



TELEDYNE INSTRUMENTS

Test Services

A Teledyne Technologies Company

MOV Software

MIDAS Fundamentals

QUIKLOOK Users' Group
2010 Annual Meeting

August 18-19, 2010

Tabor Academy

Marion, MA



Integrated

Design Calculation Software MIDAS

Test Analysis Software MIDATEST

Midas Calculations for All Plants ALL VALVES GL 96-05

File Edits Tables References Tools Help

JOG-PV-11 GATE SB-3-150
 JOG Complete

Valve	Operator	Motor	System	Output
Parameter	Ess	Value	Reference	
Valve Type	Y	GATE	3	
Gate Valve Disc Type	Y	Split Wedge	3	
Valve Vendor	Y	POWELL	3	
Valve Size	Y	20	3	
Valve Seat Diameter	Y	18.2	8	
Gate Valve Wedge Half-Angle	Y	5	1	
Calculation Method (close)		VF	10	
Calculation Method (open)		VF	10	
EPRI PPM Thrust (close)		0	10	
EPRI PPM Thrust (open)		0	10	
Valve Factor (close)	Y	0.67	32	
Valve Factor (open)	Y	0.67	32	
Non-Safety Related Valve Factor	Y	0	10	
HELB Related Valve Factor	Y	0	8	
Gate Valve Condition Load	Y	0	N/A	
Stuffing Box Load (close)	Y	11000	1	
Stuffing Box Load (open)	Y	11000	1	

N/A

Rev 1 Rich Enos 12/21/06 20:22 NOT APPROVED 12/21/06 20:22

MIDAS Maintenance for All Plants ALL VALVES GL 96-05

File Tables Tools Help

JOG-PV-11 GATE SB-3-150

Design Rev: 1 Verified by: NOT APPROVED on 12/21/06 20:22

FUNCTION	OPEN	Last Edit	SIGNOFF	Last Signoff	PRINT
Sensitivity Calculations		10/29/03 09:10	SIGNOFF NOT REQUIRED		
Control Circuit Changes		10/29/03 09:10		11/11/03 15:24	
Pre-Test Information		01/08/07 14:52		N/A	
Limit Switch Settings		10/29/03 09:10		N/A	
Data Review		01/01/00 00:00		N/A	
Trending		01/01/00 00:00		N/A	

Add New Work Order

Work Order	Schedule	Status	Test Date	Test of Record
R0700222	1997	Complete	4/17/97	YES



MOV Software Summary

- Calculate and store required thrust using standard valve factor methodologies
- Calculate and store required torque using EPRI Butterfly methodologies
- Calculate and store actuator capability at degraded voltage for both AC and DC motors using industry standard methodologies
- Generate valve setup window
- Import and store field test data
- Compare field test data to setup window
- Trend field test data
- Calculate and store margins
- Predict test frequency



TELEDYNE INSTRUMENTS

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MOV Software History

<u>YEAR</u>	<u>Company Name</u>	<u>Software Name</u>
1997	Pilgrim	TTCALC
1998	Millstone	SMARTBOOK
2000	PECO	MIDAS
2001	Entergy RiverBend	RBSMOV
2002	PPL	PPLMOV
2002	FENOC	FEMOV
2003	Entergy Fitzpatrick	JAFMOV
2004	Exelon	MIDAS
2004	Seabrook	FPLMOV
2005	Entergy North	ENNMOV
2005	Entergy South	ENSMOV



MOV Software History

<u>YEAR</u>	<u>Company Name</u>	<u>Software Name</u>
2006	NMC	NMCMOV
2006	PGN	MIDAS-PGN
2007	PSE&G	MIDAS
2007	Dominion	MIDAS-DOM
2007	Southern Company	MIDAS-SNC
2008	APS	MIDAS-APS
2010	Luminant	MIDAS-CP



MOV Software History

The 10 leading US utilities operating nuclear plants in 2006

<u>Company Name</u>	<u>Installed Capacity (MWe)</u>	<u>Number of Reactors</u>	<u>MIDAS</u>
Exelon	17,709	17	YES
Entergy	10,189	11	YES
Duke Energy	6,996	7	NO
TVA	6,695	6	NO
Dominion	6,025	7	YES
FPL	5,915	8	YES
Southern Company	5,771	6	YES
Progress Energy	4,323	5	YES
Constellation	4,074	5	NO
FENOC	3,888	4	YES

(Reference: AREVA in the United States, Dec 2007)



Design Calculation Software

- **Inputs (Valve, Operator, Motor, System)**
- **Calculated Outputs**
- **Input References**
- **Special Methodologies**
- **Tools**
- **Margins**
- **Reports**
- **Documentation**



Valve

Midas Calculations for All Plants ALL VALVES

File Edits Tables References Tools Help

FunctionGT **GATE** SMB-0-25 **NEW TEST**

JOG Incomplete

Valve Operator Motor System Output

Parameter	Ess	Value	Reference
Valve Type	Y	GATE	3
Gate Valve Disc Type	Y	Flexible Wedge	3
Valve Vendor	Y	WALWORTH	3
Valve Size	Y	6	3
Valve Seat Diameter	Y	5.688	8
Gate Valve Wedge Half-Angle	Y	5	1
Calculation Method (close)		VF	10
Calculation Method (open)		VF	10
EPRI PPM Thrust (close)		0	10
EPRI PPM Thrust (open)		0	10
Valve Factor (close)	Y	0.6	32
Valve Factor (open)	Y	0.6	32
Non-Safety Related Valve Factor	Y	0.6	10
HELB Related Valve Factor	Y	0.6	8
Gate Valve Condition Load	Y	1000	N/A
Stuffing Box Load (close)	Y	1250	1
Stuffing Box Load (open)	Y	1250	1

N/A

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Operator

Midas Calculations for All Plants ALL VALVES

File Edits Tables References Tools Help

FunctionGT **GATE** SMB-0-25 **NEW TEST**

JOG Incomplete

Valve **Operator** Motor System Output

Parameter	Ess	Value	Reference
Actuator Manufacturer	Y	LIMITORQUE	3
Actuator Model/Type	Y	SMB	3
Actuator Size	Y	0	3
Actuator Overall Gear Ratio	Y	69.56	35
Actuator Worm Gear Set	Y	37:1	1
Spring Pack	Y	0501-184	35
Spring Pack Curve Source	Y	GENERIC	N/A
Actuator Close Control Scheme	Y	TORQUE	10
Close TQ Switch Active Flag		N/A	10
Extended Close TQ Switch Bypass Flag		N/A	10
Extended Actuator Thrust Multiplier	Y	1.62	1
Extended Actuator Torque Multiplier	Y	1.1	1
Limiterque Application Factor	Y	0.9	1
ComED Efficiency Factor	Y	0.95	1
Actuator Order Number		224977-1	380
Actuator Serial Number		L474829	380
Actuator Installation Date		N/A	380

N/A

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Limiterorque Actuator Tables

Actuator Lookup for BWROG-01

Actuator Size: SMB | 1 | RPM: 1900

DAR	Worm Gear	PE	SE	RE	TH Rating	TQ Rating	Locking
72.42	34:1	0.4	0.5	0.5	45000	850	True
77.25	34:1	0.4	0.5	0.5	45000	850	True
82.55	34:1	0.4	0.5	0.5	45000	850	True
88.4	34:1	0.4	0.5	0.5	45000	850	True
92.4	66:1	0.315	0.45	0.45	45000	850	True
97.81	66:1	0.315	0.45	0.45	45000	850	True
103.7	66:1	0.315	0.45	0.45	45000	850	True
109.9	66:1	0.315	0.45	0.45	45000	850	True

72.42 34:1

Current Selection

OK Cancel



Motor*

Current Loss
Torque Loss
(LTU 93-03)

