL 89-10 scope per reference 2.29.

Motor operator capability determination can serve several purposes:

1. Determine motor operator capability - Minimum operator capability is defined as the output thrust and torque the operator is capable of producing under design basis conditions independent of control switch setting.

2. Determine the limiting thrust and torque values for the valve/actuator to protect the MOV from overthrust, overtorque and locked rotor conditions.

3. To indicate overall MOV adequacy to operate at design basis conditions prior to diagnostic testing.

4. Recommend the configuration of control switches based on minimum required thrust calculations and most limiting stress and/or thrust value of the MOV in both the opening and closing directions without compromising MOV integrity.

5. Can be used as a basis for recommending motor operator reconfiguration where thrust/torque capability is determined to be less than adequate to overcome design basis thrust requirements.

2.0 REFERENCES

2.1 Limitorque "as-shipped" data sheets:

2.1.1 Limitorque letter from Dominick Giangualano to Mr. H.N. Goldstein of Gilbert Commonwealth regarding P.O. 233617, including corrected Limitorque data sheets, dated 6/9/88

2.1.2 Limitorque letter from J.B. Drab to H.N. Goldstein of Gilbert Commonwealth regarding P.O. 230547, including Limitorque data sheets, dated 5/20/87

2.2 Limitorque Documents

2.2.1 SEL-1, dated 5/21/79
2.2.2 SEL-2, dated 7/1/77
2.2.3 SEL-3, page 1 of 4, dated 5/21/79
SEL-3, page 2 of 4, dated 12/15/75
SEL-3, page 3 of 4, dated 2/26/79
SEL-3, page 4 of 4, dated 7/1/77
2.2.4 SEL-4, dated 7/1/77
2.2.5 SEL-5, dated 11/9/88
2.2.6 SEL-7, dated 11/89

2.2.7 SEL-9, dated 6/2/75
2.2.8 900-00003, dated 3/88
2.2.9 900-00004, dated 3/88
2.2.10 Technical Update 92-02, dated 10/9/92
2.2.11 Technical Update 93-01, dated 6/8/93
2.2.12 Potential 10CFR21 Condition Reliance 3 Phase Limitorque Corporation Actuator Motors, dated 5/13/93 and Technical Update 93-03, dated 11/93
2.2.13 Limitorque letter to Barry Norcutt of SCE&G dated 10-2-91, Actuator Torque and Thrust Ratings
2.2.14 Technical Update 92-01, dated 2/28/92

2.3 EPRI Documents

2.3.1 EPRI Application Guide for Motor Operated Valves in Nuclear Power Plants NP-6660-D, Final Report, dated March 1990
2.3.2 EPRI MOV PPP, MOV Margin Improvement Guide, TR-100449, dated February 1992

2.4 Kalsi Engineering Inc. Documents

2.4.1 Thrust Rating Increase of Limitorque SB-00 Through SB-2 Spring Compensator Assemblies and SB-00 Through SB-1 Operators, Document No. 1799C, Rev. 0, dated 10-7-94
2.4.2 Thrust Rating Increase of Limitorque SMB-000, SMB-00, SMB-0 and SMB-1 Actuators, Document No. 1707C, Rev. 0, dated 11-25-91
2.4.3 Fastener Analysis: Limitorque Operator Mount and Housing Cover, Document No. 1759C, Rev. 0, dated 12-7-93
2.4.4 SB-2-60 Limitorque Actuator Cycle Testing Results, Document No. 1790, dated 3-20-93

2.5 Westinghouse E-Spec. 678852, Rev. 2, dated 3/14/77

2.6 Valve assy dwgs:Valve to dwg traceability confirmed via Ref. 2.9

Valve	West. Dwg.	VCSNS Dwg.	Elementary
LCV-0115B-CS	115E064 R8	1MS-25-069-7	B-208-021-33 R9
LCV-0115D-CS	115E064 R8	1MS-25-069-7	B-208-021-35 R 11A
XVG-8130A-CS	115E064 R8	1MS-25-069-7	B-208-021-22 R 10
XVG-8130B-CS	115E064 R8	1MS-25-069-7	B-208-021-23 R 10A
XVG-8131A-CS	115E064 R8	1MS-25-069-7	B-208-021-24 R 9A
XVG-8131B-CS	115E064 R8	1MS-25-069-7	B-208-021-25 R 10A
LCV-0115C-CS	115E062 R5	1MS-25-067-5	B-208-021-34 R 9
LCV-0115E-CS	115E062 R5	1MS-25-067-5	B-208-021-36 R 10
XVG-8106-CS	115E071 R5	1MS-25-066-1-6	B-208-021-16 R 13
XVG-8107-CS	115E071 R5	1MS-25-066-1-6	B-208-021-19 R 10A
XVG-8108-CS	115E071 R5	1MS-25-066-1-6	B-208-021-20 R 11A
XVG-8132A-CS	115E271 R6	1MS-25-176-1	B-208-021-26 R 8A
XVG-8132B-CS	115E271 R6	1MS-25-176-1	B-208-021-27 R 10A
XVG-8133A-CS	115E271 R6	1MS-25-176-1	B-208-021-28 R 10A
XVG-8133B-CS	115E271 R6	1MS-25-176-1	B-208-021-29 R 10A
XVG-8801A-SI	115E071 R5	1MS-25-066-1-6	B-208-095-09 R 13A
XVG-8801B-SI	115E071 R5	1MS-25-066-1-6	B-208-095-10 R 13A
XVG-8808A-SI *	115E079 R8	1MS-25-117-4	B-208-095-16 R 12
XVG-8808B-SI *	115E079 R8	1MS-25-117-4	B-208-095-17 R 11
XVG-8808C-SI *	115E079 R8	1MS-25-117-4	B-208-095-18 R 11
XVG-8809A-SI	1164E88 R4	1MS-25-520-0	B-208-095-19R 11B
XVG-8809B-SI	1164E88 R4	1MS-25-520-0	B-208-095-20 R 11B
XVG-8811A-SI	115E070 R5	1MS-25-118-3	B-208-095-21 R 9
XVG-8811B-SI	115E070 R5	1MS-25-118-3	B-208-095-22 R 9

Valve	West. Dwg.	VCSNS Dwg.	Elementary
XVG-8812A-SI	115E069 R5	1MS-25-075-2	B-208-095-23 R 10
XVG-8812B-SI	115E069 R5	1MS-25-075-2	B-208-095-24 R 10
XVG-8884-SI	115E071 R5	1MS-25-066-1-6	B-208-095-13 R 12A
XVG-8885-SI	115E071 R5	1MS-25-066-1-6	B-208-095-14 R 14A
XVG-8886-SI	115E071 R5	1MS-25-066-1-6	B-208-095-15 R 14A
XVG-8887A-SI	115E067 R5	1MS-25-120-2	B-208-095-25 R 10A
XVG-8887B-SI	115E067 R5	1MS-25-120-2	B-208-095-26 R 9A
XVG-8888A-SI	115E273 R7	1MS-25-175-1	B-208-095-27 R 10
XVG-8888B-SI	115E273 R7	1MS-25-175-1	B-208-095-28 R 11
XVG-8889-SI	115E273 R7	1MS-25-175-1	B-208-095-29 R 11
XVG-8701A-RH *	115E274 R5	1MS-25-160-1	B-208-084-03 R 11
XVG-8701B-RH *	1164E89 R5	1MS-25-519-1	B-208-084-04 R 12A
XVG-8702A-RH *	1164E89 R5	1MS-25-519-1	B-208-084-05 R 12
XVG-8702B-RH *	115E274 R5	1MS-25-160-1	B-208-084-06 R 12
XVG-8706A-RH	115E272 R6	1MS-25-174-1	B-208-084-09 R 11
XVG-8706B-RH	115E272 R6	1MS-25-174-1	B-208-084-10 R 11
FCV-0602A-RH	8372D26 R1	1MS-25-811-1	B-208-084-07 R 6
FCV-0602B-RH	8372D26 R1	1MS-25-811-1	B-208-084-08 R 6

Valve	Velan Dwg.	VCSNS Dwg.	Elementary
XVT-8100-CS	E-73-020 RD	1MS-25-172-3	B-208-021-17 R 10B
XVT-8104-CS	E-73-020 RD	1MS-25-172-3	B-208-021-09 R 4
XVT-8109A-CS	E-73-020 RD	1MS-25-172-3	B-208-021-13 R 10A
XVT-8109B-CS	E-73-020 RD	1MS-25-172-3	B-208-021-14 R 10A
XVT-8109C-CS	E-73-020 RD	1MS-25-172-3	B-208-021-15 R 10A
XVT-8102A-CS	E-73-018 RC	1MS-25-800-0	B-208-021-10 R 7A
XVT-8102B-CS	E-73-018 RC	1MS-25-800-0	B-208-021-11 R 7A
XVT-8102C-CS	E-73-018 RC	1MS-25-800-0	B-208-021-12 R 7A
XVT-8112-CS	E-73-024 RC	1MS-25-173-2	B-208-021-18 R 9B

2.7 Correspondence: Gilbert/Commonwealth letter CGGW-1896 to Westinghouse, dated 3/17/83

2.8 Correspondence: Westinghouse letter CGE-83-678 to G.J. Braddick of Gilbert/Commonwealth, dated 5/13/83

2.9 Minimum Required Thrust Calculations

2.9.1 DC01520-066 Rev. 3, Minimum Required Thrust For Rising Stem GL 89-10 MOVs in the CVCS System

2.9.2 DC01520-053 Rev. 4, Minimum Required Thrust For Rising Stem MOVs in the RHR System

2.9.3 DC01520-059 Rev. 3, Minimum Required Thrust For Rising Stem MOVs in the SI System

2.10 Specification for Electric Motor Valve Actuators, V.C. Summer Nuclear Station, (SP-309-2261-00), dated 10/1/71

2.11 Correspondence: Westinghouse letter from R.J. Faix to Mr. C.A. Price of SCE&G, CGWS-1184, dated 5/7/81

2.12 USNRC IEB 81-02, dated 4/9/81 and IEB 81-02 Supplement 1, dated 8/18/81; "Failure of Gate Valves to Close Under Differential Pressure"

2.13 Correspondence: Westinghouse letter from R.J. Faix to Mr. C.A. Price of SCE&G, CGWS-2013, dated 6/11/81

2.14 Correspondence: Westinghouse letter from R.J. Faix to Mr. C.A. Price of SCE&G, CGWS-2125, dated 11/12/81

2.15 Correspondence: SCE&G letter from T.C. Nichols to NRC Director James P. Reilly, dated 7/7/81

2.16 Correspondence: Westinghouse letter to R.B. Clary of SCE&G, CGE-90-1061, dated 4/4/90. Valve allowables and new Limitorque thrust rating for SB-00 and SBD-00 actuators provided with Westinghouse valves

2.17 DC0820-003, Rev. 4, Class 1E 460V MOV Starting Voltages at Degraded Voltage Conditions

2.18 Correspondence: Westinghouse letter from R.J. Faix to Mr. C.A. Price of SCE&G, CGWS-2371, dated 12/15/82 Field Change Notice FCN-CGE-10634

2.19 V.C. Summer Nuclear Station Equipment Qualification Data Base

2.20 S-021-018, Environmental Zone Information

2.21 HELB/MSLB Evaluation, Report 2616, Rev. 7

2.22 V.C. Summer Nuclear Station Surveillance Test Procedures

2.23 DC01520-050, Rev. 0, MOV Weak Link Analyses

2.24 VCSNS GL 89-10 Actuator Refurbishment Packages

2.25 MRF 21745 MCN C

2.26 MRF 21745 MCN G

2.27 MRF 21745 MCN H

2.28 MRF 21745 MCN I5

2.29 DC01520-089, Rev. 2, GL 89-10 MOV Scope, Grouping and Engineering Justificaions

3.0 ASSUMPTIONS

3.1 Spring pack limitations will not be considered as an operator limiting component.

4.0 METHODOLOGY

This calculation will determine the minimum MOV capability. These limitations can be based on degraded voltage actuator capability, actuator thrust ratings, actuator torque ratings and/or valve structural limitations(reference 2.23).

4.1 The basic actuator degraded voltage capability equation and methodology are given below.

ACTUATOR OPEN TORQUE = NOM. MOTOR TORQUE * MTF * OGR * PULLOUT EFF. * APP. FACTOR * (% OF FULL VOLTAGE/100)²

ACTUATOR OPEN THRUST = ACTUATOR OPEN TORQUE/STEM FACTOR @ 0.15

ACTUATOR CLOSE TORQUE = NOM. MOTOR TORQUE * MTF * OGR * RUN EFF. * APP. FACTOR * (% OF FULL VOLTAGE/100)²

ACTUATOR CLOSE THRUST = ACTUATOR CLOSE TORQUE/STEM FACTOR @ 0.15

ACTUATOR STALL TORQUE = NOM. MOTOR TORQUE * OGR * STALL EFF. * 1.1

Both the motor torque factor and degraded voltage factor are affected by temperature as discussed in reference 2.2.12. The maximum allowable stroke time (MAX S.T.) for each MOV was determined by a review of reference 2.22. This information is then used to determine the temperature increase internal to the motor per the guidance of ref. 2.2.12. The maximum ambient temperature for which MOV operation is required is determined by a review of references 2.19, 2.20 and 2.21. Once this data has been acquired, the internal temperature rise due to MOV operation is added to the worst case ambient temp. (MAOT) for which MOV operation is required. Note that for position changeable MOVs, the internal heat generation due to two MOV strokes (mispositioning and recovery) is used rather than the heat generation for one stroke. This total temperature is then used in determination of the overall temperature effect on motor torque reduction and motor locked rotor current reduction per Ref. 2.2.12. The locked rotor current reduction (MCF) is an input to ref. 2.17. The motor torque reduction (MTF) is used in the overall actuator capability calculation as shown above. The general equations for MCF and MTF are given below (ref. 2.2.12). Note that the % Current Loss (MCM) and % Torque Loss (MTM) from 25°C to 180°C are motor size and speed specific per reference 2.2.12.

MTF = 1 - (MAOT + 2 * (0.1 sec. * 75°C/10 sec. + MAX S.T. * 75°C/900 sec.) - 40°C) * MTM/155 (position changeable MOVs)

MTF = 1 - (MAOT + (0.1 sec. * 75°C/10 sec. + MAX S.T. * 75°C/900 sec.) - 40°C) * MTM/155 (non-position changeable MOVs)

MCF = 1 - (MAOT + (0.1 sec. * 75°C/10 sec. + MAX S.T. * 75°C/900 sec.) - 40°C) * MCM/155

The Unit Efficiency is a function of actuator size, actuator overall ratio(OGR), motor speed, closure control method, and stroke direction. Pullout efficiency is used for the valve opening per references 2.2.6 and 2.2.10. MOV closure control method is based on a review of reference 2.6 elementary diagrams. Running efficiency is used for the closing stroke per ref. 2.2.6. Running efficiency is justified in the closing direction as the initial loads are small enough to allow the entire drive train to reach rated speed per Ref. 2.3.2. Stall efficiency is from reference 2.2.6.

The Application Factor (AF) is a function of minimum motor terminal voltage per ref. 2.2.12. For minimum motor terminal voltage of less than 90%, the AF is 1.0. For cases where the minimum motor terminal voltage is greater than or equal to 90%, the AF is 0.9. Note that all MOV applications are for temperatures considerably less than 900°F and per ref. 2.2.5 do not require an AF of 0.8.

The Degraded Voltage Factor is also a function of minimum motor terminal voltage as stated in references 2.2.10 and 2.2.12. For minimum motor terminal voltage of less than 90%, the Degraded Voltage Factor is the actual percentage of rated motor voltage (460VAC) squared. For cases where the minimum motor terminal voltage is greater than or equal to 90%, the Degraded Voltage Factor is 1.0. The motor terminal voltage values are from reference 2.17.

Stem factors are from reference 2.2.9 based on reference 2.6 data. VCSNS MOV dynamic performance for the MOVs addressed within this calculation supports use of a 0.15 coefficient of friction, unless otherwise listed in this calculation.

An MOV is considered position changeable unless it cannot be mispositioned from the Main Control Board, has a power lockout switch which allows MOV electrical operation for specific operations only or has its circuit breaker locked in the open position.

4.2 Actuator thrust ratings are from reference 2.2 with the exception of Westinghouse supplied SB-00 and SBD-00 actuators which have a maximum thrust rating of 16,000 lbf. (ref. 2.16). *The standard thrust rating of SMB-00, SMB-00, SB-00, SBD-00, SMB-0, SMB-1 and SB-1 actuators may be increased to greater than 140% of the standard thrust rating based on Ref 2.4 test data only as stated throughout this calculation.*

4.3 Actuator torque ratings are from reference 2.2.7 and are dependent on OGR for a given size actuator. Exceedance of the standard torque ratings are allowed for a limited number of cycles per reference 2.2 and 2.4 data. Torque rating exceedances are addressed on a valve by valve basis.

4.4 Valve open and close thrust limitations are from reference 2.23.

4.5 Valve minimum required thrust values are from reference 2.9.

4.6 The limiting torque and thrust values in this calculation do not include diagnostic test equipment accuracy allowances.

4.7 This calculation does not evaluate torque switch/spring pack capabilities and/or limitations. Full spring pack compression must be avoided. Torque switch settings must be below the lesser of the actuator torque rating, actuator degraded voltage capability, and spring pack limitations.

4.8 Results of the minimum actuator torque and thrust capabilities are compared to the actuator torque and thrust ratings to determine which is more limiting.

4.9 The most limiting of the minimum actuator capabilities and ratings are then compared to the valve allowables to verify that the valve will not be damaged due to improper actuator configuration.

4.10 Thrust and torque bands are then developed for minimum and maximum limits as follows;

Minimum Required Thrust = Min. Required Thrust per ref. 2.9.

Maximum Thrust = Minimum of the MOV structural capability determination. <u>Total thrust cannot exceed valve allowable or actuator rating (including inertia).</u>

Maximum Torque at CST = Minimum of the actuator capabilty determination. <u>Total torque cannot exceed actuator rating (including inertia) unless otherwise stated.</u>

NOTE: <u>Diagnostic equipment error is not factored into the torque and thrust band values above.</u>

4.11 Where it is determined that actuator capability is less than the minimum required thrust or if the minimum required thrust is greater than the actuator rating, recommendations are made to reconfigure the actuator to overcome limitations and provide an adequate margin to overcome minimum required thrust without compromising the MOV integrity.

4.12 Control Switch Recommendations

Control switch configuration is determined only when an acceptable torque and thrust band is available. Minimum thrust capabilities should be greater than minimum required thrust with diagnostic equipment error included. Recommendations are based on calculated results.

Control Switch Trip (CST) is considered to be the torque switch actuation in the open direction with the open limit providing primary valve control.

CST for the closing stroke is either close limit or close torque switch actuation depending on the design of the individual MOV.

4.13 Limit Switch Control Open

The open limit switch will be adjusted to prevent backseating. Typically, this setting approximates 90 to 95% of stroke from the fully closed position but may be varied due to inertia of the MOV, motor design, and contactor drop-out time.

4.14 Limit Switch Control Close

In cases where minimum required thrust is very close to maximum rating or allowable, and/or high inertia is present, the MOV may be set for limit closure. Actuator will be configured to trip the motor on limit and coast the disk into the seat to achieve an acceptable thrust.

4.15 Torque Switch Control Open

Primary torque switch control in the opening direction is not recommended. Backup torque switch protection is provided in case of limit failure.

4.16 Torque Switch Control Close

Recommendation for torque switch control in the closing direction is based on the torque and thrust bands established in the body of the calculation. Torque switch trip must be set at a value greater than the minimum required thrust (including equipment error) and less than the lesser of the actuator torque and thrust ratings, valve allowable thrust or actuator degraded voltage torque capability. This will assure the disk is properly seated and that the torque developed is great enough to trip the motor prior to overtorque or overthrust conditions.

4.17 Close to Open Torque Switch Bypass

Close to Open (C/O) torque switch bypass will be set to bypass a minimum of 20 to 25% of disk travel time with the torque switch in the open circuit. This will ensure the open torque switch is bypassed for the highest MOV loads in the open direction.

VALVE MFG.	WESTINGHOUSE	STEM DIA.	1.250 in.
VALVE TYPE	FLEX WEDGE GATE	STEM PITCH	0.333 in.
VALVE SIZE	3.00 in.	STEM LEAD	0.333 in.
STEM FACTOR @ 0.20	0.0140'	DWG. NO.	1MS-25-066-1-6
STEM FACTOR @ 0.15	0.0116'	MAX. S.T.	10 sec.
VALVE OPEN ALL.	23995 lbf.	VALVE ID	3GM78FN
VALVE CLOSE ALL.	24922 lbf.	MAOT	39°C
POSITION CHANGEABLE	YES	90% OTS BYPASS	YES

ACTUATOR INFORMATION

MODEL	SB-00	SERIAL NO.	179527
ORDER NO.	370315A	OGR	38.60
NOM. MOTOR TORQUE	15 ft-lbf	APP. FACTOR	1.0
MOTOR RPM	3400	MOTOR VOLTAGE	460 VAC
DEGRADED VOLTAGE	412 (89.56%)	CLOSE CONTROL	LIMIT
ALLOWABLE THRUST	16000 lbf.**	PULLOUT EFF.	0.40
MOTOR TORQUE MULT.	0.214	RUN EFF.	0.60
MOTOR CURRENT MULT.	0.192	STALL EFF.	0.65
ALLOWABLE TORQUE	250 ft-lbf.	STALL TORQUE	414 ft-lbf

MOTOR CAPABILITY @ DEGRADED VOLTAGE

MTF = 1 - (MAOT + 2 * (0.1 sec. * 75°C/10 sec. + MAX S.T. * 75°C/900 sec.) - 40°C) * MTM/155
MTF = 1 - (39°C + 2 * (0.1 sec. * 75°C/10 sec. + 10 sec. * 75°C/900 sec.) - 40°C) * 0.214/155
MTF = 0.9970

MCF = 1 - (MAOT + (0.1 sec. * 75°C/10 sec. + MAX S.T. * 75°C/900 sec.) - 40°C) * MCM/155
MCF = 1 - (39°C + (0.1 sec. * 75°C/10 sec. + 10 sec. * 75°C/900 sec.) - 40°C) * 0.192/155
MCF = 0.9993

ACTUATOR OPEN TORQUE = NOM. MOTOR TORQUE * MTF * OGR * PULLOUT EFF. * APP. FACTOR * (% OF FULL VOLTAGE/100)^2

ACTUATOR OPEN TORQUE = 15 ft-lbf * 0.9970 * 38.6 * 0.40 * 1.0 * (0.8956)^2 = 185.2 ft-lbf.

ACTUATOR OPEN THRUST = ACTUATOR OPEN TORQUE/STEM FACTOR @ 0.15 = 185.2/0.0116 = 15966 lbf.

ACTUATOR CLOSE TORQUE = NOM. MOTOR TORQUE * MTF * OGR * RUN EFF. * APP. FACTOR * (% OF FULL VOLTAGE/100)^2

ACTUATOR CLOSE TORQUE = 15 ft-lbf * 0.9970 * 38.6 * 0.60 * 1.0 * (0.8956)^2 = 277.85 ft-lbf.

ACTUATOR CLOSE THRUST = ACTUATOR CLOSE TORQUE/STEM FACTOR @ 0.15 = 277.85/0.0116 = 23952 lbf.

