MIDAS UPDATE
MIDAS Users Group

Marion, MA
August 20, 2015

Presented by:
Mike Richard

TELEDYNE TEST SERVICES
Everywhereyoulook™

MIDAS Agenda 1: MIDAS Owners Group

- Utility members who plan to participate in a formal MIDAS Owners Group (show of hands)
- Formation of a formal MIDAS Owners Group
  - Utility suggestions on logistics
  - Financial considerations
  - Scheduling considerations
  - Feasibility considerations
  - Goals
  - Products
    - Software
    - Documentation
    - Support
    - Training
  - Services
    - Implementation (initial phase)
    - MOV Calculation support (ongoing phase)

MIDAS Agenda 2: MIDAS Standardization

- Process standardization
  - Exelon versus FENOC
- Methods standardization
  - BWROG DCM
  - EPRI Butterfly
  - JOG Classification
- Margin standardization
  - Min Requirements
  - Max Limitations (contributing terms)
  - Error Combinations
  - Essential margins versus non-essential
- Terminology standardization
- Report(s) standardization
- Documentation standardization (V&V)
- Integration of new ASME requirements

MIDAS Agenda 3: MIDAS-TEST Standardization

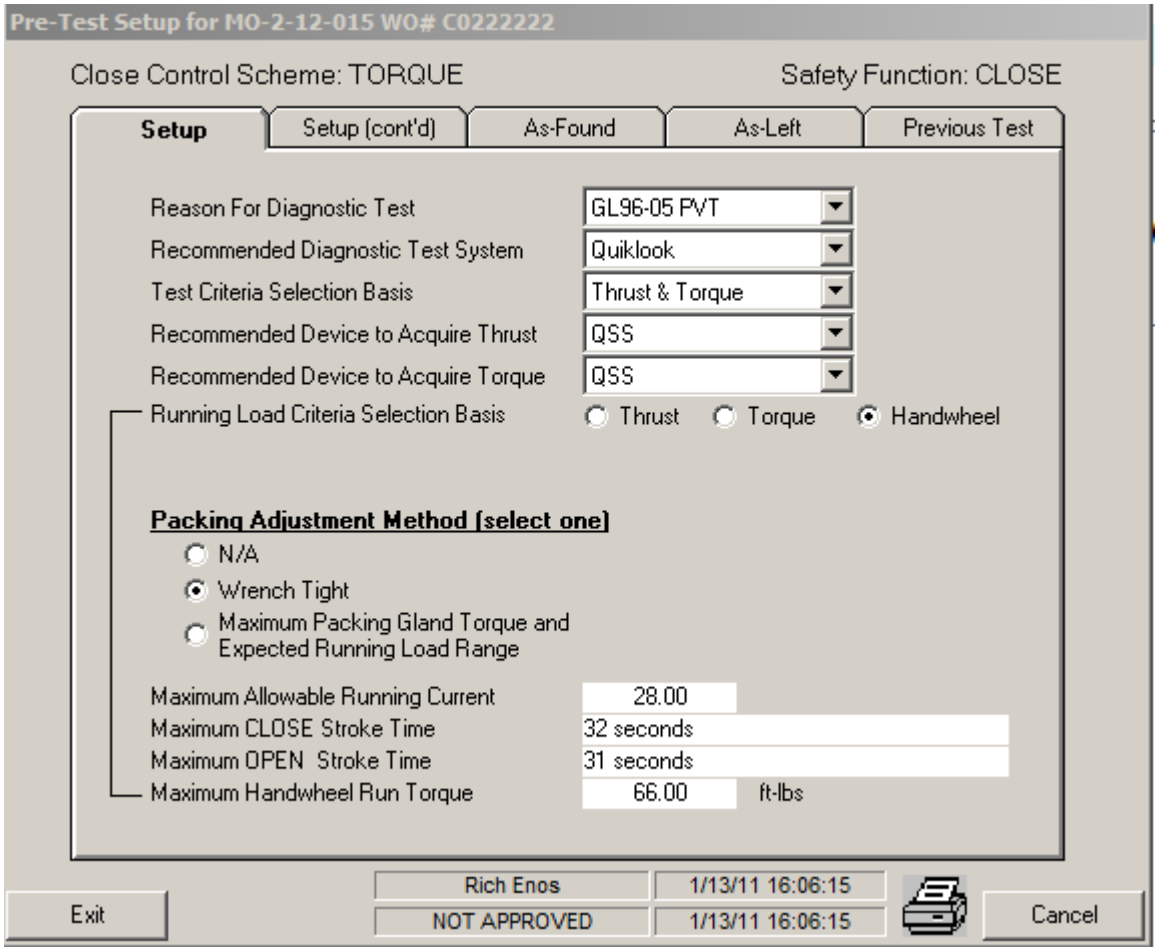
- Process standardization
  - Exelon versus FENOC
- Pre-Test Setup Window standardization
  - Short report versus long report
  - Content and terminology (proposed work)
- Post-Test Analysis standardization
  - Short report versus long report
  - Marker points used for calculations/trending
  - Criteria and terminology (work done)
- Trending standardization
  - Current As-Found to previous As-Left
  - Current As-Left to current As-Found
  - Others?
- Auxiliary features standardization
  - Rotor and Limit Switch settings
  - Lift/Lead settings
- Documentation standardization (V&V)