Rotor Material

Midas Calculations for All Plants ALL VALVES

File Edits Tables References Tools Help

FunctionGT **GATE** SMB-0-25 **NEW TEST**

JOG Incomplete

Valve Operator **Motor** System Output

Parameter	Ess	Value	Reference
Motor Methodology	Y	COMED	36
Motor Voltage Type	Y	AC	N/A
Motor Start Torque	Y	25	3
Motor Stall Torque	Y	27.6	3
Motor Frame Size	Y	56	3
Motor Rated Speed	Y	1700	7
Motor Rated Voltage	Y	460	7
Motor Stall Voltage	Y	460	7
Motor Torque Derate	Y	0.232	1
Motor Current Loss	Y	0.231	1
Motor Lock Rotor Amps	Y	25.3	33
Motor Full Load Amps		4	33
Motor Horsepower		1.6	33
Motor Curve		M1480	3
Motor Manufacturer		RELIANCE	3
Motor Rotor Material	Y	N/A	1
Use Degraded Voltage for NSR direction?	Y	No	1

N/A

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Motor Lookup Panel

Motor Curve Lookup for FunctionGT

Degraded Voltage is CALCULATED from MCC

AC/DC
 AC
 DC

Voltage
460

Torque	Manufacturer	Curve	Origin	Frame	FLA	LRA	LRT	HP	MCL
5	RELIANCE	M2734	COMED	48	1	5.25	5.78	0.33	0.29
5	RELIANCE	M1658	COMED	56	0.83	5	6.25	0.33	0.218
7.5	RELIANCE	M2925	COMED	56	2.3	11.9	11.46	0.7	0.224
10	RELIANCE	M1468	COMED	56	2.3	11.9	11.46	0.7	0.269
15	RELIANCE	M1476	COMED	56	2.8	16	18.95	1	0.237
25	RELIANCE	M1480	COMED	56	4	25.3	27.6	1.6	0.231
40	RELIANCE	M1488	COMED	56	5.9	38	51.25	2.6	0.211

AC Method
 Limitorque
 ComED

RPM
1700

25 RELIANCE M1480
Current Selection

OK Cancel



System

Midas Calculations for All Plants ALL VALVES

File Edits Tables References Tools Help

FunctionGT | GATE | SMB-0-25 | **NEW TEST**

JOG Incomplete

Valve	Operator	Motor	System	Output
Parameter	Ess		Value	Reference
Service Description	Y		CLEANUP LOOP ISOL VAL	5
Safety Function	Y		BOTH	N/A
Maximum D-P (close)	Y		1077	212
Maximum D-P (open)	Y		100	212
Maximum NSR D-P	Y		500	8
Maximum HELB D-P	Y		1077	8
Maximum Line Pressure (close)	Y		1066	212
Maximum Line Pressure (open)	Y		200	212
Maximum HELB Line Pressure	Y		1066	8
Thrust Measurement Error (%Rdg) (close)	Y		0.09	1
Thrust Measurement Error (%Rdg) (open)	Y		0.09	1
Thrust Measurement Error (lbs)	Y		500	1
Torque Measurement Error (%Rdg) (close)	Y		0.1	1
Torque Measurement Error (%Rdg) (open)	Y		0.1	1
Torque Measurement Error (ft-lbs)	Y		11	1
Torque Switch Repeatability	Y		0.05	1
Torque Switch Setting Error	Y		0.02	8

N/A

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Outputs

Midas Calculations for All Plants ALL VALVES

File Edits Tables References Tools Help

FunctionBT GATE SMB-0-25 **NEW TEST**

JOG Incomplete

Valve	Operator	Motor	System	Output
All Parameters				<input checked="" type="checkbox"/> Show All
	Ess	Value	Preference	
Orifice Area		25.41	Hide	
Stem Area		1.23	Hide	
Self-Locking Stem COF		0.14	Hide	
Design Stem Revolutions / Stroke	Y	12	Hide	
Design Stem Revolutions / Year	Y	12	Hide	
Design Stem Speed (in/min)	Y	12.2	Hide	
Nominal Stroke Time (close)	Y	29.51	Hide	
Nominal Stroke Time (open)	Y	29.51	Hide	
Minimum Design Stem Root Diameter		0.947	Hide	
Minimum Stem Diameter for Buckling		0.633	Hide	
Design Stem Dia / Buckling Stem Dia		1.496	Hide	
Maximum Stem Thread Plateau Time (sec)	Y	0.257	Hide	
Limiterque Allowable Backlash Time (sec)	Y	0.154	Hide	
Design Stem Factor (close)	Y	0.01421	Hide	
Design Stem Factor (open)	Y	0.01421	Hide	
Design Stem Factor [Assisting] (close)	Y	0.00062	Hide	
Design Stem Factor [Assisting] (open)	Y	0.00062	Hide	

CECO PER NCR PB 98-01514

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References

The screenshot shows the 'All References' application window. It contains a table with the following data:

Index	Plant	Category	Document #	Rev #	Date	Title
1	ALL	N/A	ER-AA-302-1006			Generic Letter 96-05 Motor-Operated Valve Maintenance and Testing Guidelines
2	ALL	N/A				Reference (SDOC)
3	ALL	N/A				CRL)
4	ALL	N/A				TES Manual
5	ALL	N/A				
6	ALL	N/A				
7	ALL	N/A				
8	ALL	N/A				Simulation Software
9	ALL	N/A				Torque Methodology
10	ALL	N/A				
11	ALL	N/A				ion Report
12	ALL	N/A				Stem Motor Operated Valve
13	ALL	N/A	ER-AA-302-1001			Thrust and Torque and Set-Up Window Determination Methodology
14	ALL	N/A	ER-AA-302-1002			Exelon T&RM for Quarter Turn Butterfly Valve Sizing and Set-up Window Determination

An 'Edit Reference # 1' dialog box is open over the first row of the table. The dialog contains the following fields:

- Plant: ALL (dropdown menu)
- Category: N/A (dropdown menu)
- Document #: ER-AA-302-1006 (text box)
- Rev #: (empty text box)
- Date: (empty text box)
- Title: Generic Letter 96-05 Motor-Operated Valve Maintenance and Testing Guidelines (text area)

The dialog has 'OK' and 'Cancel' buttons at the bottom. The main window has 'Find', 'Sort', and 'Exit' menu options at the top left, and 'Edit' and 'Add' buttons at the bottom left and right respectively.



Special Methodologies

- **BWROG DC Motor Torque and Stroke Time Methodology (MPR-2093)**
- **EPRI Butterfly Required Torque Methodology (EPRI TR-106563-V2, TR-103224, TR-1013463)**
- **EPRI Gate Valve Unwedging Methodology (EPRI TR-103237)**
- **JOG Valve Factor Methodology (MPR-2524, Rev A)**
- **Pressure Locking Methodology (WOG-PRESLOK)**
- **ComED AC Motor Torque Methodology (White Paper WP-125)**
- **ComED AC Motor Voltage Drop Methodology (NED-M-MSD-135 and 136)**
- **Limatorque AC Motor Torque Methodology**
- **AC Motor Voltage Drop using Voltage Divider Methodology**



BWROG DC Methodology Table

BWROG DC Methodology for BWROG-01 [Print] [Exit]

General Information | Valve Information | Detailed Results

<u>Parameters</u>		<u>CLOSE</u>	<u>OPEN</u>
System	Valve Type	GATE	
	Gate Valve Disc Type	Flexible Wedge	
	Load Profile Method	Use Default	
	Flow Type	Blowdown	Blowdown
General	Blowdown Fluid	Steam	Steam
	Use FAC for position controlled strokes?	<input type="radio"/> Yes <input checked="" type="radio"/> No	

<u>Calculated Values</u>	<u>CLOSE SAFETY</u>	<u>OPEN SAFETY</u>
Degraded Voltage at Motor (VDC)	258.9	258.8
Instantaneous Actuator Torque (ft-lbs)	1741.1	1764.1
FAC: Functional Actuator Capability (ft-lbs)	1341.2	1373.3
Predicted Stroke Time (sec)	39.11	35.27