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VALVE MFG.	WESTINGHOUSE	STEM DIA.	1.250 in.
VALVE TYPE	FLEX WEDGE GATE	STEM PITCH	0.333 in.
VALVE SIZE	3.00 in.	STEM LEAD	0.333 in.
STEM FACTOR @ 0.20	0.0140'	DWG. NO.	1MS-25-066-1-6
STEM FACTOR @ 0.15	0.0116'	MAX. S.T.	10 sec.
VALVE OPEN ALL.	23995 lbf.	VALVE ID	3GM78FN
VALVE CLOSE ALL.	24922 lbf.	MAOT	39°C
POSITION CHANGEABLE	YES	90% OTS BYPASS	YES

ACTUATOR INFORMATION

MODEL	SB-00	SERIAL NO.	229637
ORDER NO.	370315A	OGR	38.60
NOM. MOTOR TORQUE	15 ft-lbf	APP. FACTOR	1.0
MOTOR RPM	3400	MOTOR VOLTAGE	460 VAC
DEGRADED VOLTAGE	410 (89.13%)	CLOSE CONTROL	LIMIT
ALLOWABLE THRUST	16000 lbf. **	PULLOUT EFF.	0.40
MOTOR TORQUE MULT.	0.214	RUN EFF.	0.60
MOTOR CURRENT MULT.	0.192	STALL EFF.	0.65
ALLOWABLE TORQUE	250 ft-lbf.	STALL TORQUE	414 ft-lbf

MOTOR CAPABILITY @ DEGRADED VOLTAGE

MTF = 1 - (MAOT + 2 * (0.1 sec. * 75°C/10 sec. + MAX S.T. * 75°C/900 sec.) - 40°C) * MTM/155
MTF = 1 - (39°C + 2 * (0.1 sec. * 75°C/10 sec. + 10 sec. * 75°C/900 sec.) - 40°C) * 0.214/155
MTF = 0.9970

MCF = 1 - (MAOT + (0.1 sec. * 75°C/10 sec. + MAX S.T. * 75°C/900 sec.) - 40°C) * MCM/155
MCF = 1 - (39°C + (0.1 sec. * 75°C/10 sec. + 10 sec. * 75°C/900 sec.) - 40°C) * 0.192/155
MCF = 0.9993

ACTUATOR OPEN TORQUE = NOM. MOTOR TORQUE * MTF * OGR * PULLOUT EFF. * APP. FACTOR * (% OF FULL VOLTAGE/100)^2

ACTUATOR OPEN TORQUE = 15 ft-lbf * 0.9970 * 38.6 * 0.40 * 1.0 * (0.8913)^2 = 183.4 ft-lbf.

ACTUATOR OPEN THRUST = ACTUATOR OPEN TORQUE/STEM FACTOR @ 0.15 = 183.4/0.0116 = 15814 lbf.

ACTUATOR CLOSE TORQUE = NOM. MOTOR TORQUE * MTF * OGR * RUN EFF. * APP. FACTOR * (% OF FULL VOLTAGE/100)^2

ACTUATOR CLOSE TORQUE = 15 ft-lbf * 0.9970 * 38.6 * 0.60 * 1.0 * (0.8913)^2 = 275.16 ft-lbf.

ACTUATOR CLOSE THRUST = ACTUATOR CLOSE TORQUE/STEM FACTOR @ 0.15 = 275.16/0.0116 = 23721 lbf.

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VALVE MFG.	WESTINGHOUSE	STEM DIA.	1.250 in.
VALVE TYPE	FLEX WEDGE GATE	STEM PITCH	0.333 in.
VALVE SIZE	3.00 in.	STEM LEAD	0.333 in.
STEM FACTOR @ 0.20	0.0140'	DWG. NO.	1MS-25-066-1-6
STEM FACTOR @ 0.15	0.0116'	MAX. S.T.	10 sec.
VALVE OPEN ALL.	23995 lbf.	VALVE ID	3GM78FN
VALVE CLOSE ALL.	24922 lbf.	MAOT	48°C
POSITION CHANGEABLE	NO	90% OTS BYPASS	YES

ACTUATOR INFORMATION

MODEL	SB-00	SERIAL NO.	229642
ORDER NO.	370319A	OGR	31.90
NOM. MOTOR TORQUE	15 ft-lbf	APP. FACTOR	0.9
MOTOR RPM	3400	MOTOR VOLTAGE	460 VAC
DEGRADED VOLTAGE	419 (91.1%)	CLOSE CONTROL	LIMIT
ALLOWABLE THRUST	16000 lbf. **	PULLOUT EFF.	0.40
MOTOR TORQUE MULT.	0.214	RUN EFF.	0.60
MOTOR CURRENT MULT.	0.192	STALL EFF.	0.65
ALLOWABLE TORQUE	250 ft-lbf.	STALL TORQUE	342.1 ft-lbf

MOTOR CAPABILITY @ DEGRADED VOLTAGE

MTF = 1 - (MAOT + (0.1 sec. * 75°C/10 sec. + MAX S.T. * 75°C/900 sec.) - 40°C) * MTM/155
MTF = 1 - (48°C + (0.1 sec. * 75°C/10 sec. + 10 sec. * 75°C/900 sec.) - 40°C) * 0.214/155
MTF = 0.9868

MCF = 1 - (MAOT + (0.1 sec. * 75°C/10 sec. + MAX S.T. * 75°C/900 sec.) - 40°C) * MCM/155
MCF = 1 - (48°C + (0.1 sec. * 75°C/10 sec. + 10 sec. * 75°C/900 sec.) - 40°C) * 0.192/155
MCF = 0.9881

ACTUATOR OPEN TORQUE = NOM. MOTOR TORQUE * MTF * OGR * PULLOUT EFF. * APP. FACTOR * (% OF FULL VOLTAGE/100)^2

ACTUATOR OPEN TORQUE = 15 ft-lbf * 0.9868 * 31.9 * 0.40 * 0.9 * (1)^2 = 170.0 ft-lbf.

ACTUATOR OPEN THRUST = ACTUATOR OPEN TORQUE/STEM FACTOR @ 0.15 = 170.0/0.0116 = 14654 lbf.

ACTUATOR CLOSE TORQUE = NOM. MOTOR TORQUE * MTF * OGR * RUN EFF. * APP. FACTOR * (% OF FULL VOLTAGE/100)^2

ACTUATOR CLOSE TORQUE = 15 ft-lbf * 0.9868 * 31.9 * 0.60 * 0.9 * (1)^2 = 255.0 ft-lbf.

ACTUATOR CLOSE THRUST = ACTUATOR CLOSE TORQUE/STEM FACTOR @ 0.15 = 255.0/0.0116 = 21983 lbf.

VALVE MFG.	WESTINGHOUSE	STEM DIA.	1.250 in.
VALVE TYPE	FLEX WEDGE GATE	STEM PITCH	0.333 in.
VALVE SIZE	3.00 in.	STEM LEAD	0.333 in.
STEM FACTOR @ 0.20	0.0140'	DWG. NO.	1MS-25-066-1-6
STEM FACTOR @ 0.15	0.0116'	MAX. S.T.	10 sec.
VALVE OPEN ALL.	23995 lbf.	VALVE ID	3GM78FN
VALVE CLOSE ALL.	24922 lbf.	MAOT	105°C
POSITION CHANGEABLE	YES	90% OTS BYPASS	YES

ACTUATOR INFORMATION

MODEL	SB-00	SERIAL NO.	179524
ORDER NO.	370315A	OGR	31.90
NOM. MOTOR TORQUE	15 ft-lbf	APP. FACTOR	1.0
MOTOR RPM	3400	MOTOR VOLTAGE	460 VAC
DEGRADED VOLTAGE	407 (88.48%)	CLOSE CONTROL	LIMIT
ALLOWABLE THRUST	16000 lbf.**	PULLOUT EFF.	0.40
MOTOR TORQUE MULT.	0.214	RUN EFF.	0.60
MOTOR CURRENT MULT.	0.192	STALL EFF.	0.65
ALLOWABLE TORQUE	250 ft-lbf.	STALL TORQUE	342.1 ft-lbf

MOTOR CAPABILITY @ DEGRADED VOLTAGE

MTF = 1 - MAOT + (2 * (0.1 sec. * 75°C/10 sec. + MAX S.T. * 75°C/900 sec.) - 40°C) * MTM/155
MTF = 1 - 105°C + (2 * (0.1 sec. * 75°C/10 sec. + 10 sec. * 75°C/900 sec.) - 40°C) * 0.214/155
MTF = 0.9059

MCF = 1 - (MAOT + (0.1 sec. * 75°C/10 sec. + MAX S.T. * 75°C/900 sec.) - 40°C) * MCM/155
MCF = 1 - (105°C + (0.1 sec. * 75°C/10 sec. + 10 sec. * 75°C/900 sec.) - 40°C) * 0.192/155
MCF = 0.9175

ACTUATOR OPEN TORQUE = NOM. MOTOR TORQUE * MTF * OGR * PULLOUT EFF. * APP. FACTOR * (% OF FULL VOLTAGE/100)^2

ACTUATOR OPEN TORQUE = 15 ft-lbf * 0.9059 * 31.9 * 0.40 * 1.0 * (0.8848)^2 = 135.7 ft-lbf.

ACTUATOR OPEN THRUST = ACTUATOR OPEN TORQUE/STEM FACTOR @ 0.15 = 135.7/0.0116 = 11701 lbf.

ACTUATOR CLOSE TORQUE = NOM. MOTOR TORQUE * MTF * OGR * RUN EFF. * APP. FACTOR * (% OF FULL VOLTAGE/100)^2

ACTUATOR CLOSE TORQUE = 15 ft-lbf * 0.9059 * 31.9 * 0.60 * 1.0 * (0.8848)^2 = 203.6 ft-lbf.

ACTUATOR CLOSE THRUST = ACTUATOR CLOSE TORQUE/STEM FACTOR @ 0.15 = 203.6/0.0116 = 17552 lbf.

VALVE MFG.	WESTINGHOUSE	STEM DIA.	1.250 in.
VALVE TYPE	FLEX WEDGE GATE	STEM PITCH	0.333 in.
VALVE SIZE	3.00 in.	STEM LEAD	0.333 in.
STEM FACTOR @ 0.20	0.0140'	DWG. NO.	1MS-25-066-1-6
STEM FACTOR @ 0.15	0.0116'	MAX. S.T.	10 sec.
VALVE OPEN ALL.	23995 lbf.	VALVE ID	3GM78FN
VALVE CLOSE ALL.	24922 lbf.	MAOT	48°C
POSITION CHANGEABLE	NO	90% OTS BYPASS	YES

ACTUATOR INFORMATION

MODEL	SB-00	SERIAL NO.	229643
ORDER NO.	370319A	OGR	31.90
NOM. MOTOR TORQUE	15 ft-lbf	APP. FACTOR	0.9
MOTOR RPM	3400	MOTOR VOLTAGE	460 VAC
DEGRADED VOLTAGE	419 (91.1%)	CLOSE CONTROL	LIMIT
ALLOWABLE THRUST	16000 lbf.**	PULLOUT EFF.	0.40
MOTOR TORQUE MULT.	0.214	RUN EFF.	0.60
MOTOR CURRENT MULT.	0.192	STALL EFF.	0.65
ALLOWABLE TORQUE	250 ft-lbf.	STALL TORQUE	342.1 ft-lbf

MOTOR CAPABILITY @ DEGRADED VOLTAGE

MTF = 1 - (MAOT + (0.1 sec. * 75°C/10 sec. + MAX S.T. * 75°C/900 sec.) - 40°C) * MTM/155
MTF = 1 - (48°C + (0.1 sec. * 75°C/10 sec. + 10 sec. * 75°C/900 sec.) - 40°C) * 0.214/155
MTF = 0.9868

MCF = 1 - (MAOT + (0.1 sec. * 75°C/10 sec. + MAX S.T. * 75°C/900 sec.) - 40°C) * MCM/155
MCF = 1 - (48°C + (0.1 sec. * 75°C/10 sec. + 10 sec. * 75°C/900 sec.) - 40°C) * 0.192/155
MCF = 0.9881

ACTUATOR OPEN TORQUE = NOM. MOTOR TORQUE * MTF * OGR * PULLOUT EFF. * APP. FACTOR * (% OF FULL VOLTAGE/100)^2

ACTUATOR OPEN TORQUE = 15 ft-lbf * 0.9868 * 31.9 * 0.40 * 0.9 * (1)^2 = 170.0 ft-lbf.

ACTUATOR OPEN THRUST = ACTUATOR OPEN TORQUE/STEM FACTOR @ 0.15 = 170.0/0.0116 = 14654 lbf.

ACTUATOR CLOSE TORQUE = NOM. MOTOR TORQUE * MTF * OGR * RUN EFF. * APP. FACTOR * (% OF FULL VOLTAGE/100)^2

ACTUATOR CLOSE TORQUE = 15 ft-lbf * 0.9868 * 31.9 * 0.60 * 0.9 * (1)^2 = 255.0 ft-lbf.

ACTUATOR CLOSE THRUST = ACTUATOR CLOSE TORQUE/STEM FACTOR @ 0.15 = 255.0/0.0116 = 21983 lbf.

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VALVE MFG.	WESTINGHOUSE	STEM DIA.	2.500 in.
VALVE TYPE	FLEX WEDGE GATE	STEM PITCH	0.333 in.
VALVE SIZE	10.00 in.	STEM LEAD	0.667 in.
STEM FACTOR @ 0.20	0.0295'	DWG. NO.	1MS-25-175-1
STEM FACTOR @ 0.15	0.0242'	MAX. S.T.	15 sec.
VALVE OPEN ALL.	166339 lbf.	VALVE ID	10GM78FN
VALVE CLOSE ALL.	100000 lbf.	MAOT	48°C
POSITION CHANGEABLE	NO	90% OTS BYPASS	NO

ACTUATOR INFORMATION

MODEL	SBD-3	SERIAL NO.	200797
ORDER NO.	370317G	OGR	38.34
NOM. MOTOR TORQUE	150 ft-lbf	APP. FACTOR	0.9
MOTOR RPM	3400	MOTOR VOLTAGE	460 VAC
DEGRADED VOLTAGE	417 (90.6%)	CLOSE CONTROL	TORQUE
ALLOWABLE THRUST	140000 lbf.	PULLOUT EFF.	0.45
MOTOR TORQUE MULT.	0.100	RUN EFF.	0.60
MOTOR CURRENT MULT.	0.139	STALL EFF.	0.60
ALLOWABLE TORQUE	4200 ft-lbf.	STALL TORQUE	3796 ft-lbf

MOTOR CAPABILITY @ DEGRADED VOLTAGE

MTF = 1 - (MAOT + (0.1 sec. * 75°C/10 sec. + MAX S.T. * 75°C/900 sec.) - 40°C) * MTM/155
MTF = 1 - (48°C + (0.1 sec. * 75°C/10 sec. + 15 sec. * 75°C/900 sec.) - 40°C) * 0.100/155
MTF = 0.9936

MCF = 1 - (MAOT + (0.1 sec. * 75°C/10 sec. + MAX S.T. * 75°C/900 sec.) - 40°C) * MCM/155
MCF = 1 - (46°C + (0.1 sec. * 75°C/10 sec. + 15 sec. * 75°C/900 sec.) - 40°C) * 0.139/155
MCF = 0.9910

ACTUATOR OPEN TORQUE = NOM. MOTOR TORQUE * MTF * OGR * PULLOUT EFF. * APP. FACTOR * (% OF FULL VOLTAGE/100)^2

ACTUATOR OPEN TORQUE = 150 ft-lbf * 0.9936 * 38.34 * 0.45 * 0.9 * (1)^2 = 2314 ft-lbf.

ACTUATOR OPEN THRUST = ACTUATOR OPEN TORQUE/STEM FACTOR @ 0.20 = 2314/0.0295 = 78445 lbf.

ACTUATOR CLOSE TORQUE = NOM. MOTOR TORQUE * MTF * OGR * RUN EFF. * APP. FACTOR * (% OF FULL VOLTAGE/100)^2

ACTUATOR CLOSE TORQUE = 150 ft-lbf * 0.9936 * 38.34 * 0.60 * 0.9 * (1)^2 = 3086 ft-lbf.

ACTUATOR CLOSE THRUST = ACTUATOR CLOSE TORQUE/STEM FACTOR @ 0.20 = 3086/0.0295 = 104593 lbf.

SUBJECT CODE 152	SOUTH CAROLINA ELECTRIC AND GAS COMPANY CALCULATION RECORD			PAGE 1 OF 11A
CALC TITLE Force Required to Overcome Pressure Locking of XVG08000 A.B.C-RC		CALC NO DC01520-102	REV 0	STATUS A
PARENT DOCUMENT N/A	SYSTEM RC	SAFETY CLASS ☐ NN ☐ QR ☒ SR		
ORIGINATOR Ron Osborne	DISC ME	ORGANIZATION S+CE	DATE 2-2-96	XREF NO. N/A

B

A. CALCULATION INFORMATION

CONTENT DESCRIPTION: This calculation determines the force required to overcome postulated pressure locking, and associated margins, for XVG08000A.B.C-RC.

AFFECTED COMPONENTS ANALYSIS: XVG08000A-RC
XVG08000B-RC
XVG08000C-RC

CONTAINS PRELIMINARY DATA/ASSUMPTIONS:

☒ NO ☐ YES, PAGES

COMPUTER PROGRAM USED: ☒ NO (Mathcad used)

☐ YES, VALIDATION NOT REQ'D [REF. 3.5] ☐ YES, VALIDATED [OTHERS]
☐ YES, VALIDATED [ES-412] ☐ PROGRAM VALIDATION CALCULATION

B. VERIFICATION ☐ CONTINUED, ATTACHMENT

VERIFICATION SCOPE: Verifier to assure proper inputs, methods & arithmetic, reasonable assumptions and outputs consistent with methodology.

VERIFIER: ALLEN M. EDMOND
ASSIGN BY: WAYNE STUART

Ronald L. Osborne / 2-2-96
LEAD ENGINEER (DESIGNEE)/DATE

VERIFIER/DATE	APPROVAL/DATE
Allen M. Edmond 2/2/96	[signature] 2-2-96

C. RECORDS	REEL NUMBER:
TO PRS: ______________ INIT/DATE	FRAME NUMBER:
	ORIGINAL MAINTAINED BY: ☐ SCE&G DE ☐ SCE&G ________ ☐ VENDOR ________

DISTRIBUTION: CALC FILE (ORIGINAL)
PDE_____/SYSTEM ENG_____DE FILE 20.6602 ATTACH. 1 ONLY, COPY)

SOUTH CAROLINA ELECTRIC & GAS COMPANY REVISION SUMMARY	PAGE 2 OF 11
CALCULATION NO. DC01520-102	

REV NO.	SUMMARY DESCRIPTION
0	Initial issue

☐ CONTINUES ON PAGE

Purpose: This calculation will determine the force required to overcome postulated pressure locking conditions (F_{total}) for the following Power Operated Gate Valves (POGVs); XVG08000A, B, C-RC

The methodology used is consistent with the Commonwealth Edison method to predict the force required to overcome postulated pressure locking conditions.

This calculation will then compare F_{total} to the opening structural limit (MAOT) and capability limit (MPOT) for the POGVs to determine if the valves are capable of opening under the postulated pressure locking condition.

Assumptions:

1. As stated in reference 1.
2. The use of the opening valve factor will yield more representative results than the closing valve factor. VCSNS dynamic MOV testing has shown that the two are not usually the same.
3. Others as stated throughout this calculation.

References:

1. USER'S GUIDE FOR PRESLOK, A GATE VALVE PRESSURE LOCKING ANALYSIS PROGRAM USING THE COMMONWEALTH EDISON MODEL, REVISION 0, 1-2-96
2. - USNRC Generic Letter 95-07, Pressue Locking of Safety-Related Power-Operated Gate Valves
3. USNRC letter from Mr. Paul E. Fredrickson, Chief Special Inspection Branch Division of Reactor Safety to Mr. Gary Taylor, Vice President Nuclear Operations, SUMMARY OF PUBLIC WORKSHOPS TO DISCUSS GENERIC LETTER 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves", dated 1-3-96
4. TWR 13157 Tab 957-RC, GL 95-07 Review for the RC System, dated 1-30-96
5. Engineering Report G/C 3097, NRC Generic Letter 89-10 MOV Setup, Test and Performance Validation Summary Report, Rev. 0, dated 7-26-95
6. DC01520-065, Design Review and Capability for Rising Stem MOVs in the CC, EF, FS, FW, MS, RC, SP and SW Systems, Rev. 3
7. Fax from Ike Ezekoye (West.) to Ron Osborne, VCSNS MOV Data for PL Analysis, dated 1-25-96
8. DC01520-050, GL 89-10 MOV Weak Link Calculations, Rev. 0
9. Engineering Properties of Steel, American Society for Metals, 1982

Methodology: The methodology used for the determination of F_{total} is per pages 11 through 19 of ref. 1 except this calculation will use the opening valve factor rather than the closing valve factor, as discussed in assumption 2.

The opening valve factor (VF_{co}) will be corrected to account for the difference in the mean seat diameter versus the effective seat port dia. (seat port diameter plus the 1/16" seat chamfer) used in the determination of the tested opening valve factor (VF). This is necessary because the Westinghouse valves use the effective seat port area rather than mean seat area in the calculation of required operating thrust within the minimum required thrust calculations of reference 6. As such, the valve factor (VF_{co}) used within this calculation is determined as follows;

$$VF_{co} = VF * (\text{effective seat port radius/mean seat radius})^2$$

The opening structural margin evaluation will be based on a comparison of F_{total} and MAOT as follows;

$$MARGIN_{st} = (MAOT-F_{total})/F_{total}$$

A positive value shows structural margin.

The opening capability margin evaluation will be based on a comparison of F_{total} and MPOT as follows;

$$MARGIN_{cap} = (MPOT - F_{total})/F_{total}$$

A positive value shows capability margin.

Review of reference 6 shows that 8000A has the lowest opening capability of the three valves (11844 lbf.) while the 8000C valve has the highest unseating load of the three valves (6129 lbf.). Therefore, this calculation will use a MPOT of 11844 and an unseating load of 6129 lbf. to bound all three valves.

Note that review of reference 8 shows the disk material to be SA-182 F316.

Computer Calculations: N/A (This calculation is done in Mathcad.)

This section of the program reads the sixteen items of input data from the plinput1.dat file.