MIDAS Agenda 4: Miscellaneous Topics

- MIDAS Margin Review using spreadsheets
  - Exelon versus FENOC
  - FENOC versus PGN (Duke)
  - FENOC versus SNC
- MIDAS Software Classification (Class 1?)
  - Review industry classification procedures
  - Prepare common response
  - Prepare common documentation
- MIDAS Technical Issues
  - BWROG DCM
  - EPRI PPM
  - STD Voltage Drop
- MIDAS Redirector
  - New Features

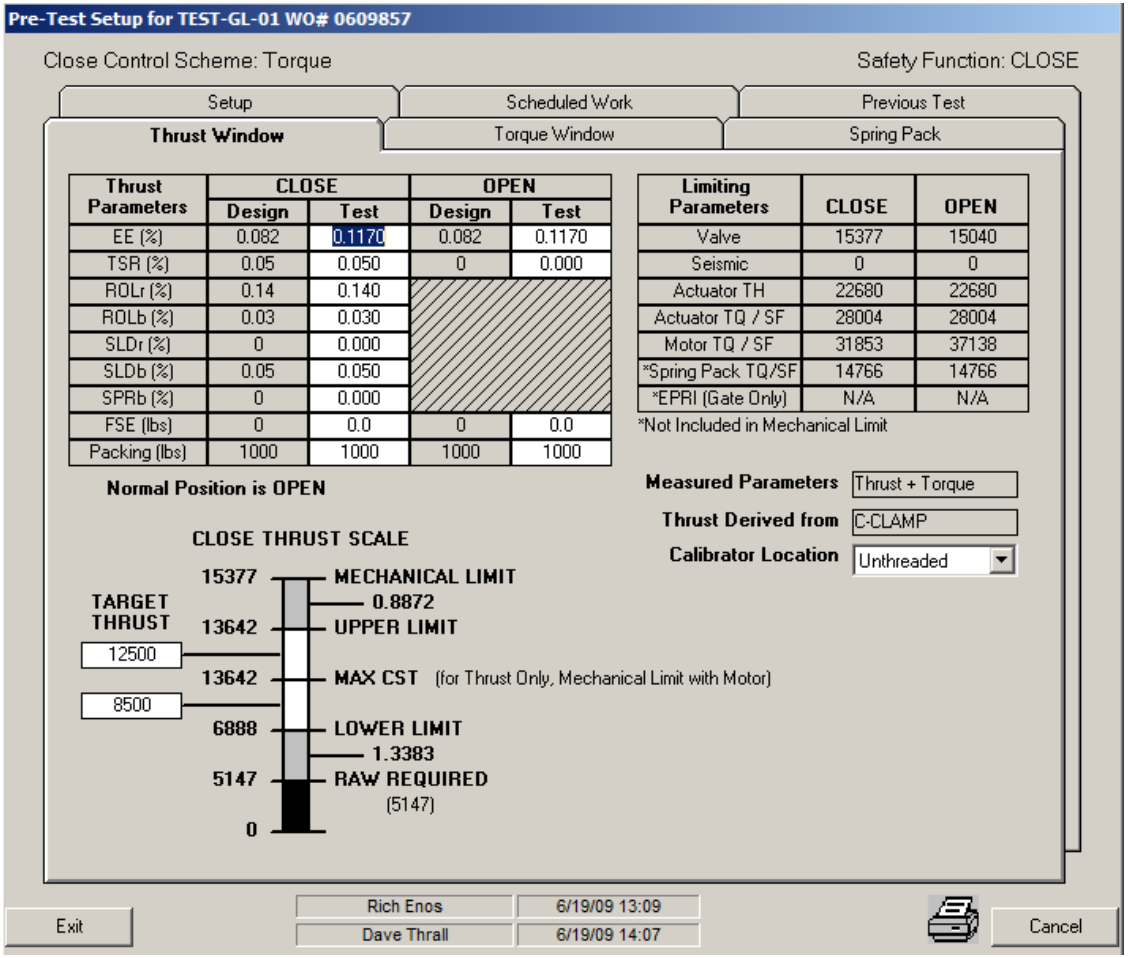
MIDAS Process: Exelon versus FENOC: Exelon

- Defines final setup windows in MIDAS
- MIDASTEST is used to implement setup window
- No changes are allowed to the setup window in MIDASTEST