BWROG DC Methodology Report

BWROG/DC METHODOLOGY RESULTS
 METHODOLOGY VERIFICATION PROBLEMS, Unit 1
 AC/DC MOTOR OPERATED VALVE TYPE
 PEERLESS 60 ft-lbs., Curve = K11114

BWROG-01 V&V - Rev. 2
 BWROG-01

General Information

Valve Type
 Gate Valve Dia Type
 Load profile method
 Flow type
 Field blowdown only

	Close	Open
GATE	GATE	GATE
Flexible Wedge	Flexible Wedge	Flexible Wedge
Use Default	Use Default	Use Default
Blowdown	Blowdown	Blowdown
Steam	Steam	Steam

Valve and Actuator Information

Stem diameter at stem exit, D_{stem} (inches)
 Stem diameter at packing, D_{stem} (inches)
 Valve mean seat diameter, D_{msd} (inches)
 Valve seat ring inner diameter, D_{sri} (inches)
 Gate Valve seat ring inner surface Dia, D_{msd-12} (inches)
 Gate Valve isolation-to-wedging travel, X_{pct} percent
 Packing load, F_{pack} (lbs)
 Required thrust (including water inertia), F_{req} (lbs)
 Required thrust due to water inertia, F_{wi} (lbs)
 Actuator overall ratio, OAR
 Motor gear set ratio, MGSR
 Actuator rated torque, T_{rated}
 Stem factor, SF (ft-lbs/lb)
 Overhauling stem factor, SF_O (ft-lbs/lb)
 Voltage at MCC, V_{MCC} (volts)
 Cable resistance, R_{cable} (ohms)
 Thermal overload resistance, R_{th} (ohms)
 Nominal voltage, V_{nom} (volts)
 Motor Type: PEERLESS, Curve = K11114
 Valve stem lead, lead (inches)
 Pilot efficiency, O_p
 Full efficiency, O_f
 Nominal motor speed (rpm), a_{nom}

2.125	2.125
2.125	2.125
8.75	8.75
0	0
8.75	8.75
0.1	0.1
4434	4434
227.49	15916
1000	0
72.42	72.42
0.47	0.47
850	850
0.02	0.02
0.00641	0.00641
268	268
0.093	0.093
0.0182	0.0182
250	250
60 ft-lb, 250 VDC	60 ft-lb, 250 VDC
0.5	0.5
0.4	0.4
0.5	0.5
1900	1900

Design Basis Conditions

Differential pressure, DP (psf)
 Valve pressure at full open, P_v (psig)
 Flow rate, Q_{max} (gpm)
 Fluid density, γ (lb/ft³)
 Ambient temperature (°C)
 Length of upstream piping, L_u (pipe diameters)
 Additional Stroke Time (Seconds)
 Partial Stroke Percentage

0	0
927	927
0	0
0	0
32	32
10000	10000
0	0
1	1

Calculated Values

Instantaneous Actuator Torque (ft-lbs)
 Functional Actuator Capability (ft-lbs)

1741.1	1764.1
1341.2	1373.3

Predicted Stroke Time (Seconds):

39.11	35.27
-------	-------



EPRI Butterfly Methodology Table*

EPRI Butterfly Methodology for EPRI-BF-08

Print Exit

General Information		DP Information	Detailed Results
Valve	System	Coefficients	
Parameter	Value	Reference	
Piping System Media	Steam	N/A	
Media / Fluid Density (lbs/ft ³)	0.075	N/A	
Downstream Fluid Level (closed)	N/A	N/A	
Upstream Length to Elbow (dia's)	5.0	N/A	
Stem In-Plane with Upstream Elbow	<input type="radio"/> Yes <input checked="" type="radio"/> No	N/A	
Valve Closing is Flow Assisted	<input type="radio"/> Yes <input checked="" type="radio"/> No	N/A	
Ignore Choked Flow	<input type="radio"/> Yes <input checked="" type="radio"/> No	N/A	
Ignore (-) Hydrodynamic Torque	<input checked="" type="radio"/> Yes <input type="radio"/> No	N/A	
Hydrodynamic Torque Factor for compressible flow	1.20	N/A	
Calculated Values		@VALVE	@ACTUATOR
Total Unseating Torque		4104.5	228.03
Total Seating Torque		4112	228.44
Total Dynamic Opening Torque		1214.9	67.49
Total Dynamic Closing Torque		16829.2	934.96
Required Opening Torque		4104.5	228.03
Required Closing Torque		16829.2	934.96



EPRI Butterfly Methodology Report

EPRI BUTTERFLY METHODOLOGY RESULTS
 METHODOLOGY VERIFICATION PROBLEMS, Unit 1

EPRI-BF-01 V&V - Rev. 1
 EPRI-BF-01

General Information

Valve Information

	<u>Input Value</u>	<u>Reference</u>
Valve Disc Configuration	Symmetric	[N/A]
Valve Disc Shaft Location	Centered	[N/A]
Valve Disc Aspect Ratio (th/dia)	0.22	[N/A]
Valve Seat Diameter (di)	30	[N/A]
Valve Stem Orientation	VERTICAL	[N/A]
Valve Stem Diameter (di)	3.48	[N/A]
Packing Torque (C) (ft-lbs)	350	[N/A]
Packing Torque (O) (ft-lbs)	350	[N/A]

System Information

Piping System Media	Water	[N/A]
Media / Fluid Density (lbs/ft ³)	62.43	[N/A]
Downstream Fluid Level (closed)	Empty	[N/A]
Upstream Length to Elbow (dia/s)	5	[N/A]
Stem In-Plane with Upstream Elbow	NO	[N/A]
Valve Closing is Flow Assisted	YES	[N/A]
Ignore Clogged Flow	NO	[N/A]
Ignore (C) Hydrodynamic Torque	NO	[N/A]

Coefficient Information

Bearing Coefficient of Friction	0.12	[N/A]
Hub Torque Coefficient (ft-lbs/in)	12	[N/A]
Pressure Independent Seat TO Coef. (in-lbs/in ²)	12	[N/A]
Pressure Dependent Seat TO Coef. (in-lbs/in ⁴)	0	[N/A]
Exclude DSE from Requirements based on Diagnostic Test @ DP (Limit Control Only)	NO	[N/A]
Exclude Seating Torque from Requirements (Close Only)	NO	[N/A]

Calculated Values

	<u>@ VALVE</u>	<u>@ ACTUATOR</u>
Total Unseating Torque, ft-lbs	2430.7	135.04
Total Seating Torque, ft-lbs	2430.7	135.04
Total Dynamic Unseating Torque, ft-lbs	2853.6	158.53
Total Dynamic Seating Torque, ft-lbs	-75.8	-4.21
Required Opening Torque, ft-lbs	2853.6	158.53
Required Closing Torque, ft-lbs	2430.7	135.04



JOG Valve Factor Methodology Report

JOG MOV EVALUATION REPORT
 METHODOLOGY VERIFICATION PROBLEMS, Unit 1
 AC MOTOR OPERATED GATE VALVE

JOG-PV-01 V&V - Rev. 2
 JOG-PV-01

JOG Results/Evaluation

	<u>Close</u>	<u>Common</u>	<u>Open</u>
Thrust Calculation Method	<u>EPRI</u>		<u>EPRI</u>
Valve Factor (Design Input)	<u>0.75</u>		<u>0.67</u>
Valve Factor (Effective)	<u>0.746</u>		<u>0.693</u>
Valve Factor based on COF Threshold	<u>0.75</u>		<u>0.66</u>
Valve Factor Effective + Allowance	<u>0.77</u>		<u>0.7</u>
Valve Factor Capability	<u>1.903</u>		<u>0</u>
COF based on Effective Valve Factor	<u>0.7</u>		<u>0.73</u>
COF based on Effective VF + Allowance	<u>0.72</u>		<u>0.74</u>
COF based on Valve Factor Capability	<u>1.626</u>		<u>0</u>
COF Threshold		<u>0.7</u>	
JOG CAI Rating		<u>0</u>	
JOG Class		<u>A</u>	
Valve Family		N/A	
PVT Margin (%)		<u>93.7</u>	
Risk Ranking		<u>L</u>	
Max PVT Interval (years)		<u>10</u>	