$i := 0..15$

$input_i := READ(plinput1)$

$P_{bonnet} := input_0 \cdot psi$

$P_{up} := input_1 \cdot psi$

$P_{down} := input_2 \cdot psi$

$t := input_3 \cdot in$

$a := input_4 \cdot in$

$b := input_5 \cdot in$

$Hub_{length} := input_6 \cdot in$

$\theta := input_7 \cdot deg$

$\nu := input_8$

$E := input_9 \cdot psi$

$D_{stem} := input_{10} \cdot in$

$F_{po} := input_{11} \cdot lbf$

$VF := input_{12}$

$MAOT := input_{13} \cdot lbf$

$MPOT := input_{14} \cdot lbf$

$c := input_{15} \cdot in$

Program PRESLOK, Version 1

INPUTS:

Bonnet Pressure (ref. 4)	$P_{bonnet} = 2485 \cdot psi$
Upstream Pressure(ref. 4)	$P_{up} = 1700 \cdot psi$
Downstream Pressure(ref. 4)	$P_{down} = 0 \cdot psi$
Disk Thickness(ref. 7) (taken at centerline of the hub vertically)	$t = 1.01 \cdot in$
Seat Radius(ref. 7) (corresponding to mean seat diameter)	$a = 1.62 \cdot in$
Hub Radius(ref. 7) (taken at plane of symmetry, perpendicular to the hub, radius of circle of equivalent area for non-circular hubs)	$b = 1.056 \cdot in$
Effective Seat Port Radius(ref. 6 thrust calc.)	$c = 1.34375 \cdot in$
Seat Angle(ref. 8)	$\theta = 7 \cdot deg$
Poisson's Ratio(ref. 8) (disk material at temperature)	$\nu = 0.3$
Modulus of Elasticity(ref. 9) (disk material at temperature)	$E = 2.8 \cdot 10^7 \cdot psi$
Static Pullout Force(ref. 5) (measured value from diagnostic test)	$F_{po} = 6129 \cdot lbf$
Valve Factor(ref. 6 thrust calc.)	$VF = 0.6$
Stem Diameter(ref. 6)	$D_{stem} = 1.25 \cdot in$
Hub Length(ref. 7) (from inside face of disk to inside face of disk)	$Hub_{length} = 0.61 \cdot in$
Open Structural Limit (ref. 6)	$MAOT = 22680 \cdot lbf$
Open Capability (ref. 6)	$MPOT = 11844 \cdot lbf$

Program PRESLOK, Version 1

PRESSURE FORCE CALCULATIONS

Open valve factor corrected for mean seat dia.

$$VF_{co} := VF\cdot\left(\frac{c}{a}\right)^2 \qquad VF_{co} = 0.413$$

Coefficient of friction between disk and seat:

$$\mu := VF_{co}\cdot\frac{\cos(\theta)}{1+VF_{co}\cdot\sin(\theta)} \qquad \mu = 0.39$$

Average DP across disks:

$$DPavg := P_{bonnet} - \frac{P_{up}+P_{down}}{2} \qquad DPavg = 1635\cdot psi$$

Disk Stiffness Constants

$$D := \frac{E\cdot(t)^3}{12\cdot\left(1-\nu^2\right)} \qquad D = 2.642\cdot 10^6\cdot lbf\cdot in$$

$$G := \frac{E}{2\cdot(1+\nu)} \qquad G = 1.077\cdot 10^7\cdot psi$$

Geometry Factors:

$$C_2 := \frac{1}{4}\cdot\left[1-\left(\frac{b}{a}\right)^2\cdot\left(1+2\cdot\ln\left(\frac{a}{b}\right)\right)\right] \qquad C_2 = 0.0529$$

$$C_3 := \frac{b}{4\cdot a}\cdot\left[\left[\left(\frac{b}{a}\right)^2+1\right]\cdot\ln\left(\frac{a}{b}\right)+\left(\frac{b}{a}\right)^2-1\right] \qquad C_3 = 0.0057$$

$$C_8 := \frac{1}{2}\cdot\left[1+\nu+(1-\nu)\cdot\left(\frac{b}{a}\right)^2\right] \qquad C_8 = 0.7987$$

$$C_9 := \frac{b}{a}\cdot\left[\frac{1+\nu}{2}\cdot\ln\left(\frac{a}{b}\right)+\frac{1-\nu}{4}\cdot\left[1-\left(\frac{b}{a}\right)^2\right]\right] \qquad C_9 = 0.2469$$

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

Program PRESLOK, Version 1

Geometry Factors: (continued)

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

$$L_{11} := \frac{1}{64}\cdot\left[1+4\cdot\left(\frac{b}{a}\right)^2-5\cdot\left(\frac{b}{a}\right)^4-4\cdot\left(\frac{b}{a}\right)^2\cdot\left[2+\left(\frac{b}{a}\right)^2\right]\cdot\ln\left(\frac{a}{b}\right)\right] \qquad L_{11} = 5.181\cdot 10^{-4}$$

$$L_{17} := \frac{1}{4}\cdot\left[1-\frac{1-\nu}{4}\cdot\left[1-\left(\frac{b}{a}\right)^4\right]-\left(\frac{b}{a}\right)^2\cdot\left[1+(1+\nu)\cdot\ln\left(\frac{a}{b}\right)\right]\right] \qquad L_{17} = 0.0488$$

Moment

$$M_{rb} := \frac{-DPavg\cdot a^2}{C_8}\cdot\left[\frac{C_9}{2\cdot a\cdot b}\cdot\left(a^2-b^2\right)-L_{17}\right] \qquad M_{rb} = -322.9\cdot lbf$$

$$Q_b := \frac{DPavg}{2\cdot b}\cdot\left(a^2-b^2\right) \qquad Q_b = 1168.4\cdot\frac{lbf}{in}$$

Deflection due to pressure and bending:

$$y_{bq} := M_{rb}\cdot\frac{a^2}{D}\cdot C_2+Q_b\cdot\frac{a^3}{D}\cdot C_3-\frac{DPavg\cdot a^4}{D}\cdot L_{11} \qquad y_{bq} = -8.5323\cdot 10^{-6}\cdot in$$

Deflection due to pressure and shear stress:

$$K_{sa} := -0.3\cdot\left[2\cdot\ln\left(\frac{a}{b}\right)-1+\left(\frac{b}{a}\right)^2\right] \qquad K_{sa} = -0.0842$$

$$y_{sq} := \frac{K_{sa}\cdot DPavg\cdot a^2}{t\cdot G} \qquad y_{sq} = -3.3231\cdot 10^{-5}\cdot in$$

Deflection due to hub stretch:

$$P_{force} := \pi\cdot\left(a^2-b^2\right)\cdot DPavg$$

$$y_{stretch} := \frac{P_{force}}{\pi\cdot b^2}\cdot\frac{Hub_{length}}{(2\cdot E)} \qquad y_{stretch} = 2.4104\cdot 10^{-5}\cdot in$$

Program PRESLOK, Version 1

Total deflection due to pressure forces (per lbf/in.):

$$y_q := y_{bq} + y_{sq} - y_{stretch} \qquad y_q = -6.5867\cdot 10^{-5}\cdot\text{in}$$

Deflection due to seat contact force and shear stress (per lbf/in.):

$$y_{sw} := -\left[\frac{1.2\cdot\left(\frac{a}{a}\right)\cdot\ln\left(\frac{a}{b}\right)\cdot a}{t\cdot G}\right] \qquad y_{sw} = -7.648\cdot 10^{-8}\cdot\frac{\text{in}}{\left(\frac{\text{lbf}}{\text{in}}\right)}$$

Deflection due to seat contact force and bending (per lbf/in.):

$$y_{bw} := -\left(\frac{a^3}{D}\right)\cdot\left[\left(\frac{C_2}{C_8}\right)\cdot\left[\left(\frac{a\cdot C_9}{b}\right) - L_9\right] - \left[\left(\frac{a}{b}\right)\cdot C_3\right] + L_3\right] \qquad y_{bw} = -2.639\cdot 10^{-8}\cdot\frac{\text{in}}{\left(\frac{\text{lbf}}{\text{in}}\right)}$$

Deflection due to hub compression:

$$y_{cmpr} := -\left(\frac{2\cdot\pi\cdot a}{\pi\cdot b^2}\cdot\frac{Hub_{length}}{2\cdot E}\right) \qquad y_{cmpr} = -3.165\cdot 10^{-8}\cdot\frac{\text{in}}{\left(\frac{\text{lbf}}{\text{in}}\right)}$$

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

$$y_w := y_{bw} + y_{sw} + y_{cmpr} \qquad y_w = -1.345\cdot 10^{-7}\cdot\frac{\text{in}}{\left(\frac{\text{lbf}}{\text{in}}\right)}$$

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

$$F_s := 2\cdot\pi\cdot a\cdot\frac{y_q}{y_w} \qquad F_s = 4984\cdot\text{lbf}$$

UNSEATING FORCES

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

$F_{piston} := \frac{\pi}{4} \cdot D_{stem}^2 \cdot P_{bonnet}$ $\qquad F_{piston} = 3049.6 \cdot lbf$

$F_{vert} := \pi \cdot a^2 \cdot \sin(\theta) \cdot (2 \cdot P_{bonnet} - P_{up} - P_{down})$ $\qquad F_{vert} = 3285.7 \cdot lbf$

$F_{preslock} := 2 \cdot F_s \cdot (\mu \cdot \cos(\theta) - \sin(\theta))$ $\qquad F_{preslock} = 2644.9 \cdot lbf$

$F_{total} := -F_{piston} + F_{vert} + F_{preslock} + F_{po}$ $\qquad F_{po} = 6129 \cdot lbf$

$F_{total} = 9010 \cdot lbf$

MARGIN EVALUATION

$$MARGIN_{st} := \frac{MAOT - F_{total}}{F_{total}}$$

$MARGIN_{st} = 151.72 \cdot \%$

$$MARGIN_{cap} := \frac{MPOT - F_{total}}{F_{total}}$$

$MARGIN_{cap} = 31.454 \cdot \%$

<u>CONCLUSION</u>: Based on the methods used throughout this calculation, it can be concluded that XVG08000A, B & C-RC are capable of overcoming the postulated pressure locking forces.

ENGINEERS SERIAL NO. 10625

ENGINEER AME

TECHNICAL WORK RECORD

DATE 2-2-96

PROJECT TITLE ES-412 VERIFICATION TAB 102 PAGE 1 of _

THE VERIFICATION OF CALCULATION NO. DC01520-102,REV. 0

Verified calculation DC01520-102, Rev.0 per the verification scope listed on the cover sheet of the calculation and per ES-416, Rev. 11 Section 6.7.3.A.

Verification per the cover sheet of the calculation

The inputs are correct based on the references identified in this calculation and are inaccordance with tl User's Guide to determine the force to overcome pressure locking. All inputs were verified by the reference listed.

The methodology is in accordance with the User's Guide For Preslok, A Gate Valve Pressure Locking Analysis Program Using the Commonwealth Edison Model, Rev. 0 for determining the force required overcome pressure locking.

The assumptions are inaccordance with the assumptions listed in the User's Guide. All assumptions arе reasonable.

The outputs and arithmetic are reasonable and correct based on the inputs and the methodology used ir this calculation.

Therefore, this calculation is acceptable per the requirements of ES-412.

Verification per ES-416, Rev. 11, Section 6.7.3.A

1. Technical concept verification- Not Applicable, this calculation is not the result of a design change, the calculation was performed as a result of addressing GL-95-07, Thermal Binding and Pressure Locking evaluation.

2. Design basis check- Not Applicable, this calculation is not the result of a design change, the calculation was performed as a result of addressing GL-95-07, Thermal Binding and Pressure Locking evaluation. However, the design inputs utilized in this calculation satsify the intent and purpose of the Calculation as identified in the purpose section of the calculation

3. Check of calculation accuracy- Not Applicable, this calculation is not the result of a design change, the calculation was performed as a result of addressing GL-95-07, Thermal Binding and Pressure Locking evaluation. **See Verification per the cover sheet of the calculation.**

ENGINEERS

SERIAL NO. 10625

ENGINEER AME

TECHNICAL WORK RECORD

DATE 2-2-96

PROJECT TITLE **ES-412 VERIFICATION** TAB 102 PAGE 1 of 1

4. Interface considerations- Not Applicable, this calculation is not the result of a design change, the calculation was performed as a result of addressing GL-95-07, Thermal Binding and Pressure Locking evaluation.

5. Systems interaction consideration- Not Applicable, this calculation is not the result of a design chang the calculation was performed as a result of addressing GL-95-07, Thermal Binding and Pressure Locking evaluation.

This calculation is acceptable per the requirements of ES-416, Rev.11, Section 6.7.3.A.

Allen M. Elmond
2/2/96

SUBJECT CODE 152	SOUTH CAROLINA ELECTRIC AND GAS COMPANY CALCULATION RECORD			PAGE 1 OF 11A
CALC TITLE Force Required to Overcome Pressure Locking of XVG08801A.B-SI		CALC NO DC01520-097	REV 0	STATUS A
PARENT DOCUMENT N/A	SYSTEM SI	SAFETY CLASS ☐NN ☐QR ☒ SR		
ORIGINATOR Ron Osborne	DISC ME	ORGANIZATION S&CE	DATE 1-29-96	XREF NO. N/A

A. CALCULATION INFORMATION

CONTENT DESCRIPTION: This calculation determines the force required to overcome postulated pressure locking conditions, and associated margins, for XVG08801A.B-SI.

AFFECTED COMPONENTS ANALYSIS: XVG08801A-SI
XVG08801B-SI

CONTAINS PRELIMINARY DATA/ASSUMPTIONS:

☒ NO ☐ YES, PAGES

COMPUTER PROGRAM USED: ☒ NO MATHCAD used

☐ YES, VALIDATION NOT REQ'D [REF. 3.5] ☐ YES, VALIDATED [OTHERS]
☐ YES, VALIDATED [ES-412] ☐ PROGRAM VALIDATION CALCULATION

B. VERIFICATION ☐ CONTINUED, ATTACHMENT

VERIFICATION SCOPE: Verifier to assure proper inputs, methods, reasonable assumptions and outputs consistent with methodology.

VERIFIER: ALLEN M. EDMOND
ASSIGN BY: WAYNE STUART

Ronald L. Osborne / 1-~~26~~ 29 -96
LEAD ENGINEER (DESIGNEE)/DATE

VERIFIER/DATE	APPROVAL/DATE
Allen M. Edmond 1/31/96	[signature] 2-2-96

C. RECORDS	REEL NUMBER:
	FRAME NUMBER:
TO PRS: ______ INIT/DATE	ORIGINAL MAINTAINED BY: ☐ SCE&G DE ☐ SCE&G ______ ☐ VENDOR______

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PDE_____/SYSTEM ENG_____DE FILE 20.6602 ATTACH. 1 ONLY, COPY)

SOUTH CAROLINA ELECTRIC & GAS COMPANY REVISION SUMMARY	PAGE 2 OF 11
CALCULATION NO. DC01520-097	

REV NO.	SUMMARY DESCRIPTION
0	Initial Issue

☐ CONTINUES ON PAGE

Purpose: This calculation will determine the required force required to overcome postulated pressure locking conditions (F_{total}) for the following Power Operated Gate Valves (POGVs); XVG08801A-SI XVG08801B-SI

The methodology used is consistent with the Commonwealth Edison method to predict the force required to overcome postulated pressure locking conditions.

This calculation will then compare F_{total} to the opening structural limit (MAOT) and capability limit (MPOT) for the POGVs to determine if the valves are capable of opening under the postulated pressure locking condition.

Assumptions:

1. As stated in reference 1.
2. The use of the opening valve factor will yield more representative results than the closing valve factor. VCSNS dynamic MOV testing has shown that the two are not usually the same.
3. Others as stated throughout this calculation.

References:

1. USER'S GUIDE FOR PRESLOK, A GATE VALVE PRESSURE LOCKING ANALYSIS PROGRAM USING THE COMMONWEALTH EDISON MODEL, REVISION 0, 1-2-96
2. USNRC Generic Letter 95-07, Pressue Locking of Safety-Related Power-Operated Gate Valves
3. USNRC letter from Mr. Paul E. Fredrickson, Chief Special Inspection Branch Division of Reactor Safety to Mr. Gary Taylor, Vice President Nuclear Operations, SUMMARY OF PUBLIC WORKSHOPS TO DISCUSS GENERIC LETTER 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves", dated 1-3-96
4. TWR 13157 Tab 957-SI GL 95-07 Review for the SI System, dated 1-19-96
5. Engineering Report G/C 3097, NRC Generic Letter 89-10 MOV Setup, Test and Performance Validation Summary Report, Rev. 0, dated 7-26-95
6. DC01520-067, Design Review and Capability for Rising Stem MOVs in the RH, CS and SI Systems, Rev. 4
7. Fax from Ike Ezekoye (West.) to Ron Osborne, VCSNS MOV Data for PL Analysis, dated 1-25-96
8. DC01520-050, GL 89-10 MOV Weak Link Calculations, Rev. 0
9. Engineering Properties of Steel, American Society for Metals, 1982

Methodology: The methodology used for the determination of F_{total} is per pages 11 through 19 of ref. 1 except this calculation will use the opening valve factor rather than the closing valve factor, as discussed in assumption 2.

The opening valve factor (VF_{co}) will be corrected to account for the difference in the mean seat diameter versus the effective seat port dia. (seat port diameter plus the 1/16" seat chamfer) used in the determination of the tested opening valve factor (VF). This is necessary because the Westinghouse valves use the effective seat port area rather than mean seat area in the calculation of required operating thrust within the minimum required thrust calculations of reference 6. As such, the valve factor (VF_{co}) used within this calculation is determined as follows;

$$VF_{co} = VF * (\text{effective seat port radius/mean seat radius})^2$$

The opening structural margin evaluation will be based on a comparison of F_{total} and MAOT as follows;

$$MARGIN_{st} = (MAOT-F_{total})/F_{total}$$

A positive value shows margin.

The opening capability margin evaluation will be based on a comparison of F_{total} and MPOT as follows;

$$MARGIN_{cap} = (MPOT - F_{total})/F_{total}$$

A positive value shows margin.

Review of reference 5 shows that XVG08801B-SI has both a lower opening capability and a higher unseating thrust than XVG08801A-SI. Therfore, use of the XVG08801B-SI data will result in a limiting analysis.

Note that review of ref. 8 reveals the disk material to be SA-182 F316.

Computer Calculations: N/A (This calculation is done in Mathcad.)

This section of the program reads the sixteen items of input data from the plinput1.dat file.

$i := 0 .. 15$

$input_i := READ(plinput1)$

$P_{bonnet} := input_0 \cdot psi$

$P_{up} := input_1 \cdot psi$

$P_{down} := input_2 \cdot psi$

$t := input_3 \cdot in$

$a := input_4 \cdot in$

$b := input_5 \cdot in$

$Hub_{length} := input_6 \cdot in$

$\theta := input_7 \cdot deg$

$\nu := input_8$

$E := input_9 \cdot psi$

$D_{stem} := input_{10} \cdot in$

$F_{po} := input_{11} \cdot lbf$

$VF := input_{12}$

$MAOT := input_{13} \cdot lbf$

$MPOT := input_{14} \cdot lbf$

$c := input_{15} \cdot in$

Program PRESLOK, Version 1

INPUTS:

Bonnet Pressure (ref. 4)	$P_{bonnet} = 2826 \cdot psi$
Upstream Pressure(ref. 4)	$P_{up} = 0 \cdot psi$
Downstream Pressure(ref. 4)	$P_{down} = 0 \cdot psi$
Disk Thickness(ref. 7) (taken at centerline of the hub vertically)	$t = 1.01 \cdot in$
Seat Radius(ref. 7) (corresponding to mean seat diameter)	$a = 1.62 \cdot in$
Hub Radius(ref. 7) (taken at plane of symmetry, perpendicular to the hub, radius of circle of equivalent area for non-circular hubs)	$b = 1.056 \cdot in$
Effective Seat Port Radius(ref. 6 thrust calc.)	$c = 1.344 \cdot in$
Seat Angle(ref. 8)	$\theta = 7 \cdot deg$
Poisson's Ratio(ref. 8) (disk material at temperature)	$v = 0.3$
Modulus of Elasticity(ref. 9) (disk material at temperature)	$E = 2.8 \cdot 10^{7} \cdot psi$
Static Pullout Force(ref. 5) (measured value from diagnostic test)	$F_{po} = 2890 \cdot lbf$
Valve Factor(ref. 6 thrust calc.)	$VF = 0.6$
Stem Diameter(ref. 6)	$D_{stem} = 1.25 \cdot in$
Hub Length(ref. 7) (from inside face of disk to inside face of disk)	$Hub_{length} = 0.61 \cdot in$
Open Structural Limit (ref. 6)	$MAOT = 22680 \cdot lbf$
Open Capability (ref. 6)	$MPOT = 15810 \cdot lbf$

Program PRESLOK, Version 1

PRESSURE FORCE CALCULATIONS

Open valve factor corrected for mean seat dia.

$$VF_{co} := VF \cdot \left(\frac{c}{a}\right)^2 \qquad VF_{co} = 0.413$$

Coefficient of friction between disk and seat:

$$\mu := VF_{co} \cdot \frac{\cos(\theta)}{1 + VF_{co} \cdot \sin(\theta)} \qquad \mu = 0.39$$

Average DP across disks:

$$DPavg := P_{bonnet} - \frac{P_{up} + P_{down}}{2} \qquad DPavg = 2826 \cdot psi$$

Disk Stiffness Constants

$$D := \frac{E \cdot (t)^3}{12 \cdot \left(1 - \nu^2\right)} \qquad D = 2.642 \cdot 10^6 \cdot lbf \cdot in$$

$$G := \frac{E}{2 \cdot (1 + \nu)} \qquad G = 1.077 \cdot 10^7 \cdot psi$$

Geometry Factors:

$$C_2 := \frac{1}{4} \cdot \left[1 - \left(\frac{b}{a}\right)^2 \cdot \left(1 + 2 \cdot \ln\left(\frac{a}{b}\right)\right)\right] \qquad C_2 = 0.0529$$

$$C_3 := \frac{b}{4 \cdot a} \cdot \left[\left[\left(\frac{b}{a}\right)^2 + 1\right] \cdot \ln\left(\frac{a}{b}\right) + \left(\frac{b}{a}\right)^2 - 1\right] \qquad C_3 = 0.0057$$

$$C_8 := \frac{1}{2} \cdot \left[1 + \nu + (1 - \nu) \cdot \left(\frac{b}{a}\right)^2\right] \qquad C_8 = 0.7987$$

$$C_9 := \frac{b}{a} \cdot \left[\frac{1 + \nu}{2} \cdot \ln\left(\frac{a}{b}\right) + \frac{1 - \nu}{4} \cdot \left[1 - \left(\frac{b}{a}\right)^2\right]\right] \qquad C_9 = 0.2469$$

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

Program PRESLOK, Version 1

Geometry Factors: (continued)

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

$L_9 = 0$

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

$L_{11} = 5.181\cdot10^{-4}$

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

$L_{17} = 0.0488$

Moment

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

$M_{rb} = -558\cdot\mathrm{lbf}$

$$Q_b := \frac{DPavg}{2\cdot b}\cdot\left(a^2-b^2\right)$$

$Q_b = 2019.5\cdot\frac{\mathrm{lbf}}{\mathrm{in}}$

Deflection due to pressure and bending:

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

$y_{bq} = -1.4748\cdot10^{-5}\cdot\mathrm{in}$

Deflection due to pressure and shear stress:

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

$K_{sa} = -0.0842$

$$y_{sq} := \frac{K_{sa}\cdot DPavg\cdot a^2}{t\cdot G}$$

$y_{sq} = -5.7437\cdot10^{-5}\cdot\mathrm{in}$

Deflection due to hub stretch:

$$P_{force} := \pi\cdot\left(a^2-b^2\right)\cdot DPavg$$

$$y_{stretch} := \frac{P_{force}}{\pi\cdot b^2}\cdot\frac{Hub_{length}}{(2\cdot E)}$$

$y_{stretch} = 4.1663\cdot10^{-5}\cdot\mathrm{in}$

Program PRESLOK, Version 1

Total deflection due to pressure forces (per lbf/in.):

$$y_q := y_{bq} + y_{sq} - y_{stretch}$$

$$y_q = -1.1385 \cdot 10^{-4} \cdot in$$

Deflection due to seat contact force and shear stress (per lbf/in.):

$$y_{sw} := -\left[-\frac{1.2 \cdot \left(\frac{a}{a}\right) \cdot \ln\left(\frac{a}{b}\right) \cdot a}{t \cdot G}\right]$$

$$y_{sw} = -7.648 \cdot 10^{-8} \cdot \frac{in}{\left(\frac{lbf}{in}\right)}$$

Deflection due to seat contact force and bending (per lbf/in.):

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

$$y_{bw} = -2.639 \cdot 10^{-8} \cdot \frac{in}{\left(\frac{lbf}{in}\right)}$$

Deflection due to hub compression:

$$y_{cmpr} := -\left(\frac{2 \cdot \pi \cdot a}{\pi \cdot b^2} \cdot \frac{Hub_{length}}{2 \cdot E}\right)$$

$$y_{cmpr} = -3.165 \cdot 10^{-8} \cdot \frac{in}{\left(\frac{lbf}{in}\right)}$$

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

$$y_w := y_{bw} + y_{sw} + y_{cmpr}$$

$$y_w = -1.345 \cdot 10^{-7} \cdot \frac{in}{\left(\frac{lbf}{in}\right)}$$

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

$$F_s := 2 \cdot \pi \cdot a \cdot \frac{y_q}{y_w}$$

$$F_s = 8614.6 \cdot lbf$$

UNSEATING FORCES

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

$F_{piston} := \frac{\pi}{4} \cdot D_{stem}^{2} \cdot P_{bonnet}$ $\qquad F_{piston} = 3468 \cdot lbf$

$F_{vert} := \pi \cdot a^{2} \cdot \sin(\theta) \cdot \left(2 \cdot P_{bonnet} - P_{up} - P_{down}\right)$ $\qquad F_{vert} = 5679.1 \cdot lbf$

$F_{preslock} := 2 \cdot F_{s} \cdot (\mu \cdot \cos(\theta) - \sin(\theta))$ $\qquad F_{preslock} = 4571.6 \cdot lbf$

$F_{total} := -F_{piston} + F_{vert} + F_{preslock} + F_{po}$ $\qquad F_{po} = 2890 \cdot lbf$

$F_{total} = 9672.6 \cdot lbf$

MARGIN EVALUATION

$$MARGIN_{st} := \frac{MAOT - F_{total}}{F_{total}}$$

$MARGIN_{st} = 134.477 \cdot \%$

$$MARGIN_{cap} := \frac{MPOT - F_{total}}{F_{total}}$$

$MARGIN_{cap} = 63.452 \cdot \%$

CONCLUSION: Based on the methods used throughout this calculation, it can be concluded that XVG08801A-SI and XVG08801B-SI are capable of overcoming the postulated pressure locking forces.