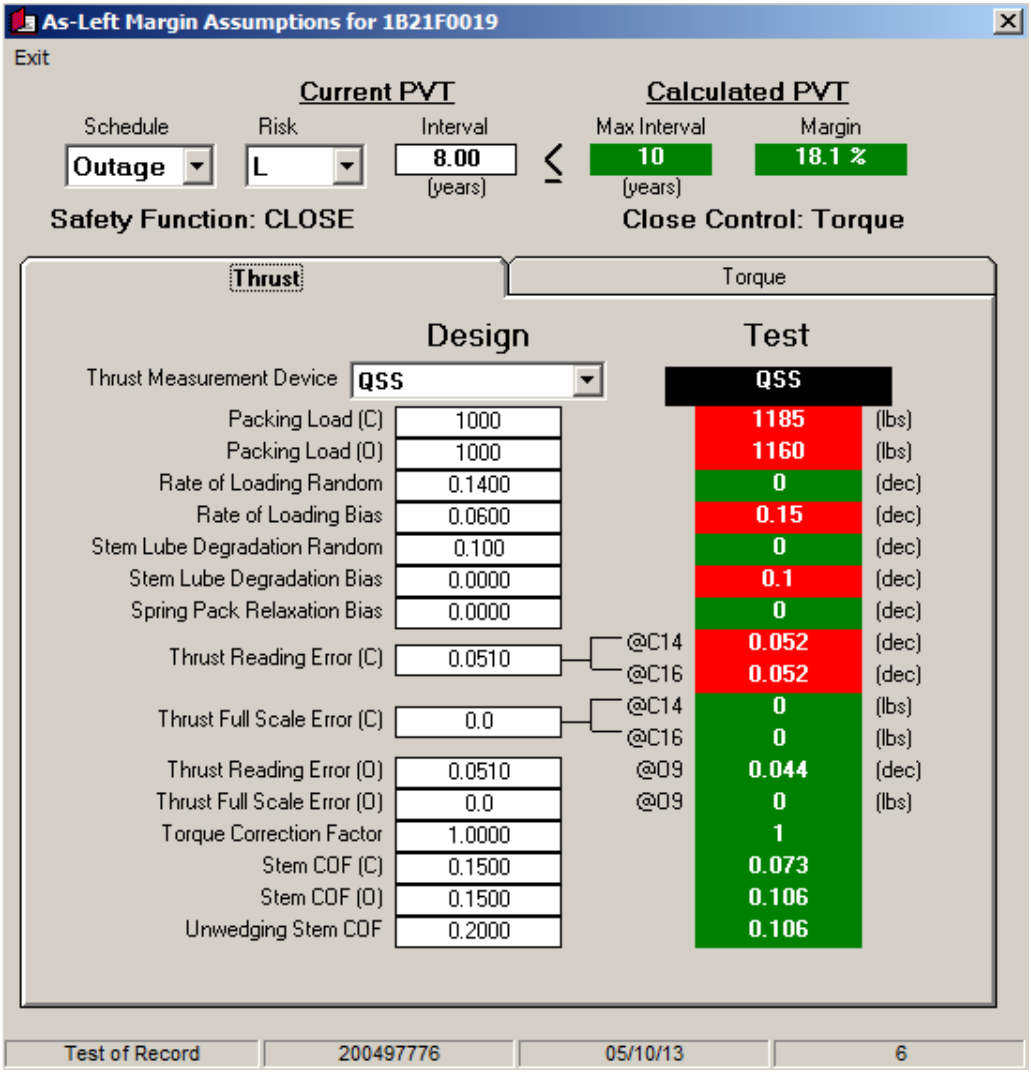
MIDAS Process: Exelon versus FENOC: FENOC

- Defines initial setup window in MIDAS.
- FETEST can be used to alter setup window.
- Any changes in FETEST must be resolved in MIDAS