Implementation / Evaluation Details

N/A



AC Voltage Drop Methodology Table

AC Voltage Drop Calculation for COMED-03

Print Exit

Voltage Drop Methodology **STD**

RELIANCE 25 ft-lbs , 1700 RPM , 460V, (M1480)

Cable Terms

Calculate Cable Resistance Cable Reactance TOL Resistance
 Input 0.361 0.018 0.20425

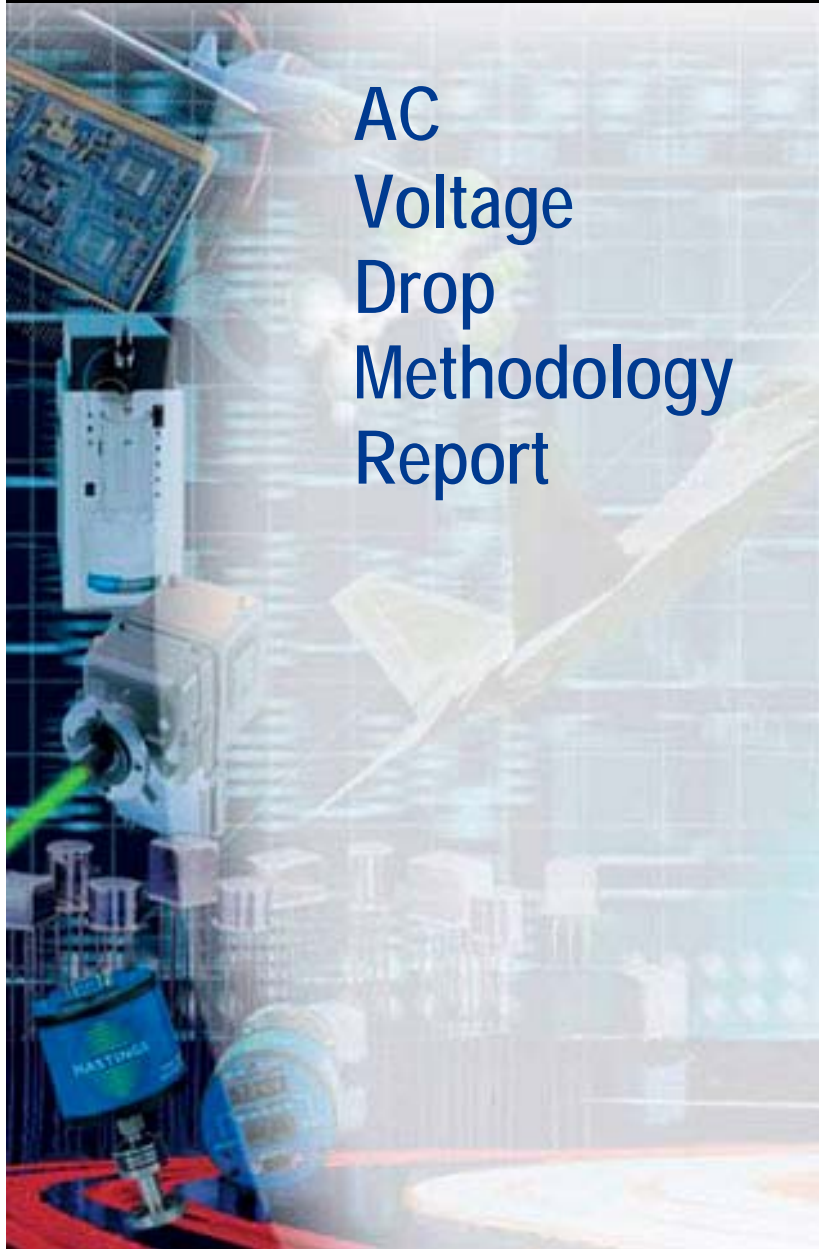
Voltage Divider Terminology (STD)

Power Factor Locked Rotor Amps Current Loss
 0.830 25.10 0.231000

	CLOSE SAFETY	OPEN NON-SAFETY	
Ambient Temperature	76.0	76.0	(°C)
Temperature Rise	0.0	0.0	(°C)
Voltage at MCC	427.2	427.2	(Volts)
Motor Impedance	11.181	11.181	(ohms)
Motor Resistance	9.496	9.496	(ohms)
Motor Reactance	5.902	5.902	(ohms)
Total Reactance	5.92	5.92	(ohms)
Total Resistance	10.061	10.061	(ohms)
Voltage at Motor	409.2	409.2	(Volts)
Voltage Ratio	0.8896	0.8896	



AC Voltage Drop Methodology Report



AC VOLTAGE DROP CALCULATION
 COMED-03 (V&V-1)
 AC MOTOR OPERATED GL96-05 GATE VALVE
 RELIANCE 25 HP, 1700 RPM, C100 - M1480

COMED-03 V&V - Rev. 1

Cable Resistance (Cable #1: 10a AWG) (Cable #2: N/A AWG) (Cable #3: N/A AWG)

$$R_{cable} = (Cable R1 / 1000) * (Cable L1) * (234.5 + Cable T1) / (234.5 + Cable T1 Ref) + (Cable R2 / 1000) * (Cable L2) * (234.5 + Cable T2) / (234.5 + Cable T2 Ref) + (Cable R3 / 1000) * (Cable L3) * (234.5 + Cable T3) / (234.5 + Cable T3 Ref)$$

$$= (1.29 / 1000) * (280) * (234.5 + 75) / (234.5 + 75) + (0 / 1000) * (0) * (234.5 + 0) / (234.5 + 0) + (0 / 1000) * (0) * (234.5 + 0) / (234.5 + 0) = 0.361 \text{ ohms}$$

Cable Reactance

$$X_{cable} = (Cable X1 / 1000) * (Cable L1) + (Cable X2 / 1000) * (Cable L2) + (Cable X3 / 1000) * (Cable L3)$$

$$= (0.063 / 1000) * (280) + (0 / 1000) * (0) + (0 / 1000) * (0) = 0.018 \text{ ohms}$$

Thermal Overload Heater Resistance (TOL: H1066 H1)

$$R_{tol} = Heater Resistance * Heater Const = 0.20425 * 1 = 0.20425 \text{ ohms}$$

Motor Impedance

Open: $Z_{motor,o} = (V_{rated}) / [S^{1/2} * (LRA) * (1 - (MCL * (Mx AmbTb + MTIse - 40) / 155))]$
 $= (460) / [S^{1/2} * 25.1 * (1 - (0.231 * (76 + 0 - 40) / 155))] = 11.181 \text{ ohms}$

Close: $Z_{motor,c} = (V_{rated}) / [S^{1/2} * (LRA) * (1 - (MCL * (Mx AmbTb + MTIse - 40) / 155))]$
 $= (460) / [S^{1/2} * 25.1 * (1 - (0.231 * (76 + 0 - 40) / 155))] = 11.181 \text{ ohms}$

Motor Reactance

$$X_{motor} = (V_{rated} * \sin(\arccos(PF))) / [S^{1/2} * (LRA)]$$

$$= (460 * \sin(\arccos(0.83))) / [S^{1/2} * (25.1)] = 5.902 \text{ ohms}$$

Motor Resistance

Open: $R_{motor,o} = [(Z_{motor,o})^2 - (X_{motor})^2]^{1/2}$
 $= [(11.181)^2 - (5.902)^2]^{1/2} = 9.496 \text{ ohms}$

Close: $R_{motor,c} = [(Z_{motor,c})^2 - (X_{motor})^2]^{1/2}$
 $= [(11.181)^2 - (5.902)^2]^{1/2} = 9.496 \text{ ohms}$