ENGINEERS

SERIAL NO. 10625

ENGINEER AME

TECHNICAL WORK RECORD

DATE 1-30-96

PROJECT TITLE ES-412 VERIFICATION TAB 097 PAGE 1 of 1

THE VERIFICATION OF CALCULATION NO. DC01520-097,REV. 0

Verified calculation DC01520-097, Rev.0 per the verification scope listed on the cover sheet of the calculation and per ES-416, Rev. 11 Section 6.7.3.A.

Verification per the cover sheet of the calculation

The inputs are correct based on the references identified in this calculation and are inaccordance with the User's Guide to determine the force to overcome pressure locking. All inputs were verified by the reference listed.

The methodology is in accordance with the User's Guide For Preslok, A Gate Valve Pressure Locking Analysis Program Using the Commonwealth Edison Model, Rev. 0 for determining the force required to overcome pressure locking.

The assumptions are inaccordance with the assumptions listed in the User's Guide. All assumptions are reasonable.

The outputs are reasonable and correct based on the inputs and the methodology used in this calculation

Therefore, this calculation is acceptable per the requirements of ES-412.

Verification per ES-416, Rev. 11, Section 6.7.3.A

1. Technical concept verification- Not Applicable, this calculation is not the result of a design change, the calculation was performed as a result of Addressing GL-95-07, Thermal Binding and Pressure Locking evaluation.

2. Design basis check- Not Applicable, this calculation is not the result of a design change, the calculation was performed as a result of Addressing GL-95-07, Thermal Binding and Pressure Locking evaluation. However, the design inputs utilized in this calculation satsify the intent and purpose of the Calculation as identified in the purpose section of the calculation

3. Check of calculation accuracy- Not Applicable, this calculation is not the result of a design change, the calculation was performed as a result of Addressing GL-95-07, Thermal Binding and Pressure Locking evaluation. **See Verification per the cover sheet of the calculation**.

ENGINEERS

SERIAL NO. 10625

ENGINEER AME

TECHN CAL WORK RECORD

DATE 1-30-96

PROJECT TITLE **ES-412 VERIFICATION** TAB 097 PAGE 1 of 1

4. Interface considerations- Not Applicable, this calculation is not the result of a design change, the calculation was performed as a result of Addressing GL-95-07, Thermal Binding and Pressure Locking evaluation.

5. Systems interaction consideration- Not Applicable, this calculation is not the result of a design chang the calculation was performed as a result of Addressing GL-95-07, Thermal Binding and Pressure Locking evaluation.

This calculation is acceptable per the requirements of ES-416, Rev.11, Section 6.7.3.A.

Allen M. Elmord
2/1/96

SUBJECT CODE 152	SOUTH CAROLINA ELECTRIC AND GAS COMPANY CALCULATION RECORD			PAGE 1 OF 11A
CALC TITLE Force Required to Overcome Pressure Locking of XVG08884 + XVG08886-SI		CALC NO DC01520-098	REV 0	STATUS A
PARENT DOCUMENT N/A	SYSTEM SI	SAFETY CLASS ☐ NN ☐ QR ☒ SR		
ORIGINATOR Ron Osborne	DISC ME	ORGANIZATION S&CE	DATE 1-29-96	XREF NO. N/A

A. CALCULATION INFORMATION

CONTENT DESCRIPTION: This calculation determines the force required to overcome postulated pressure locking conditions, and associated margins, for XVG08884 + XVG08886-SI.

AFFECTED COMPONENTS ANALYSIS:
XVG08884-SI, XVG08886-SI

CONTAINS PRELIMINARY DATA/ASSUMPTIONS:

☒ NO ☐ YES, PAGES

COMPUTER PROGRAM USED: ☒ NO ~~Matlab~~ Mathcad used 1-29-96

☐ YES, VALIDATION NOT REQ'D [REF. 3.5] ☐ YES, VALIDATED [OTHERS]
☐ YES, VALIDATED [ES-412] ☐ PROGRAM VALIDATION CALCULATION

B. VERIFICATION ☐ CONTINUED, ATTACHMENT

VERIFICATION SCOPE: Verifier to assure proper inputs, methods, reasonable assumptions, and outputs ~~based on~~ 1-29-96 consistent with methodology.

VERIFIER: ALLEN M. EDMOND
ASSIGN BY: WAYNE STUART

Ronald L. Osborne 1-29-96
LEAD ENGINEER (DESIGNEE)/DATE

VERIFIER/DATE	APPROVAL/DATE
Allen M. Edmond 1/31/96	2-2-96

C. RECORDS	REEL NUMBER: FRAME NUMBER:
TO PRS: ________ INIT/DATE	ORIGINAL MAINTAINED BY: ☐ SCE&G DE ☐ SCE&G ______ ☐ VENDOR______

DISTRIBUTION: CALC FILE (ORIGINAL)
PDE_____/SYSTEM ENG_____DE FILE 20.6602 ATTACH. 1 ONLY, COPY)

B

SOUTH CAROLINA ELECTRIC & GAS COMPANY REVISION SUMMARY	PAGE 2 OF 11
CALCULATION NO. DC01520-098	

REV NO.	SUMMARY DESCRIPTION
0	Initial issue

☐ CONTINUES ON PAGE

<u>Purpose</u>: This calculation will determine the force required to overcome postulated pressure locking conditions (F_{total}) for the following Power Operated Gate Valves (POGVs); XVG08884-SI XVG08886-SI

The methodology used is consistent with the Commonwealth Edison method to predict the force required to overcome postulated pressure locking conditions.

This calculation will then compare F_{total} to the opening structural limit (MAOT) and capability limit (MPOT) for the POGVs to determine if the valves are capable of opening under the postulated pressure locking condition.

<u>Assumptions</u>:

1. As stated in reference 1.
2. The use of the opening valve factor will yield more representative results than the closing valve factor. VCSNS dynamic MOV testing has shown that the two are not usually the same.
3. Others as stated throughout this calculation.

<u>References</u>:

1. USER'S GUIDE FOR PRESLOK, A GATE VALVE PRESSURE LOCKING ANALYSIS PROGRAM USING THE COMMONWEALTH EDISON MODEL, REVISION 0, 1-2-96
2. USNRC Generic Letter 95-07, Pressue Locking of Safety-Related Power-Operated Gate Valves
3. USNRC letter from Mr. Paul E. Fredrickson, Chief Special Inspection Branch Division of Reactor Safety to Mr. Gary Taylor, Vice President Nuclear Operations, SUMMARY OF PUBLIC WORKSHOPS TO DISCUSS GENERIC LETTER 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves", dated 1-3-96
4. TWR 13157 Tab 957-SI, GL 95-07 Review for the SI System, dated 1-19-96
5. Engineering Report G/C 3097, NRC Generic Letter 89-10 MOV Setup, Test and Performance Validation Summary Report, Rev. 0, dated 7-26-95
6. DC01520-067, Design Review and Capability for Rising Stem MOVs in the RH, CS and SI Systems, Rev. 4
7. Fax from Ike Ezekoye (West.) to Ron Osborne, VCSNS MOV Data for PL Analysis, dated 1-25-96
8. DC01520-050, GL 89-10 MOV Weak Link Calculations, Rev. 0
9. Engineering Properties of Steel, American Society for Metals, 1982

<u>Methodology</u>: The methodology used for the determination of F_{total} is per pages 11 through 19 of ref. 1 except this calculation will use the opening valve factor rather than the closing valve factor, as discussed in assumption 2.

The opening valve factor (VF_{co}) will be corrected to account for the difference in the mean seat diameter versus the effective seat port dia. (seat port diameter plus the 1/16" seat chamfer) used in the determination of the tested opening valve factor (VF). This is necessary because the Westinghouse valves use the effective seat port area rather than mean seat area in the calculation of required operating thrust within the minimum required thrust calculations of reference 6. As such, the valve factor (VF_{co}) used within this calculation is determined as follows;

$$VF_{co} = VF * (\text{effective seat port radius/mean seat radius})^2$$

The opening structural margin evaluation will be based on a comparison of F_{total} and MAOT as follows;

$$MARGIN_{st} = (MAOT-F_{total})/F_{total}$$

A positive value shows structural margin.

The opening capability margin evaluation will be based on a comparison of F_{total} and MPOT as follows;

$$MARGIN_{cap} = (MPOT - F_{total})/F_{total}$$

A positive value shows capability margin.

Review of reference 5 shows that the opening capability for the 8884 and 8886 valves are the same, with the 8884 valve have the highest unseating load of 6720 lbf. Therefore, this calculation will use an unseating load of 6720 lbf.

Note that review of reference 6 shows the disk material to be SA-182 F316.

<u>Computer Calculations</u>: N/A (This calculation is done in Mathcad.)

This section of the program reads the sixteen items of input data from the plinput1.dat file.

$i := 0..15$

$input_i := READ(plinput1)$

$P_{bonnet} := input_0 \cdot psi$

$P_{up} := input_1 \cdot psi$

$P_{down} := input_2 \cdot psi$

$t := input_3 \cdot in$

$a := input_4 \cdot in$

$b := input_5 \cdot in$

$Hub_{length} := input_6 \cdot in$

$\theta := input_7 \cdot deg$

$\nu := input_8$

$E := input_9 \cdot psi$

$D_{stem} := input_{10} \cdot in$

$F_{po} := input_{11} \cdot lbf$

$VF := input_{12}$

$MAOT := input_{13} \cdot lbf$

$MPOT := input_{14} \cdot lbf$

$c := input_{15} \cdot in$

Program PRESLOK, Version 1

INPUTS:

Bonnet Pressure (ref. 4)	$P_{bonnet} = 1854 \cdot psi$
Upstream Pressure(ref. 4)	$P_{up} = 0 \cdot psi$
Downstream Pressure(ref. 4)	$P_{down} = 0 \cdot psi$
Disk Thickness(ref. 7) (taken at centerline of the hub vertically)	$t = 1.01 \cdot in$
Seat Radius(ref. 7) (corresponding to mean seat diameter)	$a = 1.62 \cdot in$
Hub Radius(ref. 7) (taken at plane of symmetry, perpendicular to the hub, radius of circle of equivalent area for non-circular hubs)	$b = 1.056 \cdot in$
Effective Seat Port Radius(ref. 6 thrust calc.)	$c = 1.344 \cdot in$
Seat Angle(ref. 8)	$\theta = 7 \cdot deg$
Poisson's Ratio(ref. 8) (disk material at temperature)	$\nu = 0.3$
Modulus of Elasticity(ref. 9) (disk material at temperature)	$E = 2.8 \cdot 10^{7} \cdot psi$
Static Pullout Force(ref. 5) (measured value from diagnostic test)	$F_{po} = 6720 \cdot lbf$
Valve Factor(ref. 6 thrust calc.)	$VF = 0.6$
Stem Diameter(ref. 6)	$D_{stem} = 1.25 \cdot in$
Hub Length(ref. 7) (from inside face of disk to inside face of disk)	$Hub_{length} = 0.61 \cdot in$
Open Structural Limit (ref. 6)	$MAOT = 22680 \cdot lbf$
Open Capability (ref. 6)	$MPOT = 14655 \cdot lbf$

Program PRESLOK, Version 1

PRESSURE FORCE CALCULATIONS

Open valve factor corrected for mean seat dia.

$$VF_{co} := VF \cdot \left(\frac{c}{a}\right)^2 \qquad VF_{co} = 0.413$$

Coefficient of friction between disk and seat:

$$\mu := VF_{co} \cdot \frac{\cos(\theta)}{1 + VF_{co} \cdot \sin(\theta)} \qquad \mu = 0.39$$

Average DP across disks:

$$DPavg := P_{bonnet} - \frac{P_{up} + P_{down}}{2} \qquad DPavg = 1854 \cdot psi$$

Disk Stiffness Constants

$$D := \frac{E \cdot (t)^3}{12 \cdot \left(1 - \nu^2\right)} \qquad D = 2.642 \cdot 10^6 \cdot lbf \cdot in$$

$$G := \frac{E}{2 \cdot (1 + \nu)} \qquad G = 1.077 \cdot 10^7 \cdot psi$$

Geometry Factors:

$$C_2 := \frac{1}{4} \cdot \left[1 - \left(\frac{b}{a}\right)^2 \cdot \left(1 + 2 \cdot \ln\left(\frac{a}{b}\right)\right)\right] \qquad C_2 = 0.0529$$

$$C_3 := \frac{b}{4 \cdot a} \cdot \left[\left[\left(\frac{b}{a}\right)^2 + 1\right] \cdot \ln\left(\frac{a}{b}\right) + \left(\frac{b}{a}\right)^2 - 1\right] \qquad C_3 = 0.0057$$

$$C_8 := \frac{1}{2} \cdot \left[1 + \nu + (1 - \nu) \cdot \left(\frac{b}{a}\right)^2\right] \qquad C_8 = 0.7987$$

$$C_9 := \frac{b}{a} \cdot \left[\frac{1 + \nu}{2} \cdot \ln\left(\frac{a}{b}\right) + \frac{1 - \nu}{4} \cdot \left[1 - \left(\frac{b}{a}\right)^2\right]\right] \qquad C_9 = 0.2469$$

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

Program PRESLOK, Version 1

Geometry Factors: (continued)

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

$$L_{11} := \frac{1}{64}\cdot\left[1+4\cdot\left(\frac{b}{a}\right)^2-5\cdot\left(\frac{b}{a}\right)^4-4\cdot\left(\frac{b}{a}\right)^2\cdot\left[2+\left(\frac{b}{a}\right)^2\right]\cdot\ln\left(\frac{a}{b}\right)\right]$$ $L_{11} = 5.181\cdot 10^{-4}$

$$L_{17} := \frac{1}{4}\cdot\left[1-\frac{1-\nu}{4}\cdot\left[1-\left(\frac{b}{a}\right)^4\right]-\left(\frac{b}{a}\right)^2\cdot\left[1+(1+\nu)\cdot\ln\left(\frac{a}{b}\right)\right]\right]$$ $L_{17} = 0.0488$

Moment

$$M_{rb} := \frac{-DPavg\cdot a^2}{C_8}\cdot\left[\frac{C_9}{2\cdot a\cdot b}\cdot\left(a^2-b^2\right)-L_{17}\right]$$ $M_{rb} = -366.1\cdot lbf$

$$Q_b := \frac{DPavg}{2\cdot b}\cdot\left(a^2-b^2\right)$$ $Q_b = 1324.9\cdot\frac{lbf}{in}$

Deflection due to pressure and bending:

$$y_{bq} := M_{rb}\cdot\frac{a^2}{D}\cdot C_2+Q_b\cdot\frac{a^3}{D}\cdot C_3-\frac{DPavg\cdot a^4}{D}\cdot L_{11}$$ $y_{bq} = -9.6752\cdot 10^{-6}\cdot in$

Deflection due to pressure and shear stress:

$$K_{sa} := -0.3\cdot\left[2\cdot\ln\left(\frac{a}{b}\right)-1+\left(\frac{b}{a}\right)^2\right]$$ $K_{sa} = -0.0842$

$$y_{sq} := \frac{K_{sa}\cdot DPavg\cdot a^2}{t\cdot G}$$ $y_{sq} = -3.7682\cdot 10^{-5}\cdot in$

Deflection due to hub stretch:

$$P_{force} := \pi\cdot\left(a^2-b^2\right)\cdot DPavg$$

$$y_{stretch} := \frac{P_{force}}{\pi\cdot b^2}\cdot\frac{Hub_{length}}{(2\cdot E)}$$ $y_{stretch} = 2.7333\cdot 10^{-5}\cdot in$

Program PRESLOK, Version 1

Total deflection due to pressure forces (per lbf/in.):

$$y_q := y_{bq} + y_{sq} - y_{stretch} \qquad y_q = -7.469 \cdot 10^{-5} \cdot in$$

Deflection due to seat contact force and shear stress (per lbf/in.):

$$y_{sw} := -\left[\frac{1.2 \cdot \left(\frac{a}{a}\right) \cdot ln\left(\frac{a}{b}\right) \cdot a}{t \cdot G}\right] \qquad y_{sw} = -7.648 \cdot 10^{-8} \cdot \frac{in}{\left(\frac{lbf}{in}\right)}$$

Deflection due to seat contact force and bending (per lbf/in.):

$$y_{bw} := -\left(\frac{a^3}{D}\right) \cdot \left[\left(\frac{C_2}{C_8}\right) \cdot \left[\left(\frac{a \cdot C_9}{b}\right) - L_9\right] - \left[\left(\frac{a}{b}\right) \cdot C_3\right] + L_3\right] \qquad y_{bw} = -2.639 \cdot 10^{-8} \cdot \frac{in}{\left(\frac{lbf}{in}\right)}$$

Deflection due to hub compression:

$$y_{cmpr} := -\left(\frac{2 \cdot \pi \cdot a}{\pi \cdot b^2} \cdot \frac{Hub_{length}}{2 \cdot E}\right) \qquad y_{cmpr} = -3.165 \cdot 10^{-8} \cdot \frac{in}{\left(\frac{lbf}{in}\right)}$$

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

$$y_w := y_{bw} + y_{sw} + y_{cmpr} \qquad y_w = -1.345 \cdot 10^{-7} \cdot \frac{in}{\left(\frac{lbf}{in}\right)}$$

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

$$F_s := 2 \cdot \pi \cdot a \cdot \frac{y_q}{y_w} \qquad F_s = 5651.6 \cdot lbf$$

UNSEATING FORCES

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

$$F_{piston} := \frac{\pi}{4} \cdot D_{stem}^{2} \cdot P_{bonnet}$$

$$F_{piston} = 2275.2 \cdot lbf$$

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

$$F_{vert} = 3725.8 \cdot lbf$$

$$F_{preslock} := 2 \cdot F_{s} \cdot (\mu \cdot \cos(\theta) - \sin(\theta))$$

$$F_{preslock} = 2999.2 \cdot lbf$$

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

$$F_{po} = 6720 \cdot lbf$$

$$F_{total} = 11169.7 \cdot lbf$$

MARGIN EVALUATION

$$MARGIN_{st} := \frac{MAOT - F_{total}}{F_{total}}$$

$$MARGIN_{st} = 103.049 \cdot \%$$

$$MARGIN_{cap} := \frac{MPOT - F_{total}}{F_{total}}$$

$$MARGIN_{cap} = 31.203 \cdot \%$$

CONCLUSION: Based on the methods used throughout this calculation, it can be concluded that both XVG08884-SI and XVG08886-SI are capable of overcoming the postulated pressure locking forces.

ENGINEERS SERIAL NO. 10625

ENGINEER AME

TECHNICAL WORK RECORD

DATE 1-30-96

PROJECT TITLE ES-412 VERIFICATION TAB 098 PAGE 1 of 1

THE VERIFICATION OF CALCULATION NO. DC01520-098,REV. 0

Verified calculation DC01520-098, Rev.0 per the verification scope listed on the cover sheet of the calculation and per ES-416, Rev. 11 Section 6.7.3.A.

Verification per the cover sheet of the calculation

The inputs are correct based on the references identified in this calculation and are inaccordance with the User's Guide to determine the force to overcome pressure locking. All inputs were verified by the reference listed.

The methodology is in accordance with the User's Guide For Preslok, A Gate Valve Pressure Locking Analysis Program Using the Commonwealth Edison Model, Rev. 0 for determining the force required to overcome pressure locking.

The assumptions are inaccordance with the assumptions listed in the User's Guide. All assumptions are reasonable.

The outputs are reasonable and correct based on the inputs and the methodology used in this calculation

Therefore, this calculation is acceptable per the requirements of ES-412.

Verification per ES-416, Rev. 11, Section 6.7.3.A

1. Technical concept verification- Not Applicable, this calculation is not the result of a design change, the calculation was performed as a result of Addressing GL-95-07, Thermal Binding and Pressure Locking evaluation.

2. Design basis check- Not Applicable, this calculation is not the result of a design change, the calculation was performed as a result of Addressing GL-95-07, Thermal Binding and Pressure Locking evaluation. However, the design inputs utilized in this calculation satsify the intent and purpose of the Calculation as identified in the purpose section of the calculation

3. Check of calculation accuracy- Not Applicable, this calculation is not the result of a design change, the calculation was performed as a result of Addressing GL-95-07, Thermal Binding and Pressure Locking evaluation. **See Verification per the cover sheet of the calculation**.

ENGINEERS

SERIAL NO. 10625

ENGINEER AME

TECHNICAL WORK RECORD

DATE 1-30-96

PROJECT TITLE **ES-412 VERIFICATION** TAB 098 PAGE 1 of 1

4. Interface considerations- Not Applicable, this calculation is not the result of a design change, the calculation was performed as a result of Addressing GL-95-07, Thermal Binding and Pressure Locking evaluation.

5. Systems interaction consideration- Not Applicable, this calculation is not the result of a design change the calculation was performed as a result of Addressing GL-95-07, Thermal Binding and Pressure Locking evaluation.

This calculation is acceptable per the requirements of ES-416, Rev.11, Section 6.7.3.A.

Allen M. Edmond
2/1/96

SUBJECT CODE 152	SOUTH CAROLINA ELECTRIC AND GAS COMPANY CALCULATION RECORD			PAGE 1 OF 11A
CALC TITLE Force Required to Overcome Pressure Locking of XVG08885-SI		CALC NO DC01520-099	REV 0	STATUS A
PARENT DOCUMENT N/A	SYSTEM SI	SAFETY CLASS ☐ NN ☐ QR ☒ SR		
ORIGINATOR Ron Osborne	DISC ME	ORGANIZATION S&CE	DATE 1-29-96	XREF NO. N/A

B

A. CALCULATION INFORMATION

CONTENT DESCRIPTION: This calculation determines the force required to overcome postulated pressure locking conditions, and associated margins, for XVG08885-SI

AFFECTED COMPONENTS ANALYSIS: XVG08885-SI

CONTAINS PRELIMINARY DATA/ASSUMPTIONS:

☒ NO ☐ YES, PAGES

COMPUTER PROGRAM USED: ☒ NO Mathcad used

☐ YES, VALIDATION NOT REQ'D [REF. 3.5] ☐ YES, VALIDATED [OTHERS]
☐ YES, VALIDATED [ES-412] ☐ PROGRAM VALIDATION CALCULATION

B. VERIFICATION

☐ CONTINUED, ATTACHMENT

VERIFICATION SCOPE: Verifier to assure proper inputs, methods, reasonable assumptions and outputs consistent with methodology.

VERIFIER: ALLEN M. EDMOND
ASSIGN BY: WAYNE STUART

Ronald J. Osborne / 1-29-96
LEAD ENGINEER (DESIGNEE)/DATE

VERIFIER/DATE	APPROVAL/DATE
Allen M. Edmond 1/31/96	[signature] 2-2-96

C. RECORDS	REEL NUMBER:
	FRAME NUMBER:
TO PRS: ______________ INIT/DATE	ORIGINAL MAINTAINED BY: ☐ SCE&G DE ☐ SCE&G ________ ☐ VENDOR ________

DISTRIBUTION: CALC FILE (ORIGINAL)
PDE_____/SYSTEM ENG_____DE FILE 20.6602 ATTACH. 1 ONLY, COPY)

SOUTH CAROLINA ELECTRIC & GAS COMPANY REVISION SUMMARY	PAGE 2 OF 11
CALCULATION NO. DC01520-099	

REV NO.	SUMMARY DESCRIPTION
0	Initial Issue

☐ CONTINUES ON PAGE

Purpose: This calculation will determine the force required to overcome postulated pressure locking conditions (F_{total}) for the following Power Operated Gate Valve (POGV); XVG08885-SI

The methodology used is consistent with the Commonwealth Edison method to predict the force required to overcome postulated pressure locking conditions.

This calculation will then compare F_{total} to the opening structural limit (MAOT) and capability limit (MPOT) for the POGVs to determine if the valves are capable of opening under the postulated pressure locking condition.