MIDAS Process: Exelon versus FENOC: FENOC

Any changes in FETEST must be resolved in MIDAS

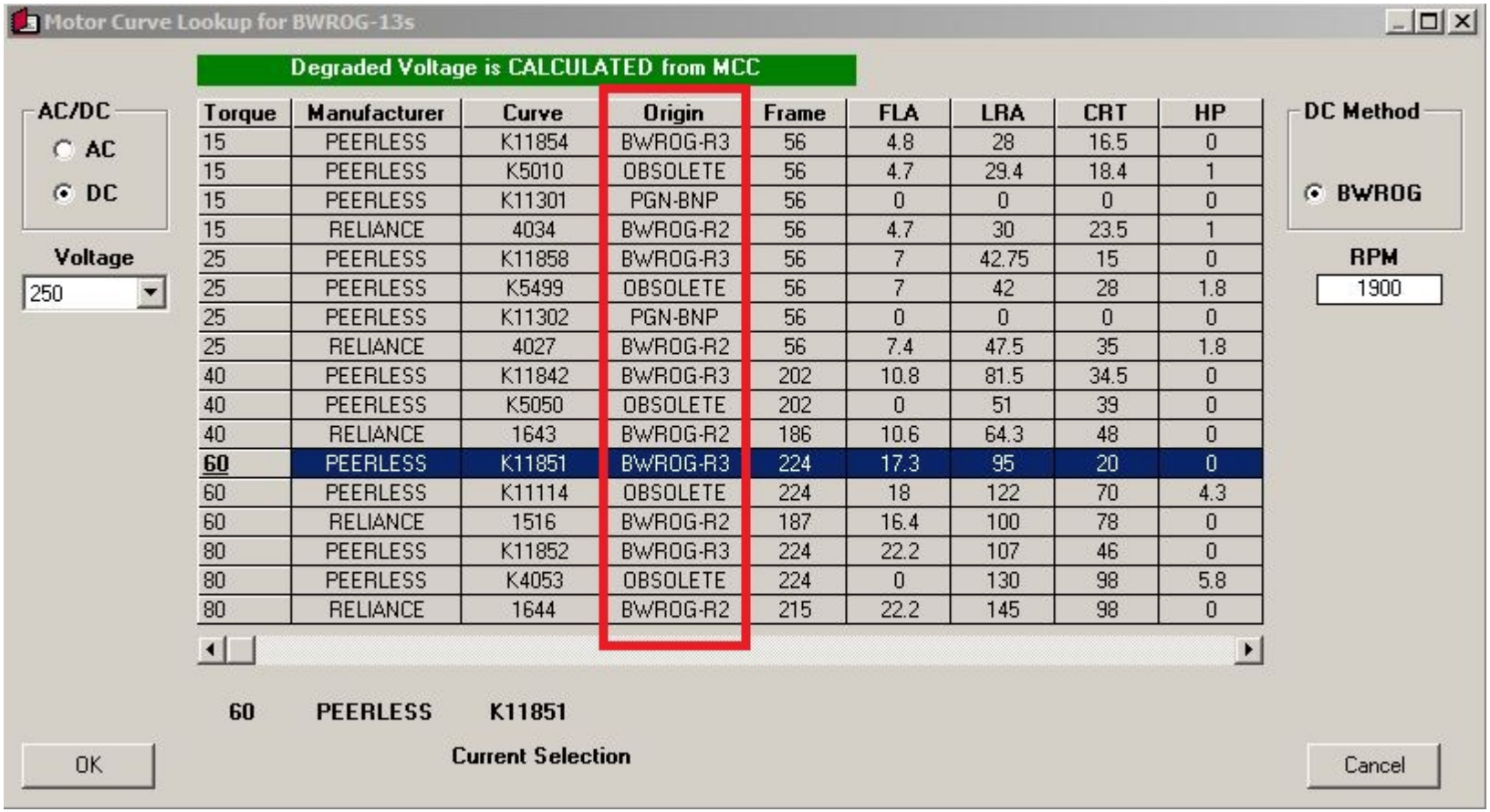


MIDAS Technical Issues – BWROG DCM

- New Peerless motor curves
  - Rev 3 curves added
  - Rev 2 curves retained but noted as obsolete
- New User Interface and associated report
- Comparison of MPR spreadsheet to MIDAS for V&V test cases leaves unanswered questions.
- Globe Valves use extra gate valve wedging steps, history and resolution. Is this resolved?
- TST and UNW Iteration problems
  - Optional TST/UNW iteration suggestion
- Functional Actuator Capability (FAC) Iteration
  - Rising stem with default profile
  - Rising stem with User Input Stem Thrust profile
  - Quarter turn with User Input Stem Torque profile
  - Optional FAC iteration suggestion
  - Scaling User Input Stem Thrust or Torque profiles