Motor Terminal Voltage

Open: $V_{mto} = (Z_{motor,o} * V_{mcc,o}) / [(R_{motor,o} + R_{cable} + R_{tol})^2 + (X_{motor} + X_{cable})^2]^{1/2}$
 $= (11.181 * 427.2) / [(9.496 + 0.361 + 0.20425)^2 + (5.902 + 0.018)^2]^{1/2}$
 $= 409.2 \text{ Vac}$

Close: $V_{mtc} = (Z_{motor,c} * V_{mcc,c}) / [(R_{motor,c} + R_{cable} + R_{tol})^2 + (X_{motor} + X_{cable})^2]^{1/2}$
 $= (11.181 * 427.2) / [(9.496 + 0.361 + 0.20425)^2 + (5.902 + 0.018)^2]^{1/2}$
 $= 409.2 \text{ Vac}$

Motor Terminal Voltage Ratio

Open: $V_{mtr,o} = (V_{mto} / V_{rated}) = (409.2 / 460) = 0.8896$

Close: $V_{mtr,c} = (V_{mtc} / V_{rated}) = (409.2 / 460) = 0.8896$



- Global Parameter Evaluator – provides the capability to change one input parameter and review the changes to one output parameter for a user defined valve selection
- Export to Excel – provides the capability to export any input or output parameters for a user defined valve selection to an Excel spreadsheet

Global Parameter Evaluator Table

Global Parameter Evaluator for Work in Progress Table [X]

File Table Sort

Input Parameter Valve Factor (close) VF (C)

Output Parameter Margin - PVT Calculation (%) MARGIN

SQL Statement WHERE ([InputData].[MLV_TYPE] Like "gate") AND
 ([InputData].[MLV_VENDOR] Like "Anchor") AND ([InputData].[VF (C)] > 0)
 AND (PLANT>0)

Build SQL

New Input 110.0 Value [%] **Valves Listed = 6**

↓

Valve ID	Old Input	Old Output	New Output	% Difference
JOG-PV-10	0.7	101.3	90.1	-11.1
JOG-PV-09	0.7	101.3	90.1	-11.1
JOG-PV-08	0.67	87.2	87.2	0.00
JOG-PV-03	0.75	80.2	80.2	0.00
JOG-PV-01	0.75	93.7	93.7	0.00
FunctionGT-DD	0.43	61.1	61.1	0.00



Export to Excel Table

Export to Excel for Work in Progress Table

File Tables

Database Fields

Special Outputs Test Data Controls

Valve Actuator Motor System

Valve Vendor
Valve Vendor Drawing Number
Valve Type
Gate Valve Disc Type
Gate Valve Wedge Angle (*)
Gate Valve Seat COF
Globe Valve Sub-Type
Globe Valve Flow Direction
Valve Size (in)
Valve Quality Class
Valve ASME Section III Edition/Class
Valve Pressure Class
Valve Low Potential for Aging
Valve Scrutiny
Valve Location
Valve Seat Diameter (in)
Valve Body Material

0 **Spreadsheet Columns**

Move Up
Add
Remove
Move Down
Reset

SQL Statement

Build SQL Export to Excel



Build SQL Interface

Build SQL Statement for Work in Progress Table

Parameters

Special Outputs Test Data Controls

Valve Actuator Motor System

- Valve Vendor
- Valve Vendor Drawing Number
- Valve Type
- Gate Valve Disc Type
- Gate Valve Wedge Angle (°)
- Gate Valve Seat CDF
- Globe Valve Sub-Type
- Globe Valve Flow Direction
- Valve Size (in)
- Valve Quality Class
- Valve ASME Section III Edition/Class
- Valve Pressure Class
- Valve Low Potential for Aging
- Valve Scrutiny
- Valve Location
- Valve Seat Diameter (in)
- Valve Body Material

Drag Parameters into an available Criteria or
Double-Click on parameter for next available Criteria

Criteria

Clear

Clear

Clear

Clear

Clear

Match all Criteria (AND)
 Match Any Criteria (OR)

Clear All

OK **SSES All Units** Cancel



Margin Calculation Process Summary

- Calculate design margins
- Import field test data
- Calculate setup margins
- Evaluate overall margin based on safety function and close control switch scheme
- Calculate test frequency based on overall margin and valve risk ranking
- User defines actual test frequency



As-Left Test Data Import

As-Left Test Data Import for FunctionGT [X]

Exit

Available As-Left Tests in TEST Database

Test	Work Order	Date	Test Method	Test of Record	Approved
1	C0123456	10/29/03	Quiklook	YES	YES
2	C0099876	10/28/03	N/A	NO	NO

Import **Modified Test of Record Data in Test database**

Parameter	Design	Test 1	Flag
Work Order Of Latest As-left Test	C0123456	C0123456	
Baseline Test Date	0/29/2003 1:20:05 PM	0/29/2003 1:20:05 PM	
Baseline Test Method	Quiklook	Quiklook	
As-Left Torque @ Trip	91	0	X
As-Left Total Torque	137	0	X
As-Left Pullout Torque	85	0	X
As-Left Running Torque (close) (C)	35	0	X
As-Left Running Torque (open) (O)	35	0	X
As-Left Thrust @ Trip	7701	7701	
As-Left Total Thrust	11551	11551	
As-Left Pullout Thrust	7584	7584	
As-Left Running Thrust (close) (C)	82	82	
As-Left Running Thrust (open) (O)	369	369	
Running Load Criteria Selection Basis	Thrust	Thrust	
As-Left Torque Switch Setting (C)	1.75	1.75	
As-Left Torque Switch Setting (O)	1.75	1.75	

Test of Record: C0123456 10/29/03 Quiklook

As-Left Test Margin Analysis Table (WIP)

As-Left Test Margin Analysis for FunctionGT-DD (Work in Progress)

Show Exit

Current PVT

Schedule: **Outage** Risk: **M** Interval: **5.0** (years)

Calculated PVT

Max Interval: **10** (years) JOG Margin: **61.1 %**

PM Frequency: **0.0** (years)
 Stem Lube Frequency: **0.0** (years)
 MCC Test Frequency: **0.0** (years)

Safety Function: BOTH Close Control: TORQUE

Eq.	Parameter	Close	Open
D1	D1: Capability Margin @Design COF (close)	442.4	--
D2	D2: Capability Margin @Design COF (open)	--	661.7
D3	D3: Capability Margin @COF = 0.2 (close)	349.5	--
D4	D4: Capability Margin @COF = 0.2 (open)	--	530.8
D5	D5: Structural Thrust Margin (close)	430.4	--
D6	D6: Structural Torque Margin (close)	705.5	--
D7	D7: Maximum COF to Close (close)	0.87	--
D8	D8: Maximum COF to Open (open)	--	1.45
D9	D9: Pullout Margin (open)	--	625.1
D10	D10: EPRI Gate Valve Max Seating Load (close)	0	--
D11	D11: Acceptable Design Thrust Window (close)	OK	--
D12	D12: Acceptable Design Capability (open)	--	OK
D13	D13: Acceptable Design Torque Window (close)	OK	--
D14	D14: EPRI Gate Valve Seating Margin (close)	-100	--
S1	S1: Thrust @TST Setup Margin (close)	218.4	--
S2	S2: Max Thrust Setup Margin (close)	41.2	--
S3	S3: Torque @TST Setup Margin (close)	23.4	--
S4	S4: Max Torque Setup Margin (close)	59.8	--
S5	S5: MLAT Pullout Torque Margin (open)	--	N/A
S6	S6: Pullout Thrust Margin (open)	--	61.1
S7	S7: Running Load Margin (close)	53.12	--
S8	S8: Running Load Margin (open)	--	14.3
S9	S9: Torque Setup Margin (close)	195	--

What-If Calculator for Test Data

Torque @TST	581	(ft-lbs)
Total Torque	712	(ft-lbs)
Pullout Torque	0	(ft-lbs)
Run Torque (C)	0	(ft-lbs)
Run Torque (O)	0	(ft-lbs)
Thrust @TST	24638	(lbs)
Total Thrust	29868	(lbs)
Pullout Thrust	14663	(lbs)
Run Thrust (C)	1172	(lbs)
Run Thrust (O)	2143	(lbs)
Run Load Basis	Thrust	
TSS (C)	3	
TSS (O)	3	