Assumptions:

1. As stated in reference 1.
2. The use of the opening valve factor will yield more representative results than the closing valve factor. VCSNS dynamic MOV testing has shown that the two are not usually the same.
3. Others as stated throughout this calculation.

References:

1. USER'S GUIDE FOR PRESLOK, A GATE VALVE PRESSURE LOCKING ANALYSIS PROGRAM USING THE COMMONWEALTH EDISON MODEL, REVISION 0, 1-2-96
2. USNRC Generic Letter 95-07, Pressue Locking of Safety-Related Power-Operated Gate Valves
3. USNRC letter from Mr. Paul E. Fredrickson, Chief Special Inspection Branch Division of Reactor Safety to Mr. Gary Taylor, Vice President Nuclear Operations, SUMMARY OF PUBLIC WORKSHOPS TO DISCUSS GENERIC LETTER 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves", dated 1-3-96
4. TWR 13157 Tab 957-SI, GL 95-07 Review for the SI System, dated 1-19-96
5. Engineering Report G/C 3097, NRC Generic Letter 89-10 MOV Setup, Test and Performance Validation Summary Report, Rev. 0, dated 7-26-95
6. DC01520-067, Design Review and Capability for Rising Stem MOVs in the RH, CS and SI Systems, Rev. 4
7. Fax from Ike Ezekoye (West.) to Ron Osborne, VCSNS MOV Data for PL Analysis, dated 1-25-96
8. DC01520-050, GL 89-10 MOV Weak Link Calculations, Rev. 0
9. Engineering Properties of Steel, American Society for Metals, 1982

Methodology: The methodology used for the determination of F_{total} is per pages 11 through 19 of ref. 1 except this calculation will use the opening valve factor rather than the closing valve factor, as discussed in assumption 2.

The opening valve factor (VF_{co}) will be corrected to account for the difference in the mean seat diameter versus the effective seat port dia. (seat port diameter plus the 1/16" seat chamfer) used in the determination of the tested opening valve factor (VF). This is necessary because the Westinghouse valves use the effective seat port area rather than mean seat area in the calculation of required operating thrust within the minimum required thrust calculations of reference 6. As such, the valve factor (VF_{co}) used within this calculation is determined as follows;

$$VF_{co} = VF * (\text{effective seat port radius/mean seat radius})^2$$

The MPOT value will be based on the reference 6 opening torque capability divided by the reference 5 static unseating stem factor.

The opening structural margin evaluation will be based on a comparison of F_{total} and MAOT as follows;

$$MARGIN_{st} = (MAOT - F_{total})/F_{total}$$

A positive value shows structural margin.

The opening capability margin evaluation will be based on a comparison of F_{total} and MPOT as follows;

$$MARGIN_{cap} = (MPOT - F_{total})/F_{total}$$

A positive value shows capability margin.

Computer Calculations: N/A (This calculation is done in Mathcad)

This section of the program reads the seventeer ms of input data from the plinput1.dat file.

$i := 0..16$

$input_i := READ(plinput1)$

$P_{bonnet} := input_0 \cdot psi$

$P_{up} := input_1 \cdot psi$

$P_{down} := input_2 \cdot psi$

$t := input_3 \cdot in$

$a := input_4 \cdot in$

$b := input_5 \cdot in$

$Hub_{length} := input_6 \cdot in$

$\theta := input_7 \cdot deg$

$\nu := input_8$

$E := input_9 \cdot psi$

$D_{stem} := input_{10} \cdot in$

$F_{po} := input_{11} \cdot lbf$

$VF := input_{12}$

$MAOT := input_{13} \cdot lbf$

$OTQC := input_{14} \cdot lbf$

$c := input_{15} \cdot in$

$SF := input_{16}$

Program PRESLOK, Version 1

INPUTS:

Bonnet Pressure (ref. 4)	$P_{bonnet} = 1854 \cdot psi$
Upstream Pressure(ref. 4)	$P_{up} = 0 \cdot psi$
Downstream Pressure(ref. 4)	$P_{down} = 0 \cdot psi$
Disk Thickness(ref. 7) (taken at centerline of the hub vertically)	$t = 1.01 \cdot in$
Seat Radius(ref. 7) (corresponding to mean seat diameter)	$a = 1.62 \cdot in$
Hub Radius(ref. 7) (taken at plane of symmetry, perpendicular to the hub, radius of circle of equivalent area for non-circular hubs)	$b = 1.056 \cdot in$
Effective Seat Port Radius(ref. 6 thrust calc)	$c = 1.344 \cdot in$
Seat Angle(ref. 8)	$\theta = 7 \cdot deg$
Poisson's Ratio(ref. 8) (disk material at temperature)	$\nu = 0.3$
Modulus of Elasticity(ref. 9) (disk material at temperature)	$E = 2.8 \cdot 10^{7} \cdot psi$
Static Pullout Force(ref. 5) (measured value from diagnostic test)	$F_{po} = 7877 \cdot lbf$
Valve Factor(ref. 6 thrust calc.)	$VF = 0.6$
Stem Diameter(ref. 6)	$D_{stem} = 1.25 \cdot in$
Hub Length(ref. 7) (from inside face of disk to inside face of disk)	$Hub_{length} = 0.61 \cdot in$
Open Structural Limit (ref. 6)	$MAOT = 22680 \cdot lbf$
Open Torque Capability (ref. 6)	$OTQC = 135.7 \cdot lbf$
Stem Factor (ref. 5)	$SF = 0.00624$

Program PRESLOK, Version 1

PRESSURE FORCE CALCULATIONS

Open valve factor corrected for mean seat dia.

$$VF_{co} := VF \cdot \left(\frac{c}{a}\right)^2 \qquad VF_{co} = 0.413$$

Coefficient of friction between disk and seat:

$$\mu := VF_{co} \cdot \frac{\cos(\theta)}{1 + VF_{co} \cdot \sin(\theta)} \qquad \mu = 0.39$$

Average DP across disks:

$$DPavg := P_{bonnet} - \frac{P_{up} + P_{down}}{2} \qquad DPavg = 1854 \cdot psi$$

Disk Stiffness Constants

$$D := \frac{E \cdot (t)^3}{12 \cdot \left(1 - \nu^2\right)} \qquad D = 2.642 \cdot 10^6 \cdot lbf \cdot in$$

$$G := \frac{E}{2 \cdot (1 + \nu)} \qquad G = 1.077 \cdot 10^7 \cdot psi$$

Geometry Factors:

$$C_2 := \frac{1}{4} \cdot \left[1 - \left(\frac{b}{a}\right)^2 \cdot \left(1 + 2 \cdot \ln\left(\frac{a}{b}\right)\right)\right] \qquad C_2 = 0.0529$$

$$C_3 := \frac{b}{4 \cdot a} \cdot \left[\left[\left(\frac{b}{a}\right)^2 + 1\right] \cdot \ln\left(\frac{a}{b}\right) + \left(\frac{b}{a}\right)^2 - 1\right] \qquad C_3 = 0.0057$$

$$C_8 := \frac{1}{2} \cdot \left[1 + \nu + (1 - \nu) \cdot \left(\frac{b}{a}\right)^2\right] \qquad C_8 = 0.7987$$

$$C_9 := \frac{b}{a} \cdot \left[\frac{1 + \nu}{2} \cdot \ln\left(\frac{a}{b}\right) + \frac{1 - \nu}{4} \cdot \left[1 - \left(\frac{b}{a}\right)^2\right]\right] \qquad C_9 = 0.2469$$

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

Program PRESLOK, Version 1

Geometry Factors: (continued)

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

$L_9 = 0$

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

$L_{11} = 5.181\cdot 10^{-4}$

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

$L_{17} = 0.0488$

Moment

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

$M_{rb} = -366.1\cdot lbf$

$$Q_b := \frac{DPavg}{2\cdot b}\cdot\left(a^2-b^2\right)$$

$Q_b = 1324.9\cdot\frac{lbf}{in}$

Deflection due to pressure and bending:

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

$y_{bq} = -9.6752\cdot 10^{-6}\cdot in$

Deflection due to pressure and shear stress:

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

$K_{sa} = -0.0842$

$$y_{sq} := \frac{K_{sa}\cdot DPavg\cdot a^2}{t\cdot G}$$

$y_{sq} = -3.7682\cdot 10^{-5}\cdot in$

Deflection due to hub stretch:

$$P_{force} := \pi\cdot\left(a^2-b^2\right)\cdot DPavg$$

$$y_{stretch} := \frac{P_{force}}{\pi\cdot b^2}\cdot\frac{Hub_{length}}{(2\cdot E)}$$

$y_{stretch} = 2.7333\cdot 10^{-5}\cdot in$

Program PRESLOK, Version 1

Total deflection due to pressure forces (per lbf/in.):

$$y_q := y_{bq} + y_{sq} - y_{stretch} \qquad y_q = -7.469 \cdot 10^{-5} \cdot in$$

Deflection due to seat contact force and shear stress (per lbf/in.):

$$y_{sw} := -\left[\frac{1.2 \cdot \left(\frac{a}{a}\right) \cdot \ln\left(\frac{a}{b}\right) \cdot a}{t \cdot G}\right] \qquad y_{sw} = -7.648 \cdot 10^{-8} \cdot \frac{in}{\left(\frac{lbf}{in}\right)}$$

Deflection due to seat contact force and bending (per lbf/in.):

$$y_{bw} := -\left(\frac{a^3}{D}\right) \cdot \left[\left(\frac{C_2}{C_8}\right) \cdot \left[\left(\frac{a \cdot C_9}{b}\right) - L_9\right] - \left[\left(\frac{a}{b}\right) \cdot C_3\right] + L_3\right] \qquad y_{bw} = -2.639 \cdot 10^{-8} \cdot \frac{in}{\left(\frac{lbf}{in}\right)}$$

Deflection due to hub compression:

$$y_{cmpr} := -\left(\frac{2 \cdot \pi \cdot a}{\pi \cdot b^2} \cdot \frac{Hub_{length}}{2 \cdot E}\right) \qquad y_{cmpr} = -3.165 \cdot 10^{-8} \cdot \frac{in}{\left(\frac{lbf}{in}\right)}$$

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

$$y_w := y_{bw} + y_{sw} + y_{cmpr} \qquad y_w = -1.345 \cdot 10^{-7} \cdot \frac{in}{\left(\frac{lbf}{in}\right)}$$

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

$$F_s := 2 \cdot \pi \cdot a \cdot \frac{y_q}{y_w} \qquad F_s = 5651.6 \cdot lbf$$

UNSEATING FORCES

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

$F_{piston} := \frac{\pi}{4} \cdot D_{stem}^{2} \cdot P_{bonnet}$ $\qquad$ $F_{piston} = 2275.2 \cdot lbf$

$F_{vert} := \pi \cdot a^{2} \cdot \sin(\theta) \cdot \left(2 \cdot P_{bonnet} - P_{up} - P_{down}\right)$ $\qquad$ $F_{vert} = 3725.8 \cdot lbf$

$F_{preslock} := 2 \cdot F_{s} \cdot (\mu \cdot \cos(\theta) - \sin(\theta))$ $\qquad$ $F_{preslock} = 2999.2 \cdot lbf$

$F_{total} := -F_{piston} + F_{vert} + F_{preslock} + F_{po}$ $\qquad$ $F_{po} = 7877 \cdot lbf$

$F_{total} = 12326.7 \cdot lbf$

MPOT DETERMINATION

$MPOT := \frac{OTQC}{SF}$

$MPOT = 21750.28 \cdot lbf$

MARGIN EVALUATION

$MARGIN_{st} := \frac{MAOT - F_{total}}{F_{total}}$

$MARGIN_{st} = 83.991 \cdot \%$

$MARGIN_{cap} := \frac{MPOT - F_{total}}{F_{total}}$

$MARGIN_{cap} = 76.448 \cdot \%$

<u>CONCLUSION</u>: Based on the methods used throughout this calculation, it can be concluded that XVG08885-SI is capable of overcoming the postulated pressure locking forces.

ENGINEERS SERIAL NO. 10625

ENGINEER AME

TECHNICAL WORK RECORD

DATE 1-30-96

PROJECT TITLE ES-412 VERIFICATION TAB 099 PAGE 1 of 1

THE VERIFICATION OF CALCULATION NO. DC01520-099,REV. 0

Verified calculation DC01520-099, Rev.0 per the verification scope listed on the cover sheet of the calculation and per ES-416, Rev. 11 Section 6.7.3.A.

Verification per the cover sheet of the calculation

The inputs are correct based on the references identified in this calculation and are inaccordance with the User's Guide to determine the force to overcome pressure locking. All inputs were verified by the reference listed.

The methodology is in accordance with the User's Guide For Preslok, A Gate Valve Pressure Locking Analysis Program Using the Commonwealth Edison Model, Rev. 0 for determining the force required to overcome pressure locking.

The assumptions are inaccordance with the assumptions listed in the User's Guide. All assumptions are reasonable.

The outputs are reasonable and correct based on the inputs and the methodology used in this calculation

Therefore, this calculation is acceptable per the requirements of ES-412.

Verification per ES-416, Rev. 11, Section 6.7.3.A

1. Technical concept verification- Not Applicable, this calculation is not the result of a design change, the calculation was performed as a result of Addressing GL-95-07, Thermal Binding and Pressure Locking evaluation.

2. Design basis check- Not Applicable, this calculation is not the result of a design change, the calculation was performed as a result of Addressing GL-95-07, Thermal Binding and Pressure Locking evaluation. However, the design inputs utilized in this calculation satsify the intent and purpose of the Calculation as identified in the purpose section of the calculation

3. Check of calculation accuracy- Not Applicable, this calculation is not the result of a design change, the calculation was performed as a result of Addressing GL-95-07, Thermal Binding and Pressure Locking evaluation. **See Verification per the cover sheet of the calculation**.

ENGINEERS | SERIAL NO. 10625

ENGINEER AME

TECHNICAL WORK RECORD

DATE 1-30-96

PROJECT TITLE **ES-412 VERIFICATION** TAB 099 PAGE 1 of 1

4. Interface considerations- Not Applicable, this calculation is not the result of a design change, the calculation was performed as a result of Addressing GL-95-07, Thermal Binding and Pressure Locking evaluation.

5. Systems interaction consideration- Not Applicable, this calculation is not the result of a design change, the calculation was performed as a result of Addressing GL-95-07, Thermal Binding and Pressure Locking evaluation.

This calculation is acceptable per the requirements of ES-416, Rev.11, Section 6.7.3.A.

Allen M. Edmond
2/1/96

VCSNS RESPONSE TO THE REQUEST FOR ADDITIONAL INFORMATION CONCERNING THE STATIONS INITIAL GENERIC LETTER 95-07 "PRESSURE LOCKING AND THERMAL BINDING OF SAFETY-RELATED POWER-OPERATED GATE VALVES" SUBMITTAL.

PURPOSE:

This enclosure provides the additional information requested in part 2 of the enclosure to the NRC letter to Mr. Taylor, dated July 3, 1996 (REQUEST FOR ADDITIONAL INFORMATION - GENERIC LETTER 95-07, "PRESSURE LOCKING AND THERMAL BINDING OF SAFETY-RELATED POWER OPERATED GATE VALVES," VIRGIL C. SUMMER NUCLEAR STATION (TAC NO. M93525).

ADDITIONAL INFORMATION REQUESTED:

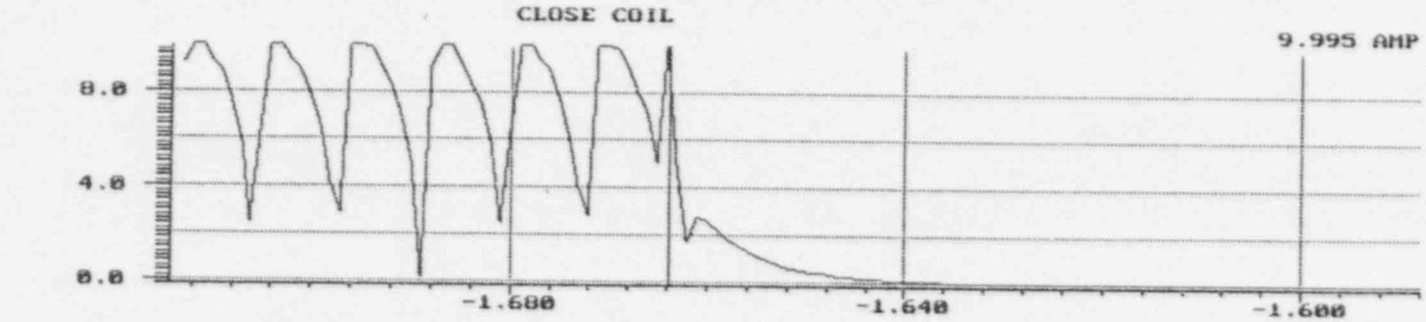
2. "The licensee's submittal discusses the susceptibility of valves 8000A/B/C, Pressurizer PORV Block Valves, to thermal binding. The licensee's submittal states that these valves have spring compensators which help mitigate the potential thermal binding condition. In addition, the licensee's submittal states that these valves have been closed numerous times during various modes of plant operation and subsequently reopened at ambient temperatures. Does the licensee have diagnostic test data that demonstrate that the spring compensators prevent excessive closing forces on the valve disk? Please discuss this issue and provide the results of the diagnostic tests, if applicable.

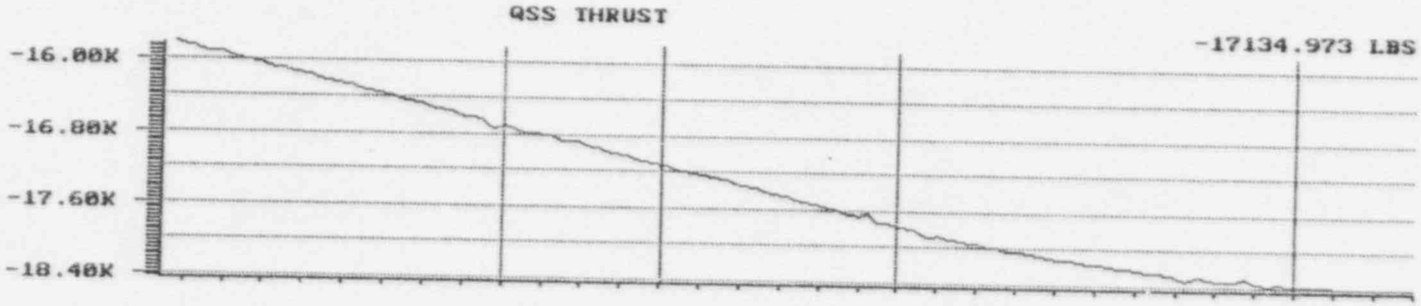
The licensee's submittal states that these valves are not used for cold over pressure protection. If these valves are shut to isolate a leaking PORV, would they remain shut as the plant cools down, and potentially have a requirement to open later for cold over pressure protection? Please address this scenario".

VCSNS ADDITIONAL INFORMATION:

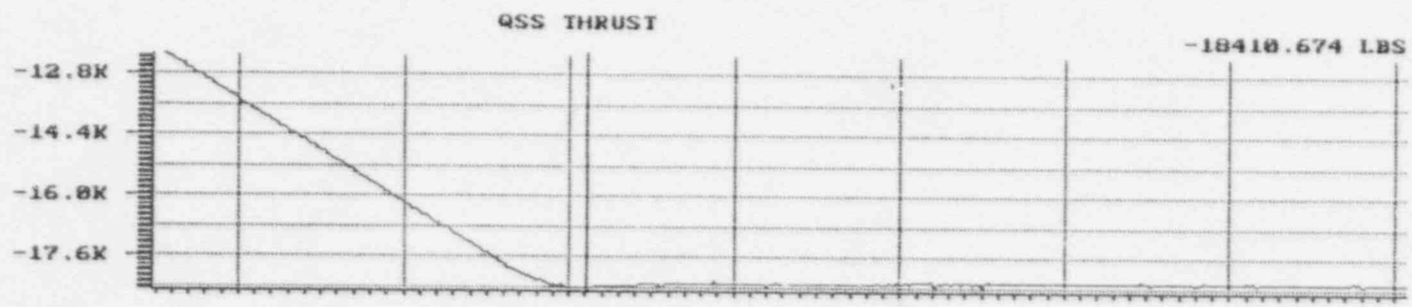
The Pressurizer PORV Block Valves (XVG08000A,B,C-RC) are fast acting valves that have Limitorque SB-00 actuators which are equipped with spring compensators. The spring compensator, which is a Belleville spring assembly mounted on top of the actuator, supports the stem nut instead of the stem nut being held rigidly in place by a lock nut as is the case for Limitorque actuators that are not equipped with spring compensators. The Belleville washers compress in response to the reactive upward force on the stem nut during the closing stoke which results in the Belleville washers absorbing most of the additional thrust due to inertia. The Belleville washers will also absorb loads caused by thermal expansion, thereby keeping the valve disc from becoming too tightly wedged into the valve seat. In order for the Belleville washers to absorb the loads caused by thermal expansion the Belleville washers must not be in full compression as a result of the closing force. The static test as-left full stroke diagnostic traces for the PORV Block Valves indicate that the Belleville washers are not fully compressed during the closing stroke and the closing forces on the valve disk are not excessive (see attached traces).

The PORV Block Valves are not required to be opened for cold over pressure protection. Cold over pressure protection at VCSNS is provided by the RHR (Residual Heat Removal) suction relief valves. If one of the PORV Block Valves were shut to isolate a leaking PORV, and remained shut as the plant cooled down, the valve would not have a requirement to reopen.