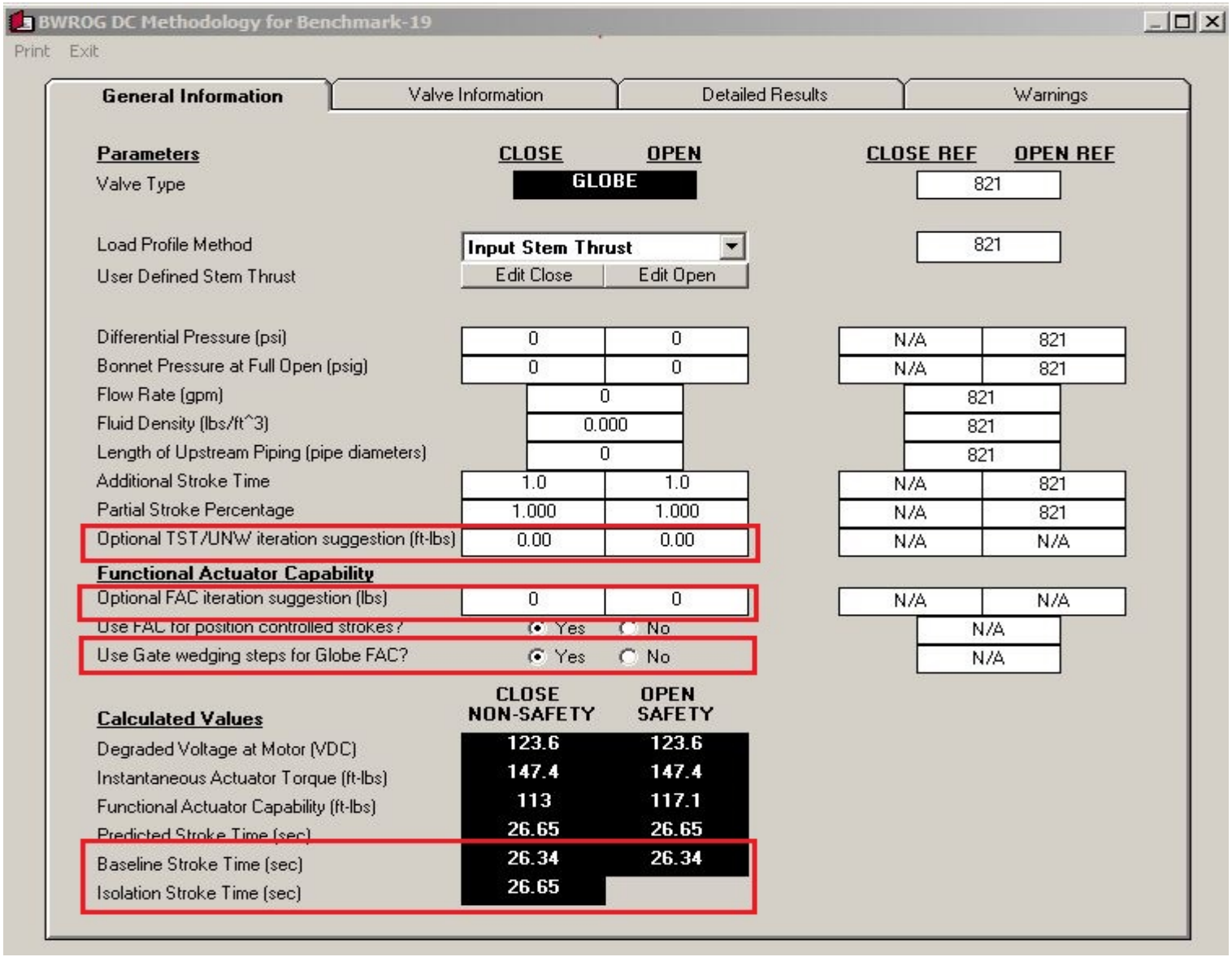
MIDAS BWROG DCM – New Motors

Peerless Rev 3 motors added to Peerless Rev 2 motors
Peerless Rev 2 motors renamed as Obsolete



Torque	Manufacturer	Curve	Origin	Frame	FLA	LRA	CRT	HP
15	PEERLESS	K11854	BWROG-R3	56	4.8	28	16.5	0
15	PEERLESS	K5010	OBSOLETE	56	4.7	29.4	18.4	1
15	PEERLESS	K11301	PGN-BNP	56	0	0	0	0
15	RELIANCE	4034	BWROG-R2	56	4.7	30	23.5	1
25	PEERLESS	K11858	BWROG-R3	56	7	42.75	15	0
25	PEERLESS	K5499	OBSOLETE	56	7	42	28	1.8
25	PEERLESS	K11302	PGN-BNP	56	0	0	0	0
25	RELIANCE	4027	BWROG-R2	56	7.4	47.5	35	1.8
40	PEERLESS	K11842	BWROG-R3	202	10.8	81.5	34.5	0
40	PEERLESS	K5050	OBSOLETE	202	0	51	39	0
40	RELIANCE	1643	BWROG-R2	186	10.6	64.3	48	0
60	PEERLESS	K11851	BWROG-R3	224	17.3	95	20	0
60	PEERLESS	K11114	OBSOLETE	224	18	122	70	4.3
60	RELIANCE	1516	BWROG-R2	187	16.4	100	78	0
80	PEERLESS	K11852	BWROG-R3	224	22.2	107	46	0
80	PEERLESS	K4053	OBSOLETE	224	0	130	98	5.8
80	RELIANCE	1644	BWROG-R2	215	22.2	145	98	0