Parameters	Close	Open
Valve Factor Capability	3.638	3.12
Current As-Left COF	0.16	N/A
MAX Design COF	0.872	1.451
OverThrust COF	0.043	(Threshold)
UnderThrust COF	0.663	(Threshold)
MLAT OverTorque COF	0.235	(Threshold)
Structural OverTorque COF	0.525	(Threshold)
Allowable COF Increase	0.075	
Allowable COF Decrease	0.117	

As-Left Test Margin Analysis Table (AB)*

As-Left Test Margin Analysis for FunctionGT-DD (Work in Progress)

Show Exit

Current PVT			Calculated PVT		PM Frequency	0.0	(years)
Schedule	Risk	Interval	Max Interval	JOG Margin	Stem Lube Frequency	0.0	(years)
Outage	M	5.0	10	61.1 %	MCC Test Frequency	0.0	(years)

As-Left Test Margin Analysis for FunctionGT-DD (As-Built)

Exit

Current PVT			Calculated PVT		PM Frequency	0.0	(years)
Schedule	Risk	Interval	Max Interval	JOG Margin	Stem Lube Frequency	0.0	(years)
Outage	M	5	10	61.1 %	MCC Test Frequency	0.0	(years)

Safety Function: BOTH	Close Control: TORQUE
------------------------------	------------------------------

Eq.	Parameter	Close	Open
D1	D1: Capability Margin @Design COF (close)	442.4	--
D2	D2: Capability Margin @Design COF (open)	--	661.7
D3	D3: Capability Margin @COF = 0.2 (close)	349.5	--
D4	D4: Capability Margin @COF = 0.2 (open)	--	530.8
D5	D5: Structural Thrust Margin (close)	430.4	--
D6	D6: Structural Torque Margin (close)	705.5	--
D7	D7: Maximum COF to Close (close)	0.87	--
D8	D8: Maximum COF to Open (open)	--	1.45
D9	D9: Pullout Margin (open)	--	625.1
D10	D10: EPRI Gate Valve Max Seating Load (close)	0	--
D11	D11: Acceptable Design Thrust Window (close)	OK	--
D12	D12: Acceptable Design Capability (open)	--	OK
D13	D13: Acceptable Design Torque Window (close)	OK	--
D14	D14: EPRI Gate Valve Seating Margin (close)	-100	--
S1	S1: Thrust @TST Setup Margin (close)	218.4	--
S2	S2: Max Thrust Setup Margin (close)	41.2	--
S3	S3: Torque @TST Setup Margin (close)	23.4	--
S4	S4: Max Torque Setup Margin (close)	59.8	--
S5	S5: MLAT Pullout Torque Margin (open)	--	N/A

Torque @TST	581	(ft-lbs)
Total Torque	712	(ft-lbs)
Pullout Torque	0	(ft-lbs)
Run Torque (C)	0	(ft-lbs)
Run Torque (O)	0	(ft-lbs)
Thrust @TST	24638	(lbs)
Total Thrust	29868	(lbs)
Pullout Thrust	14663	(lbs)
Run Thrust (C)	1172	(lbs)
Run Thrust (O)	2143	(lbs)
Run Load Basis	Thrust	
TSS (C)	3	
TSS (O)	3	

Parameters	Close	Open
Valve Factor Capability	3.638	3.12
Current As-Left COF	0.16	N/A
MAX Design COF	0.872	1.451
OverThrust COF	0.043	(Threshold)
UnderThrust COF	0.663	(Threshold)
MLAT OverTorque COF	0.235	(Threshold)

What-If Margin Analysis Table

What-If Margin Analysis for FunctionGT-DD [X]

Exit

Current PVT

Schedule: **Outage**

Risk: **M**

Interval: **5** (years)

Calculated PVT

Max Interval: **10** (years)

Margin: **61.1 %**

Safety Function: BOTH

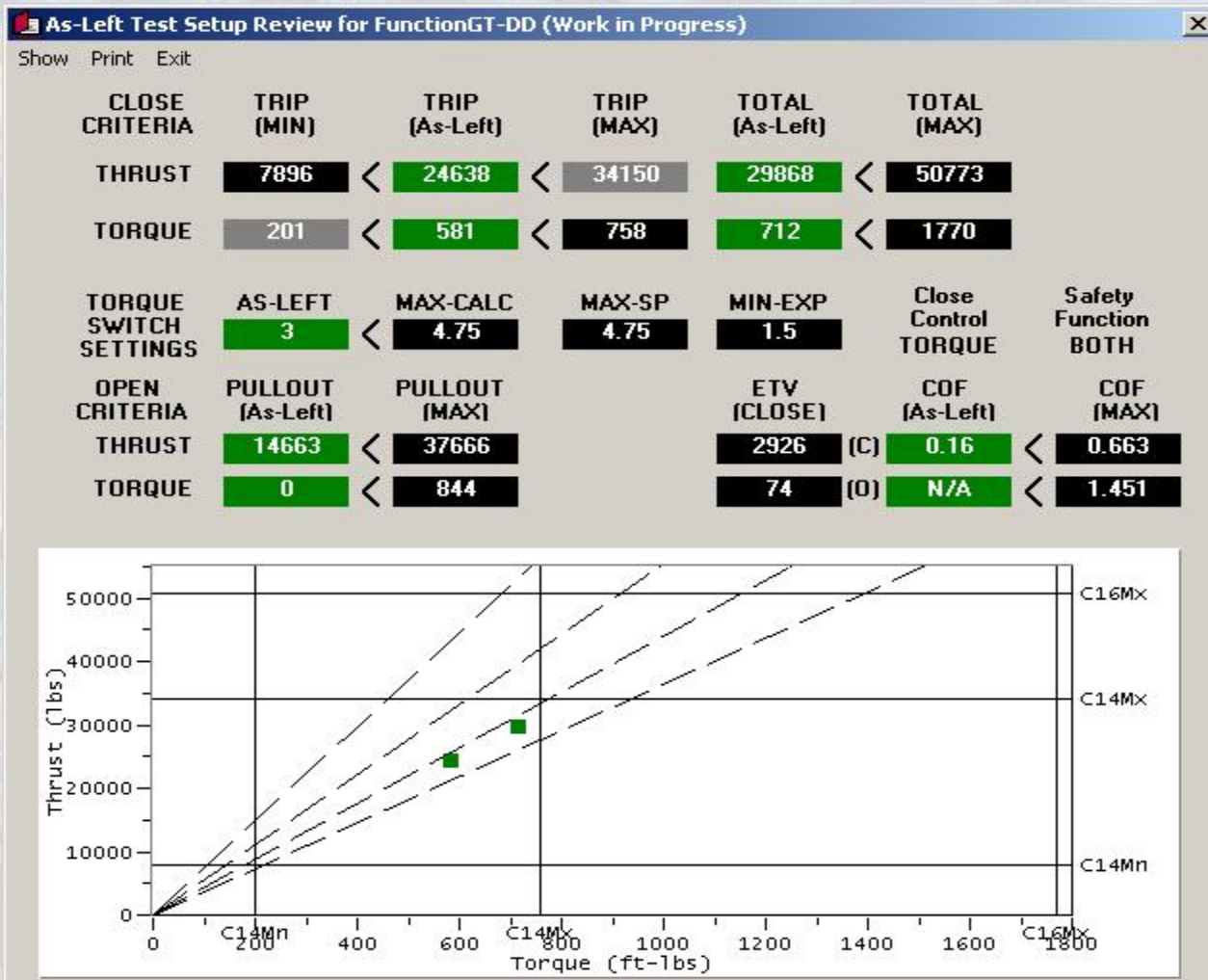
Close Control: TORQUE

Eq.	Parameter	Close	Open
S1	S1: Thrust @TST Setup Margin (close)	218.4	--
S2	S2: Max Thrust Setup Margin (close)	41.2	--
S3	S3: Torque @TST Setup Margin (close)	23.4	--
S4	S4: Max Torque Setup Margin (close)	59.8	--
S5	S5: MLAT Pullout Torque Margin (open)	--	N/A
S6	S6: Pullout Thrust Margin (open)	--	61.1
S7	S7: Running Load Margin (close)	53.12	--
S8	S8: Running Load Margin (open)	--	14.3
S9	S9: Torque Setup Margin (close)	195	--
S10	S10: MLAT Max Thrust Setup Margin (close)	28	--
S21	S21: EPRI Open Unseating Margin	--	N/A