Thrust @ CST = 17,135 LBS
Total Thrust = 18,411 LBS



ITI MOVATS
Series 3500
(c) 1990-1994

Tag:
XVG08000A

File:
170.L01

Date/Time:
Oct 28 1994
00:48

Demand:
O->C->O

Test Type:
STATIC

Source:
NONE

Temp:
85.0 Deg F

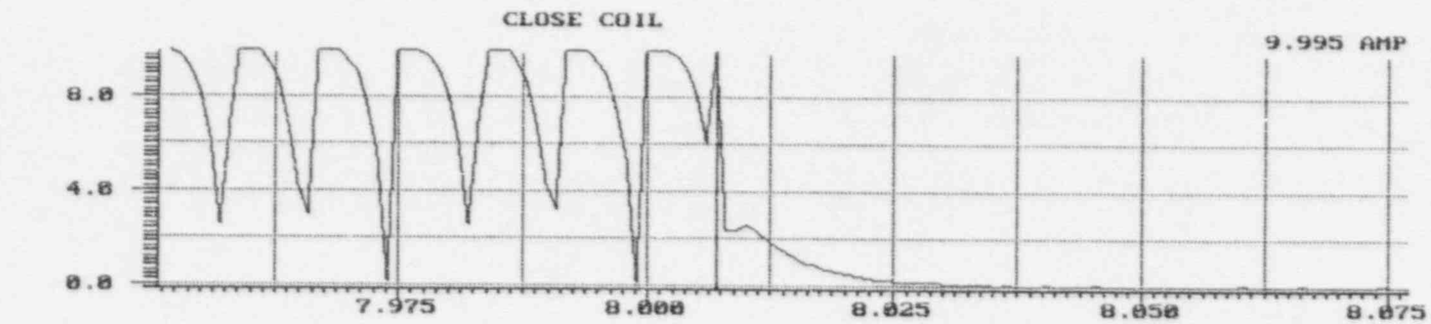
Pressure:
0.0 PSIG

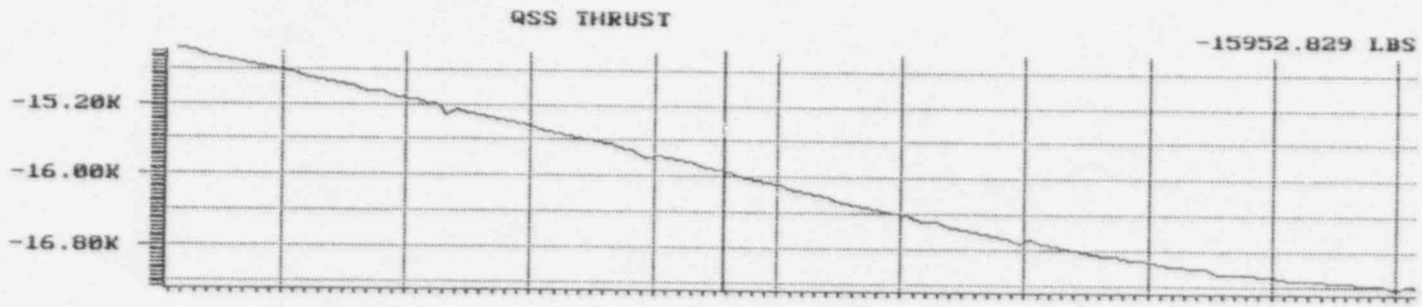
Fluid/Flow:
Other
0.0 ALFS
0.0 PSI/

AF Torque SW:
Open: 1.00
Close: 1.00

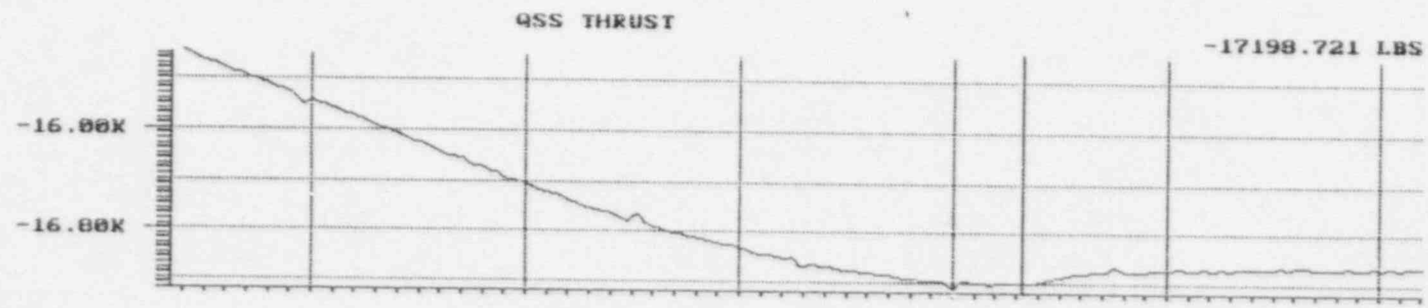
AL Torque SW:
Open: 1.00
Close: 1.00

Sample Rate:
1000 Samp/Sec





Thrust @ CST = 15,953 LBS
Total Thrust = 17,199 LBS



ITI MOVATS
Series 3500
(c) 1990-1994

Tag:
XVG08000B

File:
171.L06

Date/Time:
Dec 09 1994
10:20

Demand:
O->C->O

Test Type:
STATIC

Source:

Temp:
75.0 Deg F

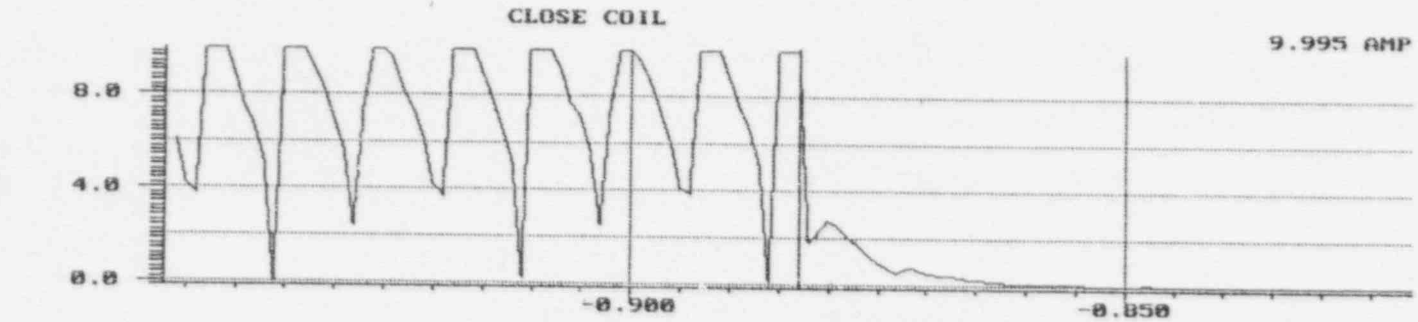
Pressure:
0.0 PSIG

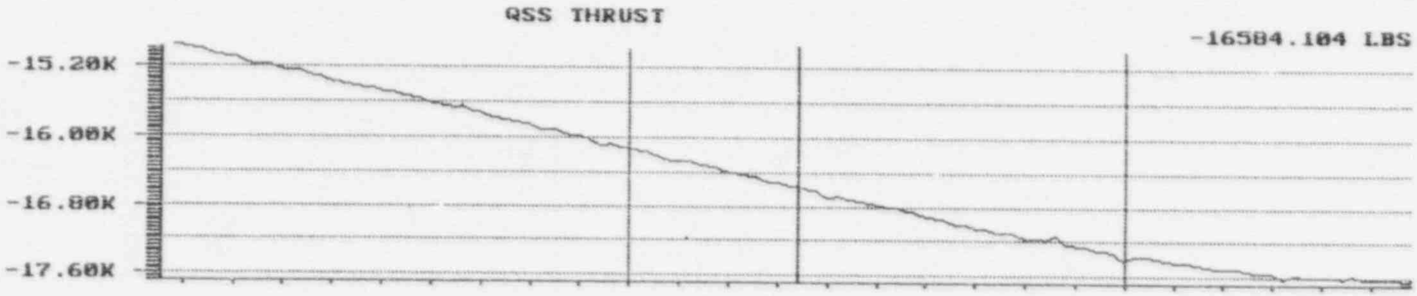
Fluid/Flow:
WATER
0.0 ALFS
0.0 PSID

AF Torque SW:
Open: 0.00
Close: 0.00

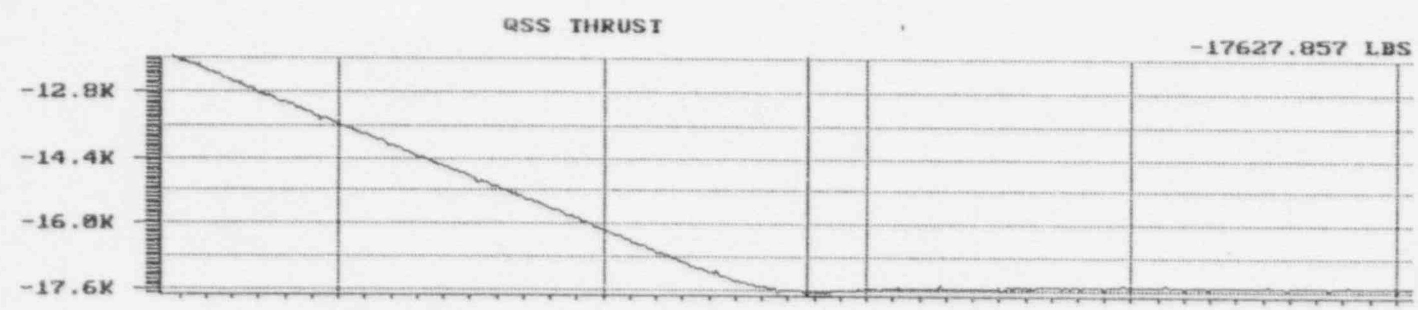
AL Torque SW:
Open: 1.00
Close: 0.00

Sample Rate:
1000 Samp/Sec





Thrust @ CST = 16,584 LBS
Total Thrust = 17,628 LBS



ITI MOVATS
Series [illegible]
(c) 1990-1994

Tag:
XVG08000C

File:
172.L01

Date/Time:
Oct 27 1994
23:51

Demand:
O->C->O

Test Type:
STATIC

Source:
NONE

Temp:
85.0 Deg F

Pressure:
0.0 PSIG

Fluid/Flow:
Other
0.0 ALFS
0.0 PSI/

AF Torque SW:
Open: 1.00
Close: 1.00

AL Torque SW:
Open: 1.00
Close: 1.00

Sample Rate:
1000 Samp/Sec

VCSNS RESPONSE TO THE REQUEST FOR ADDITIONAL INFORMATION CONCERNING THE STATIONS INITIAL GENERIC LETTER 95-07 "PRESSURE LOCKING AND THERMAL BINDING OF SAFETY-RELATED POWER-OPERATED GATE VALVES" SUBMITTAL.

PURPOSE:

This enclosure provides the additional information requested in part 3 of the enclosure to the NRC letter to Mr. Taylor, dated July 3, 1996 (REQUEST FOR ADDITIONAL INFORMATION - GENERIC LETTER 95-07, "PRESSURE LOCKING AND THERMAL BINDING OF SAFETY-RELATED POWER OPERATED GATE VALVES," VIRGIL C. SUMMER NUCLEAR STATION (TAC NO. M93525).

ADDITIONAL INFORMATION REQUESTED:

3. "The licensee's submittal discusses the susceptibility of valves 8887A/B, A/B Train Low Head Safety Injection (LHSI) Cross-Connect Valves, to pressure locking. The licensee's submittal states that the valves are closed to align the LHSI pumps for cold leg recirculation and are reopened to align the LHSI pumps for hot leg recirculation at a lower temperature. Based on a review of system diagrams, it appears that, during the time these valves are shut for cold leg recirculation, they may experience heat transfer from the LHSI system, causing thermally-induced pressure locking. Please address this issue. If the licensee has completed heat transfer, thrust requirement and actuator capability calculations, please provide them for our review".

VCSNS ADDITIONAL INFORMATION:

The A/B Train Low Head Safety Injection (LHSI) Cross-Connect Valves (XVG8887A,B-SI) are not susceptible to thermally induced pressure locking. The valves are normally open and are closed to align the LHSI pumps for Cold Leg recirculation after the LHSI pump suction is aligned to the recirculation sumps. Closing the valves after the LHSI pump suction is aligned to the sumps results in the valves being closed at the time of the highest system temperature. The fluid temperature at the time of valve closure is approximately 145 degrees F. The valves are reopened to align the pumps for Hot Leg recirculation at a fluid temperature of approximately 125 degrees F (the Residual Heat Removal Heat Exchangers are cooling the recirculating water). Since the fluid temperature is highest when the valves are first closed and the system cools during the time the valves are closed the valves are not susceptible to thermally-induced pressure locking.

VCSNS RESPONSE TO THE REQUEST FOR ADDITIONAL INFORMATION CONCERNING THE STATIONS INITIAL GENERIC LETTER 95-07 "PRESSURE LOCKING AND THERMAL BINDING OF SAFETY-RELATED POWER-OPERATED GATE VALVES" SUBMITTAL.

PURPOSE:

This enclosure provides the additional information requested in part 4 of the enclosure to the NRC letter to Mr. Taylor, dated July 3, 1996 (REQUEST FOR ADDITIONAL INFORMATION - GENERIC LETTER 95-07, "PRESSURE LOCKING AND THERMAL BINDING OF SAFETY-RELATED POWER OPERATED GATE VALVES," VIRGIL C. SUMMER NUCLEAR STATION (TAC NO. M93525).

ADDITIONAL INFORMATION REQUESTED:

4. "Regarding valve 8889, LHSI to RCS Hot Legs, the licensee's submittal states that this valve is not susceptible to pressure locking because 1) the downstream check valves must pass stringent leakage and testing requirements, 2) the valve is stroked quarterly without any problems to date, 3) the valve would not be required to open until hours after the LOCA which would allow the bonnet pressure to decrease and 4) all valve operations occur with the LHSI pumps running. Please address the following issues:

a. Over time, swing check valves may transmit high pressure even though they pass leak tightness criteria. The NRC staff notes that the licensee's submittal states, on page 6 of Enclosure 1, that even though check valves may prevent gross backleakage, they may not prevent pressure from increasing in the pipe between the check valve(s) and the gate valve under evaluation. Please discuss assurance that the check valves downstream of valve 8889 will not transmit pressure over the entire operating cycle.

b. The quarterly stroke testing may not be conducted under the same conditions as that during a design basis accident. Please discuss the correlation of past quarterly stroke testing to the potential pressure locking condition.

c. Through operating experience feedback discussed in NUREG-1275 Volume 9, Appendix A, Example A, the NRC staff is aware that gate valves can maintain bonnet pressure over a significant period of time. Please provide information to support the assertion that valve 8889 will not continue to maintain bonnet pressure when called upon to open.

d. Please provide more detailed information regarding the timing of the LHSI pump operation relative to the time at which the valve would be required to open".

VCSNS ADDITIONAL INFORMATION:

4. a. The two in-series check valves that isolate the LHSI to RCS Hot Legs valve (XVG08889-SI) from the RCS could leak by and allow the RCS to pressurize the LHSI to RCS Hot Leg valve to RCS pressure prior to it being required to open (8 hours after a large break loss of coolant accident (LOCA)) to align the LHSI pumps for Hot Leg Recirculation. The likelihood of the check valves leaking by and pressurizing the valve during the operating cycle is reduced since the valve is stroked quarterly and the Residual Heat Removal system pressure would increase when the valve was opened alerting Operations that the check valves were leaking by. For conservatism we will assume the LHSI to RCS Hot Legs valve is susceptible to hydraulic pressure locking and the in-series check valves transmit the full RCS pressure to the valve (8889) just prior to a large break LOCA (See the attached pressure locking thrust calculation, DC01520-134). Based on the actuator capability (See Enclosure 1, Attachment II) and the pressure locking thrust requirement, this valve has sufficient thrust capability to overcome the postulated pressure locking forces.

   b. If the in-series check valves were to transmit pressure during the operating cycle, the quarterly stroke testing of valve 8889 would result in the valve being required to open against whatever pressure was transmitted by the check valves. The potential pressure locking conditions occurring during the time the valve is required to be opened (approximately 8 hours after a large break LOCA) would be less severe than surveillance test conditions due to the valve depressurization that would take place over the 8 hour time period following the RCS depressurization as a result of the accident (See item c. for more details). The valve actuator torque/thrust capability is essentially the same for both the surveillance test and the LOCA conditions since the motor terminal voltage remains above 90% for both cases and the LOCA does not result in a significant reduction in actuator output torque/thrust due to elevated ambient temperatures.

   c. Westinghouse has performed an analysis of the bonnet depressurization rates of gate valves tested by Commonwealth Edison Company (Reference: WOG-96-073, Final Program Verification Letter Report, "V-EC-1619 Bonnet Depressurization Rate"). The analysis determined the following bonnet depressurization rates:

Differential Pressure <u>Range</u>	Bonnet Depressurization <u>Range</u>
Below 500 psid	1.0 psi / minute
500 - 1,000 psid	2.5 psi / minute
1,000 - 1,500 psid	4.0 psi / minute
> 1,500 psid	5.5 psi / minute

Assuming the initial bonnet pressure for valve 8889 was 2235 psig (RCS normal operating pressure) the bonnet pressure would be 479 psig when called upon to open, 8 hours after the LOCA, to provide LHSI to the RCS Hot Legs.

d. The LHSI pumps run continuously during the injection, cold leg and hot leg recirculation phases. The pumps are not secured when swapping back and forth between cold leg and hot leg recirculation as is the case for the HHSI pumps. The quarterly surveillance test of XVG08889-SI is performed with the pumps secured. Even though the LHSI pumps are running during the time valve 8889 is required to open to establish Hot Leg Recirculation the valve may be isolated from the pumps by the closure of valves XVG08887A,B-SI. Since the valve may be isolated from the LHSI pumps when it is required to open no credit is taken for the head of the pumps in the pressure locking thrust calculation (See attached pressure locking thrust calculation, DC01520-134).

SUBJECT CODE 152	SOUTH CAROLINA ELECTRIC AND GAS COMPANY CALCULATION RECORD			PAGE 1 OF 11
CALC TITLE Force Required to Overcome Pressure Locking of XVG08889-SI		CALC NO DC01520-134	REV 0	STATUS A
PARENT DOCUMENT N/A	SYSTEM SI	SAFETY CLASS ☐NN ☐QR ☒SR		
ORIGINATOR Ron Osborne	DISC ME	ORGANIZATION S&CE	DATE 7-19-96	XREF NO. N/A

B

A. CALCULATION INFORMATION

CONTENT DESCRIPTION: This calculation determines the force required to overcome postulated pressure locking and associated margins for XVG08889-SI.

AFFECTED COMPONENTS ANALYSIS: XVG08889-SI

CONTAINS PRELIMINARY DATA/ASSUMPTIONS:

☒ NO ☐ YES, PAGES

COMPUTER PROGRAM USED: ☒ NO (Mathcad used)

☐ YES, VALIDATION NOT REQ'D [REF. 3.5] ☐ YES, VALIDATED [OTHERS]
☐ YES, VALIDATED [ES 412] ☐ PROGRAM VALIDATION CALCULATION

B. VERIFICATION ☐ CONTINUED, ATTACHMENT

VERIFICATION SCOPE: Verifier to assure proper inputs, methods and arithmetic, reasonable assumptions and outputs consistent with methodology.

VERIFIER: Robert Justice
ASSIGN BY: Al Paglia

Ronald L. Osborne / 7-19-96
LEAD ENGINEER (DESIGNEE)/DATE

VERIFIER/DATE	APPROVAL/DATE
Robert Justice 7/22/96	B. B. Williams 7/24/96

C. RECORDS	REEL NUMBER:
	FRAME NUMBER:
TO PRS: ______________ INIT/DATE	ORIGINAL MAINTAINED BY: ☐ SCE&G DE ☐ SCE&G ________ ☐ VENDOR ________

DISTRIBUTION: CALC FILE (ORIGINAL)
PDE______/SYSTEM ENG_____DE FILE 20.6602 ATTACH. 1 ONLY, COPY)

B

SOUTH CAROLINA ELECTRIC & GAS COMPANY
REVISION SUMMARY

PAGE
2 OF 11

CALCULATION NO.
DC01520-134

REV NO.	SUMMARY DESCRIPTION
0	Initial issue.

☐ CONTINUES ON PAGE

Purpose: This calculation will determine the force required to overcome postulated hydraulic pressure locking conditions (F_{total}) for the following Power Operated Gate Valve (POGV); XVG08889-SI

The methodology used is consistent with the Commonwealth Edison method to predict the force required to overcome postulated pressure locking conditions.

This calculation will then compare F_{total} to the opening structural limit (MAOT) and capability limit (MPOT) for the POGVs to determine if the valve is capable of opening under the postulated hydraulic pressure locking condition.

Assumptions:

1. As stated in reference 1.
2. The use of the opening valve factor will yield more representative results than the closing valve factor. VCSNS dynamic MOV testing has shown that the two are not usually the same.
3. Others as stated throughout this calculation.

References:

1. USER'S GUIDE FOR PRESLOK, A GATE VALVE PRESSURE LOCKING ANALYSIS PROGRAM USING THE COMMONWEALTH EDISON MODEL, REVISION 0, 1-2-96
2. USNRC Generic Letter 95-07, Pressue Locking of Safety-Related Power-Operated Gate Valves
3. USNRC letter from Mr. Paul E. Fredrickson, Chief Special Inspection Branch Division of Reactor Safety to Mr. Gary Taylor, Vice President Nuclear Operations, SUMMARY OF PUBLIC WORKSHOPS TO DISCUSS GENERIC LETTER 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves", dated 1-3-96
4. TWR 13157 Tab 95-7R1, GL-95-07 Additional Info. SI System, dated 7-19-96
5. Diagnostic test traces and associated Engineering Evaluation for MWR 96O3392, dated 4-28-96
6. DC01520-067, Design Review and Capability for Rising Stem MOVs in the RH, CS and SI Systems, Revision 5
7. Fax from Ike Ezekoye (West.) to Ron Osborne, GEOMETRIC PARAMETERS FOR VALVE PRESSURE LOCKING ANALYSIS, dated 7-19-96
8. DC01520-050, GL 89-10 MOV Weak Link Calculations
9. Engineering Properties of Steel, American Society for Metals, 1982

<u>Methodology</u>: The methodology used for the determination of F_{total} is per pages 11 through 19 of ref. 1 except this calculation will use the opening valve factor rather than the closing valve factor, as discussed in assumption 2.

The opening valve factor (VF_{co}) will be corrected to account for the difference in the mean seat diameter versus the effective seat port dia. (seat port diameter plus the 1/16" seat chamfer) used in the determination of the tested opening valve factor (VF). This is necessary because the Westinghouse valves use the effective seat port area rather than mean seat area in the calculation of required operating thrust within the minimum required thrust calculations of reference 6. As such, the valve factor (VF_{co}) used within this calculation is determined as follows;

VF_{co} = VF * (effective seat port radius/mean seat radius)^2

The opening structural margin evaluation will be based on a comparison of F_{total} and MAOT as follows;

$MARGIN_{st} = (MAOT-F_{total})/F_{total}$

A positive value shows structural margin.

The opening capability margin evaluation will be based on a comparison of F_{total} and MPOT as follows;

$MARGIN_{cap} = (MPOT - F_{total})/F_{total}$

A positive value shows capability margin.

<u>Computer Calculations</u>: N/A (This calculation is done in Mathcad)

This section of the program reads the sixteen items of input data from the plinput1.dat file.