MIDAS BWROG DCM: New User Interface



MIDAS BWROG DCM: Globe valve additional steps

QL3 QUIKLOOK 3

BWROG DC Methodology for Benchmark-19

Print Exit

General Information | Valve Information | **Detailed Results** | Warnings

☐ Combined Plot

Close | **Open**

Stroke	Position	Stem Thrust	Avg Stem Thrust	Avg Stem Torque	Worm Speed	Gearbox Eff	Avg Motor
0%	0.00	268	0	0.00	0	0.000	0.00
0%	0.00	268	268	2.39	0	0.350	0.06
0%	0.00	268	268	2.39	1182	0.337	0.06
0%	0.00	268	268	2.39	1181	0.337	0.06
0%	0.00	268	268	2.39	1181	0.337	0.06
0%	0.00	268	268	2.39	1181	0.337	0.06
0%	0.00	268	268	2.39	1181	0.337	0.06
0%	0.00	268	268	2.39	1181	0.337	0.06
0%	0.00	268	268	2.39	1181	0.337	0.06
0%	0.00	268	268	2.39	1181	0.337	0.06
0%	0.00	268	268	2.39	1181	0.337	0.06
0%	0.00	268	268	2.39	1181	0.337	0.06
1%	0.02	268	268	2.39	1181	0.337	0.06
2%	0.04	268	268	2.39	1181	0.337	0.06
3%	0.06	268	268	2.39	1181	0.337	0.06
4%	0.07	268	268	2.39	1181	0.337	0.06
5%	0.09	268	268	2.39	1181	0.337	0.06
6%	0.11	268	268	2.39	1181	0.337	0.06
7%	0.13	268	268	2.39	1181	0.337	0.06
8%	0.15	268	268	2.39	1181	0.337	0.06
9%	0.17	268	268	2.39	1181	0.337	0.06
10%	0.19	268	268	2.39	1181	0.337	0.06
12%	0.22	268	268	2.39	1181	0.337	0.06
14%	0.26	268	268	2.39	1181	0.337	0.06
16%	0.30	268	268	2.39	1181	0.337	0.06

Double-Click on a column for graphical representation

MIDAS BWROG DCM: TST/UNW Iteration Problems

Step 7 -- Calculate Maximum Allowable Thrust at Torque Switch Trip (Closing Strokes Only)

For closing strokes, calculate the maximum allowable thrust at torque switch trip, $T_{TST\text{-}max}$, as follows.

7.1. Determine the terminal voltage (V_T) and the available motor torque using the following iterative approach.

7.1.1. Using the motor performance data in Table 2-3 for the appropriate motor, determine the motor current corresponding to the nominal motor torque, ϑ_{nom}. Use interpolation in Table 2-3, as needed. Initially set the motor current, I (amps), to this value.

7.1.2. Calculate the motor voltage, V_T (volts), using the following equation.

Equation 2-22: $V_T = V_{mcc} - (I)(R_{cable} + R_{tol})$

- Problem
  - Iteration started using nominal motor torque
  - Lookup motor current using nominal motor torque
  - Calculate motor voltage < 0. Iteration stops.
- Solution
  - Iteration started using nominal motor torque adjusted for degraded voltage. Repeat process.
  - Optional TST/UNW iteration suggestion

MIDAS BWROG DCM: FAC Definition

Step 6 -- Calculate Functional Actuator Capability and Margin

Calculate the functional actuator capability, AC_{func}, and margin, M_{func}, as follows.

6.1. Set the required thrust, F_R, equal to 90% of the minimum instantaneous actuator capability for the stroke.

6.2. Repeat Steps 2.4, 2.5 and 3 to implement the DC motor performance method for this required thrust. Determine the maximum adjusted motor torque, ϑ', for the stroke.

6.3. If ϑ' is less than ϑ_{nom}, then increase F_R and repeat step 6.2. If ϑ' is more than ϑ_{nom}, then decrease F_R and repeat step 6.2.

6.4. Repeat step 6.3 until ϑ' equals ϑ_{nom}. The functional actuator capability (AC_{func}) is the value of F_R for which ϑ' equals ϑ_{nom}.

- Problems
  - Iteration sometimes diverges
  - Iteration sometimes oscillates
  - How to scale user input thrust/torque profiles
- Solution
  - Optional FAC iteration suggestion
  - Provide graphical representation of iteration process
  - Holding endpoints constant for profile scaling

MIDAS BWROG DCM: New FAC Iteration form

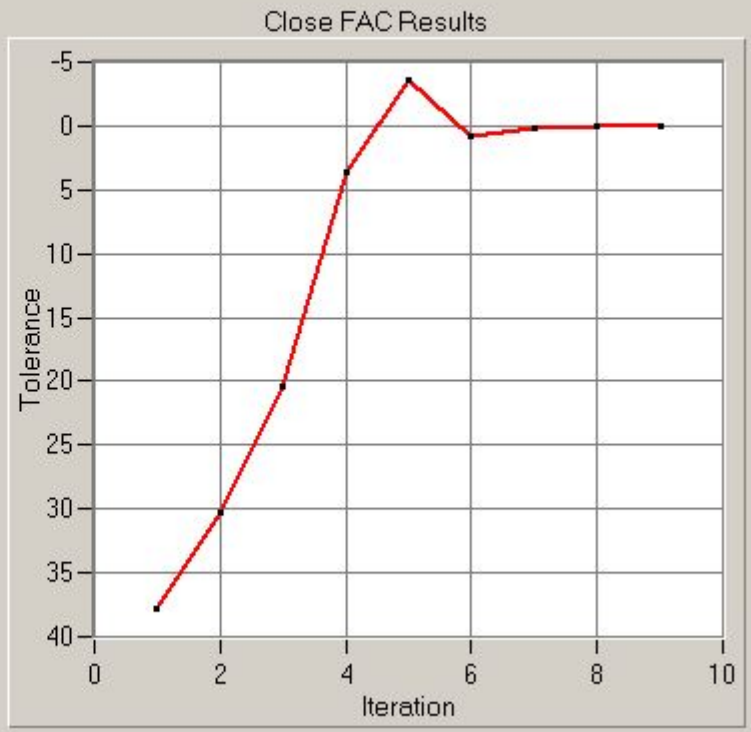
FAC Iteration Case #1 – Simple convergence