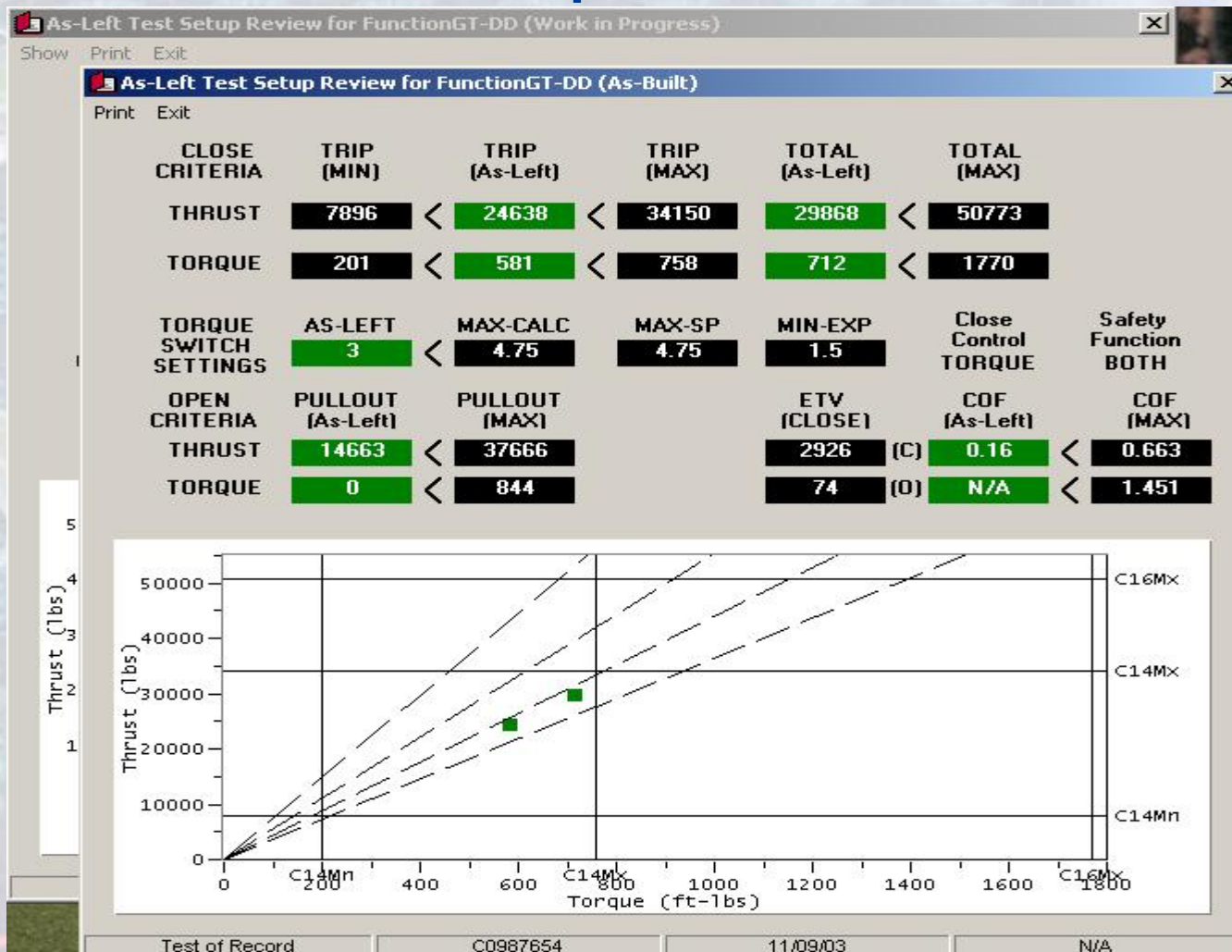
<u>Test Data</u>	New	Original	
Torque @TST	581.0	581	(ft-lbs)
Total Torque	712.0	712	(ft-lbs)
Pullout Torque	0.0	0	(ft-lbs)
Run Torque (C)	0.0	0	(ft-lbs)
Run Torque (O)	0.0	0	(ft-lbs)
Thrust @TST	24638	24638	(lbs)
Total Thrust	29868	29868	(lbs)
Pullout Thrust	14663	14663	(lbs)
Run Thrust (C)	1172.0	1172	(lbs)
Run Thrust (O)	2143.0	2143	(lbs)

<u>Parameters</u>	Close	Open
Valve Factor Capability	3.638	3.12
Current As-Left COF	0.16	N/A
MAX Design COF	0.872	1.451
OverThrust COF	0.043	(Threshold)
UnderThrust COF	0.663	(Threshold)
MLAT OverTorque COF	0.235	(Threshold)
Structural OverTorque COF	0.525	(Threshold)
Allowable COF Increase	0.075	
Allowable COF Decrease	0.117	

As-Left Test Setup Review Table (WIP)



As-Left Test Setup Review Table (AB)*





Reconcile Assumptions Between Design and Test

As-Left Margin Assumptions for MOV-1CH-142

Exit

Current PVT			Calculated PVT	
Schedule	Risk	Interval	Max Interval	Margin
Outage	L	6.00 (years)	10 (years)	49.7 %

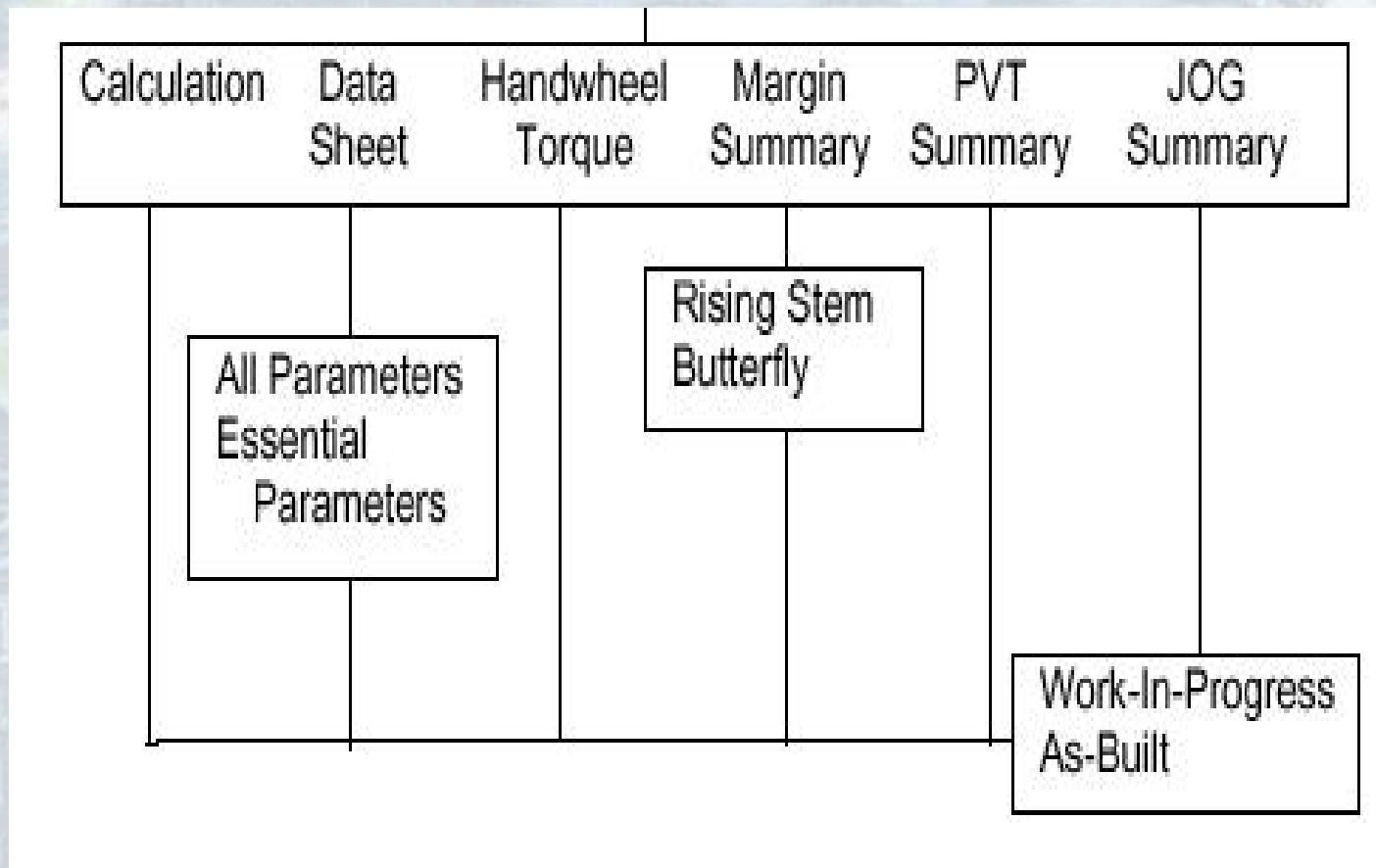
Safety Function: BOTH Close Control: Torque