$i := 0..15$

$input_i := READ(plinput1)$

$P_{bonnet} := input_0 \cdot psi$

$P_{up} := input_1 \cdot psi$

$P_{down} := input_2 \cdot psi$

$t := input_3 \cdot in$

$a := input_4 \cdot in$

$b := input_5 \cdot in$

$Hub_{length} := input_6 \cdot in$

$\theta := input_7 \cdot deg$

$\nu := input_8$

$E := input_9 \cdot psi$

$D_{stem} := input_{10} \cdot in$

$F_{po} := input_{11} \cdot lbf$

$VF := input_{12}$

$MAOT := input_{13} \cdot lbf$

$MPOT := input_{14} \cdot lbf$

$c := input_{15} \cdot in$

Program PRESLOK, Version 1

INPUTS:

Bonnet Pressure (ref. 4)	$P_{bonnet} = 479 \cdot psi$
Upstream Pressure(ref. 4)	$P_{up} = 0 \cdot psi$
Downstream Pressure(ref. 4)	$P_{down} = 0 \cdot psi$
Disk Thickness(ref. 7) (taken at centerline of the hub vertically)	$t = 2.744 \cdot in$
Seat Radius(ref. 7) (corresponding to mean seat diameter)	$a = 5.011 \cdot in$
Hub Radius(ref. 7) (taken at plane of symmetry, perpendicular to the hub, radius of circle of equivalent area for non-circular hubs)	$b = 2.694 \cdot in$
Effective Seat Port Radius(ref. 6)	$c = 4.409 \cdot in$
Seat Angle(ref. 8)	$\theta = 7 \cdot deg$
Poisson's Ratio(ref. 8) (disk material at temperature)	$\nu = 0.3$
Modulus of Elasticity(ref. 9) (disk material at temperature)	$E = 2.8 \cdot 10^{7} \cdot psi$
Static Pullout Force(ref. 5) (measured value from diagnostic test)	$F_{po} = 22833 \cdot lbf$
Valve Factor(ref. 6 thrust calc.)	$VF = 0.65$
Stem Diameter(ref. 6)	$D_{stem} = 2.5 \cdot in$
Hub Length(ref. 7) (from inside face of disk to inside face of disk)	$Hub_{length} = 0.82 \cdot in$
Open Structural Limit (ref. 6)	$MAOT = 140000 \cdot lbf$
Open Thrust Capability (ref. 6)	$MPOT = 78445 \cdot lbf$

Program PRESLOK, Version 1

PRESSURE FORCE CALCULATIONS

Open valve factor corrected for mean seat dia.

$$VF_{co} = VF \cdot \left(\frac{c}{a}\right)^2 \qquad VF_{co} = 0.503$$

Coefficient of friction between disk and seat:

$$\mu = VF_{co} \cdot \frac{\cos(\theta)}{1 + VF_{co} \cdot \sin(\theta)} \qquad \mu = 0.471$$

Average DP across disks:

$$DPavg = P_{bonnet} - \frac{P_{up} + P_{down}}{2} \qquad DPavg = 479 \cdot psi$$

Disk Stiffness Constants

$$D = \frac{E \cdot (t)^3}{12 \cdot (1 - \nu^2)} \qquad D = 5.298 \cdot 10^7 \cdot lbf \cdot in$$

$$G = \frac{E}{2 \cdot (1 + \nu)} \qquad G = 1.077 \cdot 10^7 \cdot psi$$

Geometry Factors:

$$C_2 = \frac{1}{4} \cdot \left[1 - \left(\frac{b}{a}\right)^2 \cdot \left(1 + 2 \cdot \ln\left(\frac{a}{b}\right)\right)\right] \qquad C_2 = 0.0881$$

$$C_3 = \frac{b}{4 \cdot a} \cdot \left[\left[\left(\frac{b}{a}\right)^2 + 1\right] \cdot \ln\left(\frac{a}{b}\right) + \left(\frac{b}{a}\right)^2 - 1\right] \qquad C_3 = 0.012$$

$$C_8 = \frac{1}{2} \cdot \left[1 + \nu + (1 - \nu) \cdot \left(\frac{b}{a}\right)^2\right] \qquad C_8 = 0.7512$$

$$C_9 = \frac{b}{a} \cdot \left[\frac{1 + \nu}{2} \cdot \ln\left(\frac{a}{b}\right) + \frac{1 - \nu}{4} \cdot \left[1 - \left(\frac{b}{a}\right)^2\right]\right] \qquad C_9 = 0.2838$$

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

Program PRESLOK, Version 1

Geometry Factors: (continued)

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

$$L_{11} = \frac{1}{64}\cdot\left[1+4\cdot\left(\frac{b}{a}\right)^2-5\cdot\left(\frac{b}{a}\right)^4-4\cdot\left(\frac{b}{a}\right)^2\cdot\left[2+\left(\frac{b}{a}\right)^2\right]\cdot\ln\left(\frac{a}{b}\right)\right] \qquad L_{11} = 0.002$$

$$L_{17} = \frac{1}{4}\cdot\left[1-\frac{1-\nu}{4}\cdot\left[1-\left(\frac{b}{a}\right)^4\right]-\left(\frac{b}{a}\right)^2\cdot\left[1+(1+\nu)\cdot\ln\left(\frac{a}{b}\right)\right]\right] \qquad L_{17} = 0.0793$$

Moment

$$M_{rb} = \frac{-DPavg\cdot a^2}{C_8}\cdot\left[\frac{C_9}{2\cdot a\cdot b}\cdot\left(a^2-b^2\right)-L_{17}\right] \qquad M_{rb} = -1733.8\cdot lbf$$

$$Q_b = \frac{DPavg}{2\cdot b}\cdot\left(a^2-b^2\right) \qquad Q_b = 1587.1\cdot\frac{lbf}{in}$$

Deflection due to pressure and bending:

$$y_{bq} = M_{rb}\cdot\frac{a^2}{D}\cdot C_2 + Q_b\cdot\frac{a^3}{D}\cdot C_3 - \frac{DPavg\cdot a^4}{D}\cdot L_{11} \qquad y_{bq} = -3.5817\cdot 10^{-5}\cdot in$$

Deflection due to pressure and shear stress:

$$K_{sa} = -0.3\cdot\left[2\cdot\ln\left(\frac{a}{b}\right)-1+\left(\frac{b}{a}\right)^2\right] \qquad K_{sa} = -0.1591$$

$$y_{sq} = \frac{K_{sa}\cdot DPavg\cdot a^2}{t\cdot G} \qquad y_{sq} = -6.4747\cdot 10^{-5}\cdot in$$

Deflection due to hub stretch:

$$P_{force} = \pi\cdot\left(a^2-b^2\right)\cdot DPavg$$

$$y_{stretch} = \frac{P_{force}}{\pi\cdot b^2}\cdot\frac{Hub_{length}}{(2\cdot E)} \qquad y_{stretch} = 1.7253\cdot 10^{-5}\cdot in$$

Program PRESLOK, Version 1

Total deflection due to pressure forces (per lbf/in.):

$$y_q = y_{bq} + y_{sq} - y_{stretch}$$

$$y_q = -1.1782 \cdot 10^{-4} \cdot in$$

Deflection due to seat contact force and shear stress (per lbf/in.):

$$y_{sw} = -\left[\frac{1.2 \cdot \left(\frac{a}{a}\right) \cdot \ln\left(\frac{a}{b}\right) \cdot a}{t \cdot G}\right]$$

$$y_{sw} = -1.263 \cdot 10^{-7} \cdot \frac{in}{\left(\frac{lbf}{in}\right)}$$

Deflection due to seat contact force and bending (per lbf/in.):

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

$$y_{bw} = -9.41 \cdot 10^{-8} \cdot \frac{in}{\left(\frac{lbf}{in}\right)}$$

Deflection due to hub compression:

$$y_{cmpr} = -\left(\frac{2 \cdot \pi \cdot a}{\pi \cdot b^2} \cdot \frac{Hub_{length}}{2 \cdot E}\right)$$

$$y_{cmpr} = -2.022 \cdot 10^{-8} \cdot \frac{in}{\left(\frac{lbf}{in}\right)}$$

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

$$y_w = y_{bw} + y_{sw} + y_{cmpr}$$

$$y_w = -2.406 \cdot 10^{-7} \cdot \frac{in}{\left(\frac{lbf}{in}\right)}$$

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

$$F_s = 2 \cdot \pi \cdot a \cdot \frac{y_q}{y_w}$$

$$F_s = 15417.3 \cdot lbf$$

UNSEATING FORCES

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

$F_{piston} = \frac{\pi}{4} \cdot D_{stem}{}^{2} \cdot P_{bonnet}$ $\qquad$ $F_{piston} = 2351.3 \cdot lbf$

$F_{vert} = \pi \cdot a^{2} \cdot \sin(\theta) \cdot \left(2 \cdot P_{bonnet} - P_{up} - P_{down}\right)$ $\qquad$ $F_{vert} = 9210 \cdot lbf$

$F_{preslock} = 2 \cdot F_{s} \cdot (\mu \cdot \cos(\theta) - \sin(\theta))$ $\qquad$ $F_{preslock} = 10644.6 \cdot lbf$

$F_{total} = -F_{piston} + F_{vert} + F_{preslock} + F_{po}$ $\qquad$ $F_{po} = 22833 \cdot lbf$

$F_{total} = 40336.3 \cdot lbf$

MARGIN EVALUATION

$$MARGIN_{st} = \frac{MAOT - F_{total}}{F_{total}}$$

$MARGIN_{st} = 247.1 \cdot \%$

$$MARGIN_{cap} = \frac{MPOT - F_{total}}{F_{total}}$$

$MARGIN_{cap} = 94.48 \cdot \%$

<u>**CONCLUSION**</u>: **Based on the methods used throughout this calculation, it can be concluded that XVG08889-SI is capable of overcoming the postulated pressure locking forces.**

ENGINEERS
TECHNICAL WORK RECORD

Serial 13157
Engineer RLJ
Date 7/24/96

Project Title DC01520-134 VERIFICATION Tab 95-7R1 Page 1

THIS IS A VERIFICATION IN ACCORDANCE WITH ES - 412 & 110.

DESIGN CALCULATION DC0152-134 REV.0 "Force Required to Overcome Pressure Locking of XVG08889-SI" meets all of the requirements of ES-412 And ES-110.

CALCULATION EVALUATION :

1, Calculation DC0152-134 REV.0 includes all necessary information. Inputs are correctly incorporated into the calculation.

2, Assumptions are reasonable, are adequately described and are justifiable.

3, The Methodology is consistent with industry pressure locking thrust calculations. The Commonwealth Edision methodology is recognized by the industry and the NRC as one of the best.

4, All references are adequately defined.

5, All other design verification questions listed on attachment II of ES-110 are not applicable to this design calculation.

6, The calculation, which was performed in MATHCAD, was verified by perfoming the sample problem given in Westinghouse letter ESBU/WOG-96-050, dated February 13, 1996 and verifying the proper MATHCAD outputs.

CONCLUSION : CALCULATION DC0152-134 IS CORRECT AS IT IS WRITTEN PER ES-412 AND 110.

ROBERT L JUSTICE
Systems Engineering

VCSNS RESPONSE TO THE REQUEST FOR ADDITIONAL INFORMATION CONCERNING THE STATIONS INITIAL GENERIC LETTER 95-07 "PRESSURE LOCKING AND THERMAL BINDING OF SAFETY-RELATED POWER-OPERATED GATE VALVES" SUBMITTAL.

PURPOSE:

This enclosure provides the additional information requested in part 5 of the enclosure to the NRC letter to Mr. Taylor, dated July 3, 1996 (REQUEST FOR ADDITIONAL INFORMATION - GENERIC LETTER 95-07, "PRESSURE LOCKING AND THERMAL BINDING OF SAFETY-RELATED POWER OPERATED GATE VALVES," VIRGIL C. SUMMER NUCLEAR STATION (TAC NO. M93525).

ADDITIONAL INFORMATION REQUESTED:

5. "Through review of operational experience feedback, the staff is aware of instances where licensees have completed design or procedural modifications to preclude pressure locking or thermal binding which may have had an adverse impact on plant safety due to incomplete or incorrect evaluation of the potential effects of these modifications. Please describe evaluations and training for plant personnel that have been conducted for each design or procedural modification completed to address potential pressure locking or thermal binding concerns".

VCSNS ADDITIONAL INFORMATION:

5. The Recirculation Sump to RHR/LHSI Pump A/B valves (XVG08811A,B-SI and XVG08812A,B-SI) had holes drilled in their discs to mitigate potential pressure locking conditions. The valve discs were modified per MRF 22765B. The 10CFR50.59 screening evaluation is attached (See Attachment I). Plant personnel were trained on MRF 22765B as it relates to plant operation during licensed operator requal training (See Attachment II).

   The following surveillance test procedures were modified to address potential pressure locking concerns:

   Surveillance test procedure STP-220.001A "Motor Driven Emergency Feedwater Pump and Valve Test" was revised to require monitoring the opposite train's pressure during the test. The 10CFR50.59 screening evaluation is attached (See Attachment III).

   Surveillance test procedure STP-205.004 "RHR Pump and Valve Operability Test" was revised to eliminate the requirement for closing the valves XVG0888A,B-SI (LHSI to RCS Cold Legs) during the performance of the test, in operational modes 1 through 3. The 10CFR50.59 screening evaluation is attached (See Attachment IV).

Surveillance test procedure STP-212.002 "Reactor Building Spray Pump Test" was revised to require monitoring the opposite train's pressure during the test and to require manually opening the valve (XVG03003A(B)-SP) on the tested train, after performing the pump test, to ensure the valve's bonnet cavity is vented. The 10CFR50.59 screening evaluation is attached (See Attachment V).

Surveillance test procedure STP-223.002A "Service Water System Pump Test" was revised to require that valves XVG03109A,B,C,D-SW be placed in the open position during the pump test. The 10CFR50.59 screening evaluation is attached (See Attachment VI).

The discipline supervisor responsible for the procedure changes determined that the changes did not require special training.

10CFR50.59 SCREENING PROCESS WORKSHEET

PARENT DOCUMENT MRF 22765 REV. MCN B

Activity Description Pressure Locking of SI Sump Recirc Valves

Screening Questions:

		Yes	No
A.	Does the activity represent a change to the procedures described in the FSAR or FPER?	☐	☒

Discussion of the basis for the answer: The base MRF was a temporary design change that did address procedures described in the FSAR with respect to an added surveillance and valve stroking after RHR operation. MCN B will be a permanent change that will no longer require the added surveillance or the valve stroking.

		Yes	No
B.	Does the activity represent a change to the facility as described in the FSAR or FPER?	☒	☐

Discussion of the basis for the answer: MRF 22765 MCN B will be a permanent design change to XVG08811A, XVG08811B, XVG08812 A, and XVG08812B. These valves are described in FSAR sections 6.2.4.2.2 and 6.3.2.2.6.1 and are listed in FSAR Tables 6.2-53a and 6.2-54.

		Yes	No
C.	Does the activity represent a test or experiment not described in the FSAR or FPER?	☐	☒

Discussion of the basis for the answer: The activity is neither a test nor an experiment. Drilling a hole in the high pressure side flexible wedge gate valve discs is a commonly accepted means of precluding pressure locking and is recommended by INPO and NRC.

		Yes	No
D.	Does the activity represent a change to the Technical Specifications?	☐	☒

Discussion of the basis for the answer: The proposed activity will not affect the design function of the valves with respect to containment isolation or RHR operation; therefore, Tech Spec operability of these valves will be unaffected by this change. No change to Tech Specs is required.

Mike Dantzler	9-15-95	D. D. Williams	10/3/95
Preparer's Signature	Date	Independent Reviewer's Sign./	Date
W D Alton	10/6/95		
Approval Signature	Date		

VIRGIL C. SUMMER NUCLEAR STATION
10CFR50.59 SAFETY EVALUATION WORKSHEET

Check Applicable Yes [ ] and No [ ] Indications

PARENT DOCUMENT MRF 2276 MCN B

Does this evaluation change the Final Safety Analysis Report or Fire Protection Evaluation Report?

*1

Yes [✓] No [ ]

TECH. SPEC. REFERENCE	
Section	Page
3.5.2	—
3.5.3	—
3.6.4	—

Not addressed in Tech Specs. [ ]

FSAR/FPER REFERENCE		
Chapter	Section	Page
6	6.2.4.2.2	—
6	6.3.2.2.6.1	—
6	Table 6.2-53a Table 6.2-54	—

Not addressed in FSAR/FPER [ ]

Is a change in Tech. Specification involved?

*2

Yes [ ] No [✓]

Nuc. Lic. Reviewer / Date

PSRC/NSRC Review

Request and Receive Nuclear Regulatory Commission Authorization For Change Prior To Implementation Of the Subject Change

Authorization Denied

Abort The Change

UNREVIEWED SAFETY QUESTION DETERMINATION:

Answer the seven questions on pages 2 and 3. Provide specific reasons justifying the decision for the "yes" or "no" answers.

NOTE:

Restatement of the question in a negative sense or making a simple statement of conclusion is not sufficient and shall be avoided. It is recognized, however, that for certain very simple activities, a statement of the conclusion with identification of references consulted to support the conclusion will be adequate.

Complete the items below after the questions on pages 2 and 3 have been addressed.

Any Answer Yes [ ] All Answers No [✓]

*3

Authorization Received

Initiate The Change

*If answer (1) is "yes" but answers (2) and (3) are "no", then the change is reportable under 10CFR50.59b and a description of the change will be included in the Annual Report. If answer (2) is "yes" then 10CFR50.59 is not applicable. Proceed to 10CFR50.90.

Mike Dantzler | 9-15-
Lead Engineer/Preparer | Date

G. G. Williams | 10/3/
Independent Reviewer | Date

J. O. Arthur | 10/5/
Approval Signature | Date

10CFR50.59 SAFETY EVALUATION QUESTIONS PARENT DOCUMENT MRF 22765 MCN [illegible]

		YES	NO
1.	May the proposed activity increase the probability of occurrence of an accident previously evaluated in the FSAR or FPER?		X

Basis: See attached TWR

		YES	NO
2.	May the proposed activity increase the consequences of an accident previously evaluated in the FSAR or FPER?		X

Basis: See attached TWR

		YES	NO
3.	May the proposed activity increase the probability of occurrence of a malfunction of equipment important to safety previously evaluated in the FSAR or FPER?		X

Basis: See attached TWR

		YES	NO
4.	May the proposed activity increase the consequences of a malfunction of equipment important to safety previously evaluated in the FSAR or FPER?		X

Basis: See attached TWR

PARENT DOCUMENT MRF 22765 MCN B

	YES	NO
5. May the proposed activity create the possibility of an accident of a different type than any previously evaluated in the FSAR or FPER?		X

Basis: See attached TWR

	YES	NO
6. May the proposed activity create the possibility of a different type of malfunction of equipment important to safety than any previously evaluated in the FSAR or FPER?		X

Basis: See attached TWR

	YES	NO
7. Does the proposed activity reduce the margin of safety as defined in the basis for any technical specification?		X

Basis: See attached TWR

NOTE: Attach additional supportive documentation to this form.

ENGINEERS
TECHNICAL WORK RECORD

Serial 11917
Engineer M.Dantzler
Date 9-15-95

Project Title 10CFR50.59 Evaluation for MRF 22765, MCN B Tab 14 Page 1 of

1. May the proposed activity increase the probability of occurrence of an accident previously evaluated in the FSAR or FPER? NO

Basis: The proposed change will result in a hole being drilled on the RB side of the discs of the XVG08811 valves, and a hole on the RHR side of the XVG08812 valves. This activity will not increase the probability of occurrence of accidents as described in chapters 6 and 15 of the FSAR nor will it affect the evaluations of the FPER. Supporting factors are:

- Although the design of the valves will be altered by the hole, the structural integrity of the discs will be unaffected (see Westinghouse letter #CGE-95-030).

- The overall system performance will be unaffected by the modification. The valves will become unidirectional as a result of this modification, but this will not affect the function for which these valves are designed. The XVG08811 valves will still seal against RB pressure, and the XVG08812 valves will still seal against RHR system pressure. Individually, these valves will provide uni-directional isolation; however, in tandem, they will provide bi-directional isolation.

- These valves provide isolation between the SI Recirculation Sump and the RHR system. They automatically open during an SI when the RWST reaches its Lo-Lo level in order to place the plant in the recirculation mode for accident mitigation. These valves, and their interfaces with other equipment/systems, have no effect on the probability of the *initiation* of accidents described in the FSAR or FPER.

2. May the proposed activity increase the consequences of an accident previously evaluated in the FSAR or FPER? NO

Basis: The XVG08811 valves and the XVG08812 valves function to provide a path for low head and high head post-LOCA recirculation. The XVG08811 valves also function as containment isolation valves. The proposed modification to these valves will not adversely affect these functions, and, therefore, it will not increase the consequences of accidents previously evaluated in the FSAR or FPER. Supporting factors are:

- The purpose of the proposed modification is to provide additional assurance that the valves will not become pressure-locked, and will open when needed to provide a post-LOCA recirculation path, thereby mitigating the radiological consequences of a LOCA.

- The modification to the XVG08811 valves will not degrade the function of these valves as containment isolation valves. Flexible wedge gate valves utilize a difference in system pressure to wedge the disc against the seat opposite the higher system pressure. This seat, then, is the sealing boundary for the valve disc. Since the XVG08811 valves must seal against RB design pressure in their function as containment isolation valves, sealing must occur at the seat opposite to the RB. Drilling the hole on the RB side of the disc will not affect the capability of this valve to isolate against RB pressure since sealing will occur at the seat opposite to the RB.

ENGINEERS
TECHNICAL WORK RECORD

Serial 11917
Engineer M.Dantzler
Date 9-15-95

Project Title 10CFR50.59 Evaluation for MRF 22765, MCN B   Tab 14   Page 2 of

3. May the proposed activity increase the probability of occurrence of a malfunction of equipment important to safety previously evaluated in the FSAR or FPER? NO

Basis: The XVG08811valves and the XVG08812 valves are safe shutdown components (SSC): however, the proposed modification will have negligible effects on the structural integrity of the valves' discs and will, in fact, increase the reliability of the valves by ensuring that they will not be susceptible to pressure locking. No other important to safety (ITS) equipment will be affected, either directly or indirectly, by this modification. Supporting factors are:

- The proposed size and location of the hole will not affect the structural integrity of the discs (refer to Westinghouse letter CGE-95-030).
- The hole will provide a drain path from the bonnet to the high pressure side of the valve, thereby providing assurance against pressure locking.
- Although, individually the valves will provide uni-directional isolation, in tandem they will maintain bi-directional isolation capability; therefore, interfaces with other ITS equipment will be unaffected by this modification.

4. May the proposed activity increase the consequences of a malfunction of equipment important to safety previously evaluated in the FSAR or FPER? NO

Basis: The proposed change will not result in a different response of the ECCS or safety related systems and components to accident scenarios than that postulated in the FSAR or FPER. No new equipment malfunctions will be introduced that will affect fission product barrier integrity. Therefore, it is concluded that the proposed changes will not increase the consequences of a malfunction of equipment important to safety previously evaluated in the FSAR or FPER.

5. May the proposed activity create the possibility of an accident of a different type than any previously evaluated in the FSAR or FPER? NO

Basis: The proposed change will not cause the initiation of an accident, create any new limiting single failure, or result in any event previously deemed incredible being made credible. As such, the change will not create the possibility of an accident different than any evaluated in the FSAR or FPER.

6. May the proposed activity create the possibility of a different type of malfunction of equipment important to safety than any previously evaluated in the FSAR or FPER? NO

Basis: The proposed change will not adversely affect the operation of the Reactor Protection System, Engineering Safety Features, or other systems, components, or devices required for accident mitigation. These systems, including the ECCS, will remain qualified and capable to perform their design function

ENGINEERS
TECHNICAL WORK RECORD

Serial 11917
Engineer M.Dantzler
Date 9-15-95

Project Title 10CFR50.59 Evaluation for MRF 22765, MCN B Tab 14 Page 3 of

for the proposed change. Therefore, the proposed change will not create the possibility of a malfunction of equipment important to safety different than previously evaluated in the FSAR or FPER.

7. Does the proposed activity reduce the margin of safety as defined in the basis for any Technical Specification? NO

Basis: The proposed modification will not affect any margin of safety as described in the Tech. Specs., FSAR, FPER, or SER. The modification will affect containment isolation valves, XVG08811A,B; however, the modification will not affect the side of the disc (RHR side) which is utilized for isolating containment, therefore, the type C testing leak rates for these valves will be unaffected.

NUCLEAR OPERATION TRAINING

PLANT MODIFICATIONS

CYCLE 9 MRFs	REFUEL MRFs	REFUEL MRFs
MRF-22305	MRF-90109	MRF-90112
MCN-90009D	MRF-22737	MRF-22755
MRF-22291	MRF-90107	MRF-90109A
MRF-22467	MRF-22177G	MRF-90102
MRF-22741	MRF-22765B	MRF-21042B
MRF-22769	MRF-22771	MRF-22769B, C, &D
MRF-22766	ETBT 411	MRF-22742
	MRF-22410	MRF-90102D
	MRF-22766B	MRF-22764
	MRF-90102A	MRF-22657D
	MRF-22553	MRF-22293
		MRF-22654

LESSON PLAN

REVISION 0

TIME: 1.0 HOUR

Recommended James E. Gitt Date 4/29/96

Approved James E. Gitt Date 4/29/96
Senior Instructor, Development

I. OBJECTIVES

A. **TERMINAL OBJECTIVE**: The student shall be able to relate the plant modification to the operation of the V.C. Summer Station.

B. **ENABLING OBJECTIVES**: The student shall be able to:

1. **OUTLINE** the background that necessitated the need to change plant equipment.

2. **STATE** the purpose(s) for the modification.

3. **DESCRIBE** the system/component changes.

4. **RELATE** the changes of the modification to the operation of the V.C. Summer Station, including System Operating Procedure, Technical Specifications, etc.

II. DETAILED DESCRIPTION

A. Cycle 9 MRFs

1. MRF-22305 RMA0005A(B) Removal
   a. Removed RMA0005A(B), Auxiliary Building Charcoal Plenum radiation monitors.
   b. Had a poor operating history and had been inoperable for several years.
   c. No regulatory requirements for these monitors.

2. MCN-90009D MSR Tube Bundle Replacement
   a. Replaced the MSR tube bundle in 1993.
   b. MCN D made minor changes to the forth stage drain valve logic.
   c. The base MRF had the drain valve to heater 1A(B) open when
      1) power was greater then 40 percent,
      2) heater level was not at the Hi-Hi setpoint
      3) Reheater Drain Tank dump valve to the condenser was not opened.
         a) Once the forth stage drain to the heater is opened, the drain valve to the condenser closes.
   d. MCN D added an additional input
   e. In summary, when the following conditions are met, the forth stage drain valve to number 1 heater, XVT02068A(B) **will open**:
      1. XVG02859A-MS, main steam line to MSR drain valve, is closed
      2. Power level is greater than 40 percent (IPS05636)
      3. Heater 1A(B) level is less than its HI-HI level setpoint
      4. ILV03704 (ILV03714) Reheater Drain Tank Condenser Dump Valve, is closed

4. MRF- 22177G CHANGE TO LOW FLOW SETPOINT ON RML-8

   a. MCN G of MRF 22177 changes the low flow setpoint of RML-8 from 1.9 gpm to 4.0 gpm decreasing

   b. Requires RML-8 to be manually reset after sufficient flow is re-established from a low flow condition.