BWROG DC METHODOLOGY FAC Iteration Results for Benchmark-18

Sort Exit

Iteration	Tolerance	Stem Thrust	Adjusted MTQ
1	37.84	49681	49.27
2	30.34	51939	55.21
3	20.38	54198	63.11
4	3.55	56456	76.44
5	-3.55	56933	82.07
6	0.8	56695	78.62
7	0.18	56739	79.12
8	-0.03	56751	79.28
9	0	56749	79.26

Tnom = 79.26



MIDAS BWROG DCM: New FAC Iteration form

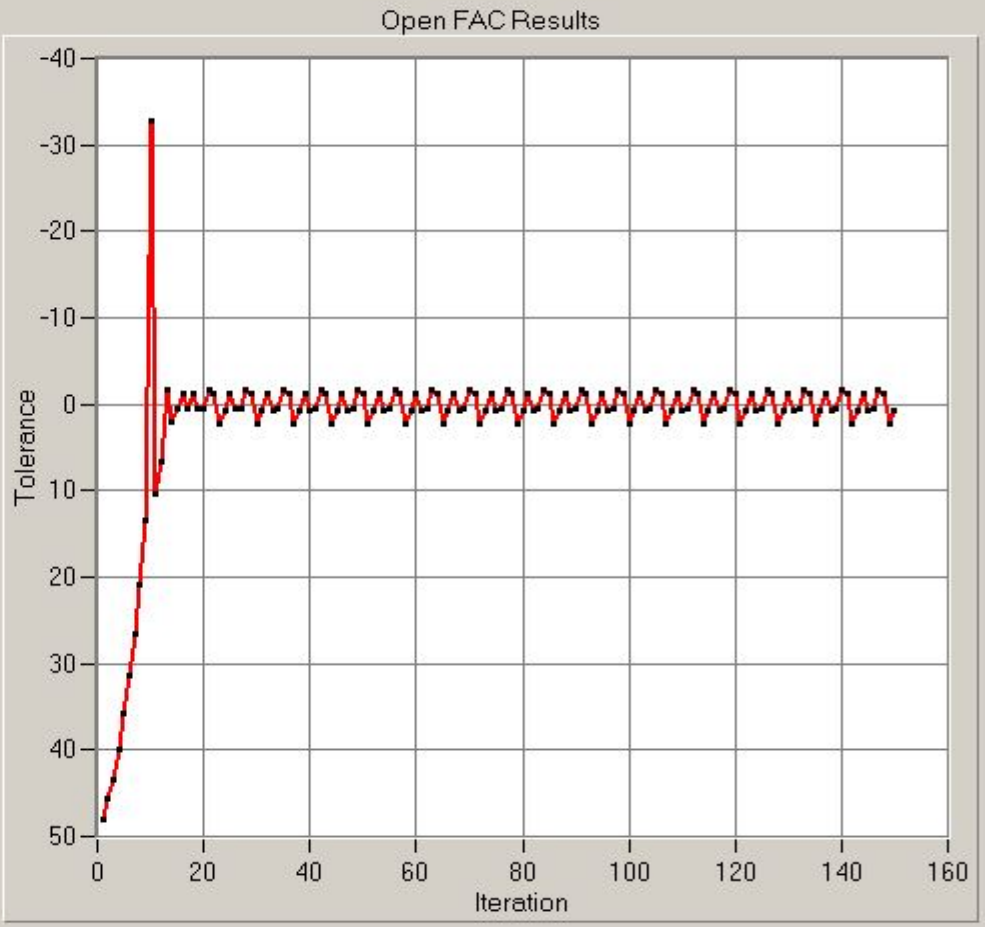
FAC Iteration Case #2 – Oscillating convergence