Thrust		Torque	
Design		Test	
Thrust Measurement Device	N/A	STRAIN GAGE	
Packing Load (C)	1000	1256	(lbs)
Packing Load (O)	1000	1015	(lbs)
Rate of Loading Random	0.1000	0.1	(dec)
Rate of Loading Bias	0.0300	0.03	(dec)
Stem Lube Degradation Random	0.110	0.11	(dec)
Stem Lube Degradation Bias	0.0450	0.045	(dec)
Spring Pack Relaxation Bias	0.0400	0.04	(dec)
Thrust Reading Error (C)	0.1200	@C14 0.12	(dec)
		@C16 0.12	(dec)
Thrust Full Scale Error (C)	133.0	@C14 133	(lbs)
		@C16 133	(lbs)
Thrust Reading Error (O)	0.1000	@09 0.1	(dec)
Thrust Full Scale Error (O)	111.0	@09 111	(lbs)
Torque Correction Factor	0.0000	1.022	
Stem COF (C)	0.2000	0.17	
Stem COF (O)	0.2000	0.146	

Test of Record 03-004684-00 04/11/03 N/A



Report Menu Options





Standard Software V&V Documents

<u>Document ID</u>	<u>Rev</u>	<u>Date</u>	<u>Subject</u>
TTS-CC-127	1	03/05/09	Limitorque
TTS-CC-128	2	11/27/07	BWROG/DC
TTS-CC-129	1	03/14/08	EPRI/BF
TTS-CC-130	2	03/12/08	JOG
TTS-CC-137	2	03/05/09	ComED

TTS Quality Assurance Program meets the requirements of 10CFR50, Appendix B, 10CFR21, ANSI/ASME NQA-1, ANSI N45.2 and ASME BPVC Section III, NCA-4000.



Sample Limitorque Documentation

A1 - 2

TECHNICAL REPORT
 TTS-CC-127, Rev. 0

(Lookup: SMB Efficiencies)
Limitorque Actuator Efficiencies

1	2	3	4	5	6	7	8	9	10	11	12	Col's 1 to 10	Col's 11 & 12
SMB type	Type	RPM	Worm Gear	Min OAR	Max OAR	POE	RE	SE	LOCK-ING	TQ Rating	TH Rating	Efficiency References	Rating References
0	B	1800	15 2/3:1	11.18	17.5	0.55	0.65	0.75	0	500	24000	SEL-12 Pg 6	SEL-12 Pg 8A
0	B	1800	15 2/3:1	18.5	28	0.5	0.65	0.75	0	500	24000	SEL-12 Pg 6	SEL-12 Pg 8A
0	B	1800	37:1	26.42	41.33	0.4	0.55	0.55	-1	500	24000	SEL-12 Pg 6	SEL-12 Pg 8A
0	B	1800	37:1	43.69	96.2	0.35	0.5	0.5	-1	500	24000	SEL-12 Pg 6	SEL-12 Pg 8A
0	B	1800	58:1	102.6	150.8	0.35	0.45	0.45	-1	500	24000	SEL-12 Pg 6	SEL-12 Pg 8A
0	B	1800	95:1	158.3	247	0.3	0.4	0.4	-1	340	24000	SEL-12 Pg 6	SEL-12 Pg 8A
0	B	3600	15 2/3:1	11.18	17.5	0.6	0.7	0.85	0	500	24000	SEL-12 Pg 6	SEL-12 Pg 8A
0	B	3600	15 2/3:1	18.5	28	0.55	0.7	0.8	0	500	24000	SEL-12 Pg 6	SEL-12 Pg 8A
0	B	3600	37:1	26.42	41.33	0.4	0.55	0.6	-1	500	24000	SEL-12 Pg 6	SEL-12 Pg 8A
0	B	3600	37:1	43.69	96.2	0.4	0.5	0.55	-1	500	24000	SEL-12 Pg 6	SEL-12 Pg 8A
0	B	3600	58:1	102.6	150.8	0.35	0.5	0.5	-1	500	24000	SEL-12 Pg 6	SEL-12 Pg 8A
0	B	3600	95:1	158.3	247	0.3	0.45	0.45	-1	340	24000	SEL-12 Pg 6	SEL-12 Pg 8A
0	GG	1800	15 2/3:1	11.18	17.5	0.65	0.65	0.85	0	500	24000	SEL-7	SEL-9
0	GG	1800	15 2/3:1	18.5	28	0.6	0.65	0.8	0	500	24000	SEL-7	SEL-9
0	GG	1800	37:1	26.42	41.33	0.4	0.55	0.55	-1	500	24000	SEL-7	SEL-9
0	GG	1800	37:1	43.69	96.2	0.4	0.5	0.5	-1	500	24000	SEL-7	SEL-9
0	GG	1800	58:1	102.6	150.8	0.35	0.45	0.45	-1	500	24000	SEL-7	SEL-9
0	GG	1800	95:1	158.3	247	0.3	0.4	0.4	-1	340	24000	SEL-7	SEL-9
0	GG	3600	15 2/3:1	11.18	17.5	0.65	0.7	0.95	0	500	24000	SEL-7	SEL-9
0	GG	3600	15 2/3:1	18.5	28	0.65	0.7	0.9	0	500	24000	SEL-7	SEL-9
0	GG	3600	37:1	26.42	41.33	0.45	0.55	0.6	-1	500	24000	SEL-7	SEL-9
0	GG	3600	37:1	43.69	96.2	0.4	0.5	0.55	-1	500	24000	SEL-7	SEL-9
0	GG	3600	58:1	102.6	150.8	0.4	0.5	0.5	-1	500	24000	SEL-7	SEL-9
0	GG	3600	95:1	158.3	247	0.35	0.45	0.45	-1	340	24000	SEL-7	SEL-9
0	SG	1800	15 2/3:1	11.18	17.5	0.55	0.65	0.75	0	500	24000	SEL-8	SEL-9



MIDAS Questions?

- **History**
- **Basic Capabilities**
- **Special Methodologies**
- **Tools**
- **Margins**
- **Reports**
- **Verification & Validation**
- **Documentation**