5. MRF 22765B Press Lock of SI Sump Recirc Valves

   a. IN 95-14

   b. Pressure locking of the containment sump isolation valves MVG08811A(B)-SI and MVG08812A(B)-SI due to high temperature sump water following a LOCA.

   c. Fluid becomes pressurized within the valve bonnet and that this pressurization creates a differential pressure across the valve disc

   d. Preventing the actuator from overcoming the added thrust requirements.

   e. Valves would therefore fail in the closed direction, resulting in a loss of all SI flow following RWST depletion.

   f. MRF 22765 provided a temporary solution

   g. Established 10 foot water seal between the SI sumps and the valves.

   h. Limit the temperature rise in the valve bonnet during post LOCA conditions.

   i. Limit the pressurization within the disc to within the capability of the valve actuator.

   j. The MRF also required that the valves be stroked following decay heat removal with the RHR system.

   k. Relieve any pressure that built up within the disc during the cooldown operation.

   l. RWST maximum allowed level was reduced by 1%.

   m. The level in the sump was limited to the 408' elevation

   n. Sump water had to be at a boron concentration equal to the RWST.

o. A quarterly surveillance was implemented to verify that the water leg was still there

p. Permanent fix is holes drilled through valve discs

6. MRF 22771 RC SYSTEM VENTING

a. Each outage, PVC piping is installed in the Reactor Building (RB) from the PRT and RCDT to the top of the pressurizer and then to the RB purge exhaust manifold

b. Purge gases from the tanks without contaminating the RB.

c. Cost of installation and removal is $12,500.00 per outage.

d. Replace the PVC piping will steel pipe and tube.

7. ETBT 411 Loose Parts Monitoring System

a. Siemens Loose Parts Monitoring System (LPMS)

b. Detects loose parts in the Reactor Coolant System (RCS)

c. Structure-borne acoustic signals that originate from parts hitting against the walls or internals.

d. Accomplished by using piezoelectric accelerometers with sensitivity in the audible frequency range.

e. Components are located in the same location as the old system.

f. Once the system is in place and is in automatic, there are no operational procedures for the actual monitoring process.

g. Observation of the system entails the following:

1) Periodically check system switches set to normal.

2) Watch for LED indication of trouble in Signal Conditioning Unit of the LPMS.

3) Check the Main Computer Monitor for error messages.

4) Periodically listen to the audiochannels to detect differences in sound.

5) Acknowledge event alarm or system failure alarm.

10 CFR 50.59 SCREENING PROCESS WORKSHEET

PARENT DOCUMENT STP-220.001A REV. 4 CHANGE B

Activity Description:

The proposed activity is Change B to Revision 4 of STP-220.001A. The purpose of this change was to incorporate the following:

Steps 6.6, 6.7, 6.8 and 6.9, added C_{02} in accordance with RC-96-0032, Response to GL 95-07, Pressure Locking and Thermal Binding of SR Power Operated Gate Valves.

Renumbered Step 8.3.4 to 8.3.6 and added N_{01} Pcap per NCN-4099, Suction Piping Over - Pressure Concern, 2-7-91.

Added Step 9.9, RC-96-0032, Response to GL 95-07, Pressure Locking and Thermal Binding of SR Power Operated Gate Valves

Added Steps 8.3.4 and 8.3.5 and associated C_{02} Pcap in accordance with RC-96-0032, Response to GL 95-07, Pressure Locking and Thermal Binding of SR Power Operated Gate Valves.

Attachment IVA, corrected step number from 5.5.3 to 5.1.3 to correct typo.

Attachment IVA and VA, Steps 6.6.2.C and 6.8.5, added C_{02} and changed the peak suction header pressure limit from $\leq$275 psig to $\leq$100 psig in accordance with the commitment requirements of the V.C. Summer response to GL 95-07, Pressure Locking and Thermal Binding of SR Power Operated Gate Valves.

Attachment IVB, corrected step number from 5.5.3 to 5.1.3 to correct typo.

Attachment IVB and VB, Steps 6.7.2.C and 6.9.5, added C_{02} and changed the peak suction header pressure limit from $\leq$275 psig to $\leq$100 psig in accordance with RC-96-0032, Response to GL 95-07, Pressure Locking and Thermal Binding of SR Power Operated Gate Valves.

Updated procedure format as suggested during the procedure review process.

The original intent of this procedure was to perform periodic surveillance testing of Emergency Feedwater System components in accordance with GTP-301 and GTP-302 as required by FSAR Section 5.7.7 and Technical Specification Surveillance Requirements 4.0.5, 4.7.1.2.a.1 and 4.3.2.1 Table 4.3-2 Items 6a and 6b. This original intent remains unchanged.

10 CFR 50.59 SCREENING PROCESS WORKSHEET

PARENT DOCUMENT STP-220.001A REV. 4 CHANGE B

Screening Questions:

	YES	NO
A. Does the activity represent a change to the procedures described in the FSAR or FPER?	__	X

FSAR Section 5.7.7 states the requirements to perform the surveillance test activities performed by STP-220.001A. FSAR Section 13.5.8 describes the general content of a Surveillance Test Procedure. However no system or component specific details are presented by these FSAR Sections.

FSAR Section 7.3.2.2.5 describes in general the testing methodology of the Engineered Safety Features Actuation System but does not provide specific detail into the testing of each associated component.

FSAR Section 10.4.9 states that testing of the Emergency Feedwater Pumps will be conducted in accordance with ASME Section XI but does not provide any specific details as to the test methodology or procedure to be used.

Based on the above statements, the description of the proposed activity, and the review of FSAR Sections 5.7.7, 7.3.2, 10.4.9 and 13.5, the proposed activity does not represent a change to procedures as described in the FSAR or FPER.

	YES	NO
B. Does the activity represent a change to the facility as described in the FSAR or FPER?	__	X

STP-220.001A is designed to perform surveillance testing of the Motor Driven Emergency Feedwater Pumps utilizing existing plant components, controls, test connections, process instruments and the installed testing capabilities of the Engineered Safety Features Actuation System. No modifications or changes to the plant are represented by this surveillance test procedure.

Based on the above statements, the description of the proposed activity, and the review of FSAR Sections 5.7.7, 7.3.2, and 10.4.9, the proposed activity does not represent a change to the facility as described in the FSAR or FPER.

10 CFR 50.59 SCREENING PROCESS WORKSHEET

PARENT DOCUMENT STP-220.001A REV. 4 CHANGE B

	YES	NO
C. Does the activity represent a test or experiment not described in the FSAR or FPER?	___	X

STP-220.001A is designed to perform surveillance testing of the Motor Driven Emergency Feedwater Pumps utilizing existing plant components, controls, test connections, process instruments and the installed testing capabilities of the Engineered Safety Features Actuation System. This testing is performed as required by FSAR Sections 5.7.7, 7.3.2.2.5 and 10.4.9.

Based on the above statements, the review of FSAR Sections 5.7.7, 7.3.2, and 10.4.9, the proposed activity does not represent a test or experiment not described in the FSAR or FPER.

	YES	NO
D. Does the activity represent a change to the Technical Specifications?	___	X

In addition to "C" above STP-220.001A is designed to perform surveillance testing of the Motor Driven Emergency Feedwater Pumps in accordance with Technical Specification Surveillance Requirements 4.0.5, 4.7.1.2.a.1, and 4.3.2.1 Table 4.3-2 Items 6a and 6b. The proposed change has not altered this requirement.

Based on the above statements, the description of the proposed activity, and the review of Technical Specification Surveillance Requirements 4.0.5, 4.7.1.2.a.1, and 4.3.2.1 Table 4.3-2 Items 6a and 6b and Technical Specifications 3.3.2 and 3.7.1.2, the proposed activity does not represent a change to Technical Specifications.

Robert B McGowen 2-21-96
Preparer's Signature Date

David Stoner 2-22-96
Independent Reviewer's Signature/Date

[signature] 2/22/96
Approval Signature Date

10 CFR 50.59 SCREENING PROCESS WORKSHEET

PARENT DOCUMENT STP-205.004 REV. 2 CHANGE B

Activity Description:

The proposed activity is Change B to Revision 2 of STP-205.004. The purpose of this change is to incorporate the following:

1. Address the requirements of RTS# LTR950007. This was accomplished by adding Steps 6.1.4 and 6.2.4, in which XVG08888A-SI and XVG08888B-SI are closed only in Modes 4, 5 or 6. Attachments IIA and IIB were changed to ensure that XVG08888A-SI and XVG08888B-SI remain open in modes 1, 2 and 3. Maintaining XVG08888A-SI and XVG08888B-SI open during testing while in Modes 1, 2 or 3 will have no effect on the performance of the required testing.

2. Address the recommendation of RTS# ONO 950204. This was accomplished by addings Steps 6.1.9.C and 6.2.9.C, which provide guidance for depressurization of RHR Header A or B if the pressure indicated on the associated Field Standard is greater than 60 psig. The depressurization is accomplished using the local sample connections installed on each RHR header. Attachments IIA and IIB were updated to include the valves manipulated during Steps 6.1.9.C and 6.2.9.C.

The original intent of this procedure was to perform inservice testing of the Residual Heat Removal System / Safety Injection System components in accordance with the requirements of FSAR Section 5.7.7 and Technical Specification 4.0.5. This intent remains unchanged.

Screening Questions:

	YES	NO
A. Does the activity represent a change to the procedures described in the FSAR or FPER?	_	X

FSAR Section 5.7.7 states the requirements to perform the surveillance test activities performed by STP-205.004. FSAR Section 13.5.8 describes the general content of a Surveillance Test Procedure. However, no system or component specific details are presented by these FSAR Sections.

FSAR Section 6.3.4 describes in general the test activities that are performed during testing of the RHR and Safety Injection System components but does not provide specific detail into the testing of each associated component. FSAR Section 6.3.4.4 states testing of RHR and Safety Injection System components will be conducted in accordance with ASME Section XI but does not provide any specific details as to the test methodology or procedure to be used.

Based on the above statements, the description of the proposed activity, and the review of FSAR Sections 5.7.7, 6.3 and 13.5, the proposed activity does not represent a change to procedures as described in the FSAR or FPER.

10 CFR 50.59 SCREENING PROCESS WORKSHEET

PARENT DOCUMENT STP-205.004 REV. 2 CHANGE B

	YES	NO
B. Does the activity represent a change to the facility as described in the FSAR or FPER?	__	X

The purpose of this procedure is to perform inservice testing of Residual Heat Removal System / Safety Injection System components in accordance with the requirements of FSAR Section 5.7.7.

FSAR Section 6.3.4 describes in general the test activities that are performed during testing of the RHR and Safety Injection System components but does not provide specific detail into the testing of each associated component. FSAR Section 6.3.4.4 states testing of RHR and Safety Injection System components will be conducted in accordance with ASME Section XI but does not provide any specific details as to the test methodology or procedure to be used.

The test activities performed by STP-205.004 are conducted using installed plant components, controls and test connections. No modifications to the facility are performed or required by the performance of STP-205.004.

Based on the above statements, the description of the proposed activity, and the review of FSAR Sections 5.7.7, 6.3 and 13.5, the proposed activity does not represent a change to the facility as described in the FSAR or FPER.

	YES	NO
C. Does the activity represent a test or experiment not described in the FSAR or FPER?	__	X

The purpose of this procedure is to perform inservice testing of Residual Heat Removal System / Safety Injection System components in accordance with the requirements of FSAR Section 5.7.7.

FSAR Section 6.3.4 describes in general the test activities that are performed during testing of the RHR and Safety Injection System components but does not provide specific detail into the testing of each associated component. FSAR Section 6.3.4.4 states testing of RHR and Safety Injection System components will be conducted in accordance with ASME Section XI but does not provide any specific details as to the test methodology or procedure to be used.

Based on the above statements, the description of the proposed activity, and the review of FSAR Sections 5.7.7, 6.3 and 13.5, the proposed activity does not represent a test or experiment not described in the FSAR or FPER.

10 CFR 50.59 SCREENING PROCESS WORKSHEET

PARENT DOCUMENT STP-205.004 REV. 2 CHANGE B

	YES	NO
D. Does the activity represent a change to the Technical Specifications?	__	X

In addition to "C" above, STP-205.004 is designed to perform surveillance testing of RHR and Safety Injection System components in accordance with Technical Specification Surveillance Requirements 4.0.5, 4.5.2.f.2 and 4.5.3.1. The proposed change has not altered this intent.

Based on the above statements, the description of the proposed activity, and the review of Technical Specification Surveillance Requirements 4.0.5, 4.5.2.f.2 and 4.5.3.1 and Technical Specifications 3.4.1.3, 3.4.1.4.1, 3.4.1.4.2, 3.5.2, 3.5.3, 3.9.7.1, and 3.9.7.2, the proposed activity does not represent a change to Technical Specifications.

Robert B McGowan 2-21-96
Preparer's Signature Date

2-27-96
Independent Reviewer's Signature/Date

2/27/96
Approval Signature Date

10 CFR 50.59 SCREENING PROCESS WORKSHEET

PARENT DOCUMENT STP-212.002 REV. 2 CHANGE C

Activity Description:

The proposed activity is Change C to Revision 2 of STP-212.002. The purpose of this change was to incorporate the following:

1. Steps 6.1.4.G, 6.1.4.J, 6.1.5.D, 6.2.4.G, 6.2.4.J and 6.2.5.D, added to monitor the opposite train of Reactor Building Spray for any increase in system pressure during testing. Attachments IIIA and IIIB, added data blocks to record opposite train pressures.

2. Steps 6.1.6.A and 6.2.6.A, added steps to manually verify that XVG03003A/B-SP were not pressure locked following the completion of pump testing. This also included the performance of a complete valve stroke cycle for XVG03003A/B-SP following closure of the power supply breaker to ensure that the MOV will operate satisfactorily following manual operation.

3. Steps 8.3.4 and 8.3.5, added to incorporate the limit of 80 psig for the pressure increase of the opposite train during pump testing.

4. Step 9.7, incorporated reference to RC-96-0032, response to GL 95-07,

5. Added C_{01} Pcap as required to preserve the responses to GL 95-07 as recorded in RC-96-0032.

The original intent of this procedure was to perform periodic surveillance testing of Reactor Building Spray System components in accordance with GTP-301 and GTP-302 as required by FSAR Section 5.7.7 and Technical Specification Surveillance Requirements 4.0.5, 4.6.2.1.b, 4.3.2.1 Table 4.3-2 Item 2.b, and 4.8.4.2.a. This original intent remains unchanged.

Screening Questions:

	YES	NO
A. Does the activity represent a change to the procedures described in the FSAR or FPER?	__	X

FSAR Section 5.7.7 states the requirements to perform the surveillance test activities performed by STP-212.002. FSAR Section 13.5.8 describes the general content of a Surveillance Test Procedure. However no system or component specific details are presented by these FSAR Sections.

FSAR Section 7.3.2.2.5 describes in general the testing methodology of the Engineered Safety Features Actuation System but does not provide specific detail into the testing of each associated component.

FSAR Section 6.2.2.4.1.1, System Actuation Tests, describes the testing methodology incorporated by this procedure for the testing of K644, Spray Actuation Relays.

10 CFR 50.59 SCREENING PROCESS WORKSHEET

PARENT DOCUMENT STP-212.002 REV. 2 CHANGE C

FSAR Section 6.2.2.4.1 states that testing of the Reactor Building Spray System will be conducted in accordance with ASME Section XI but does not provide any specific details as to the test methodology or procedure to be used.

Based on the above statements, the description of the proposed activity, and the review of FSAR Sections 5.7.7, 6.2.2, 7.3.2, and 13.5, the proposed activity does not represent a change to procedures as described in the FSAR or FPER.

	YES	NO
B. Does the activity represent a change to the facility as described in the FSAR or FPER?	__	X

STP-212.002 is designed to perform surveillance testing of Reactor Building Spray System components utilizing existing plant components, controls, test connections, process instruments and the installed testing capabilities of the Engineered Safety Features Actuation System. No modifications or changes to the plant are represented by this surveillance test procedure.

Based on the above statements, the description of the proposed activity, and the review of FSAR Sections 5.7.7, 6.2.2, and 7.3.2, the proposed activity does not represent a change to the facility as described in the FSAR or FPER.

	YES	NO
C. Does the activity represent a test or experiment not described in the FSAR or FPER?	__	X

STP-212.002 is designed to perform surveillance testing of Reactor Building Spray System components utilizing existing plant components, controls, test connections, process instruments and the installed testing capabilities of the Engineered Safety Features Actuation System. This testing is performed as required by FSAR Section 5.7.7, 6.2.2.4.1, 6.2.2.4.1.1 and 7.3.2.2.5.1.

Based on the above statements, the description of the proposed activity, and the review of FSAR Sections 5.7.7, 6.2.2, and 7.3.2, the proposed activity does not represent a test or experiment not described in the FSAR or FPER.

	YES	NO
D. Does the activity represent a change to the Technical Specifications?	__	X

In addition to "C" above STP-212.002 is designed to perform surveillance testing of Reactor Building Spray System components in accordance with Technical Specification Surveillance Requirements 4.0.5, 4.6.2.1.b, 4.3.2.1 Table 4.3-2 Item 2.b, and 4.8.4.2.a. The proposed changes have not altered this requirement.

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PARENT DOCUMENT STP-212.002 REV. 2 CHANGE C

Based on the above statements, the description of the proposed activity, and the review of Technical Specification Surveillance Requirements 4.0.5, 4.6.2.1.b, 4.3.2.1 Table 4.3-2 Item 2.b, and 4.8.4.2.a, and Technical Specifications 3.3.2, 3.6.2.1, 3.6.2.2, and 3.8.4.2, the proposed activity does not represent a change to Technical Specifications.

Robert B McGowen 3-8-96
Preparer's Signature Date

David Stone 3-14-96
Independent Reviewer's Signature/Date

[signature] 3/14/96
Approval Signature Date

10 CFR 50.59 SCREENING PROCESS WORKSHEET

PARENT DOCUMENT STP-223.002A REV. 5 CHANGE A

Activity Description:

The proposed activity is Change A to Revision 5 of STP-223.002A. This revision was performed to implement the following:

1. Added Step 9.6.8, reference to RC-96-0032, Response to GL 95-07, Pressure Locking and Thermal Binding of SR Power Operated Valves.

2. Enclosure 10.1 Page 2, corrected line spacing.

3. Attachment VIA, deleted Notes 1 and 2, changed the Test Position for MVG-3109A and B to OPEN and added C_{02} Pcap. This was performed in response to RC-96-0032.

4. Attachment VIB, deleted Notes 1 and 2, changed the Test Position for MVG-3109C and D to OPEN and added C_{02} Pcap. This was performed in response to RC-96-0032.

Prior to this change, the Service Water Booster Pumps were tested with a flow path through either XVG03109A-SW or XVG03109B-SW for the A Pump and through either XVG03109C-SW or XVG03109D-SW for the B Pump. The following is an evaluation of the change in test flowpath and the impact this will have on the Service Water Booster Pumps and associated components during the performance of the required testing.

FSAR Section 9.2.1.2, System Description, states that the reactor building cooling units receive water from the service water booster pumps and the digital rod position indication system cooling unit is isolated from the reactor building cooling units by closing the isolation valves under safety injection, loss of non-Class 1E power, or test conditions. Upon receipt of a safety injection signal, the ESFLS starts the inactive loop at high speed. The service water booster pumps, with the throttling orifices in the discharge piping, maintain system pressure inside the reactor building above peak post accident pressure when service water flow is maintained to two reactor building cooling units.

FSAR Section 9.2.1.3, Safety Evaluation, states that during a postulated LOCA, the two service water booster pumps supplying service water to the reactor building cooling units are started. Throttling orifices in the return lines control back pressure to maintain service water pressure above long term post accident reactor building ambient pressure.

The Service Water System DBD lists the capacity of the Service Water Booster Pumps as a rated capacity of 4,000 gpm.

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PARENT DOCUMENT STP-223.002A REV. 5 CHANGE A

MRF-21022 Post Mod Test Review as documented by TWR Serial 13867, Tab 11, Dated 1-9-89, showed that the operation of the Service Water Booster Pumps with two RBCUs in service resulted in the following flowrates:

	1 RBCU	2 RBCU
XPP0045A	171 psi / 2450 gpm	168 psi / 2670 gpm
XPP0045B	161 psi / 2500 gpm	168 psi / 2750 gpm

Design Calculation DC-433-0428-16, Service Water RBCU Disch. Orifice Size, was performed to determine the required pressure drop for sizing orifice XPS-29, XPS-99 or FE-4468/98 to yield 2000+ gpm thru a single RBCU 70 sec. after diesel start signal and less than 3500 gpm at 85 sec after diesel start signal, all valves fully stroked at 85 sec. This was performed to support MRF-21022. The results of which are shown above.

It is concluded that the performance of Service Water Booster Pump testing with two RBCUs in service will not operate the system outside its asbuilt configuration and maximum flow parameters during testing performed by STP-223.002A as proposed by Change A to Revision 5 of this procedure.

The original intent of this procedure was to perform surveillance testing of Service Water System pumps and valves as required by FSAR Section 5.7.7 and Technical Specifications 4.0.5 and 4.6.2.3.b.2. This intent remains unchanged by the proposed activity.

Screening Questions:

		YES	NO
A.	Does the activity represent a change to the procedures described in the FSAR or FPER?	___	X

FSAR Section 5.7.7 states the requirements to perform the surveillance test activities performed by STP-223.002A. FSAR Section 13.5.8 describes the general content of a Surveillance Test Procedure. However no system or component specific details are presented by these FSAR Sections.

FSAR Section 9.2.1.4 states that normal operation verifies the operability and performance of the Service Water pumps, therefore no periodic testing is necessary. FSAR Section 5.7.7.1 states that Code Class 2 and 3 pumps will be tested in accordance with ASME Section XI. The Service Water Pumps will be tested by STP-223.002A to satisfy the requirements of FSAR Section 5.7.7.

Based on the above statements, the description of the proposed activity, and the review of FSAR Sections 5.7.7, 9.2.1 and 13.5, the proposed activity does not represent a change to procedures as described in the FSAR or FPER.

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PARENT DOCUMENT STP-223.002A REV. 5 CHANGE A

	YES	NO
B. Does the activity represent a change to the facility as described in the FSAR or FPER?	___	X

STP-223.002A is designed to perform surveillance testing of Service Water System components utilizing existing plant components, controls, test connections and process instruments. This testing is performed as required by FSAR Sections 5.7.7. The changes made to this procedure by Revision 5 do not alter this intent.

Based on the above statements, the description of the proposed activity, and the review of FSAR Sections 5.7.7 and 9.2.1, the proposed activity does not represent a change to the facility as described in the FSAR or FPER.

	YES	NO
C. Does the activity represent a test or experiment not described in the FSAR or FPER?	___	X

STP-223.002A is designed to perform surveillance testing of Service Water System components utilizing existing plant components, controls, test connections and process instruments. This testing is performed as required by FSAR Sections 5.7.7. The changes made to this procedure by Revision 5 do not alter this intent.

Based on the above statements, the description of the proposed activity, and the review of FSAR Sections 5.7.7 and 9.2.1, the proposed activity does not represent a test or experiment not described in the FSAR or FPER.

	YES	NO
D. Does the activity represent a change to the Technical Specifications?	___	X

In addition to "C" above STP-223.002A is designed to perform surveillance testing of Service Water System components in accordance with Technical Specification Surveillance Requirements 4.0.5 and 4.6.2.3.b.2.

Based on the above statements, the description of the proposed activity, and the review of Technical Specification Surveillance Requirements 4.0.5, and 4.6.2.3.b.2 and Technical Specifications 3.5.2, 3.5.3, 3.6.2.3, 3.7.1.3, 3.7.3, 3.7.4, 3.9.7.1, and 3.9.7.2, the proposed activity does not represent a change to Technical Specifications.

Robert B. McGowen 3-7-96
Preparer's Signature Date

Vince Bawdy 3-8-96
Independent Reviewer's Signature/Date

3/11/96
Approval Signature Date