BWROG DC METHODOLOGY FAC Iteration Results for Benchmark-04

Sort Exit

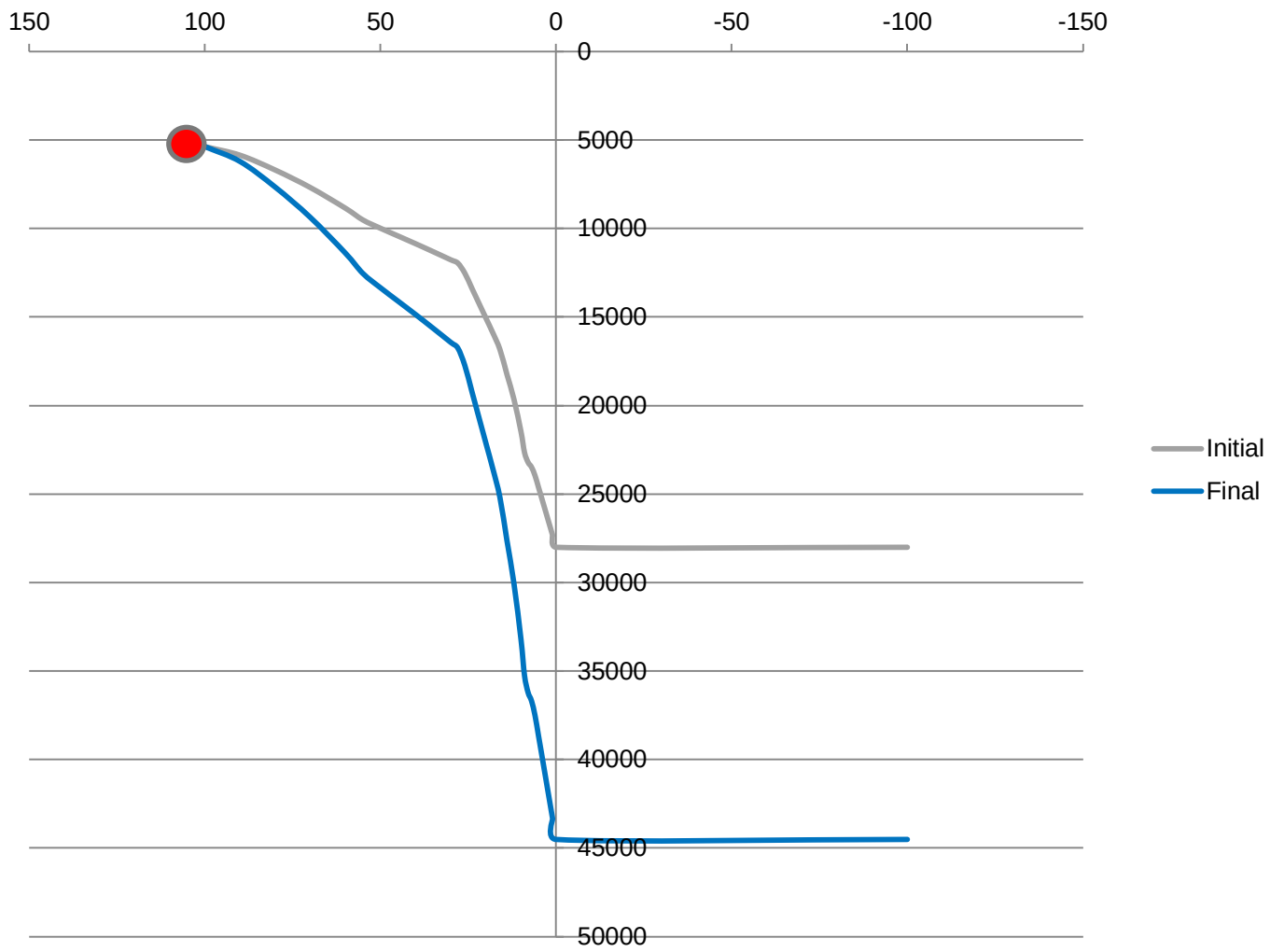
Iteration	Tolerance	Stem Thrust	Adjusted MTQ
76	0.55	81100	78.82
34	0.55	81101	78.82
27	0.54	81102	78.83
17	0.5	81107	78.87
19	0.48	81109	78.88
20	0.47	81110	78.89
18	-1.17	81113	80.19
113	-1.2	81116	80.21
71	-1.2	81116	80.21
64	-1.2	81116	80.21
43	-1.2	81116	80.21
148	-1.2	81116	80.21
120	-1.2	81116	80.21
106	-1.2	81116	80.21
78	-1.2	81116	80.21
36	-1.2	81116	80.21
57	-1.2	81116	80.21
141	-1.2	81116	80.21
85	-1.2	81116	80.21
134	-1.2	81116	80.21
99	-1.2	81116	80.21
50	-1.2	81116	80.21
127	-1.2	81116	80.21
92	-1.2	81116	80.21
29	-1.2	81117	80.21
137	-1.23	81119	80.23
130	-1.23	81119	80.23
123	-1.23	81119	80.23
144	-1.23	81119	80.23

Tnom = 79.26



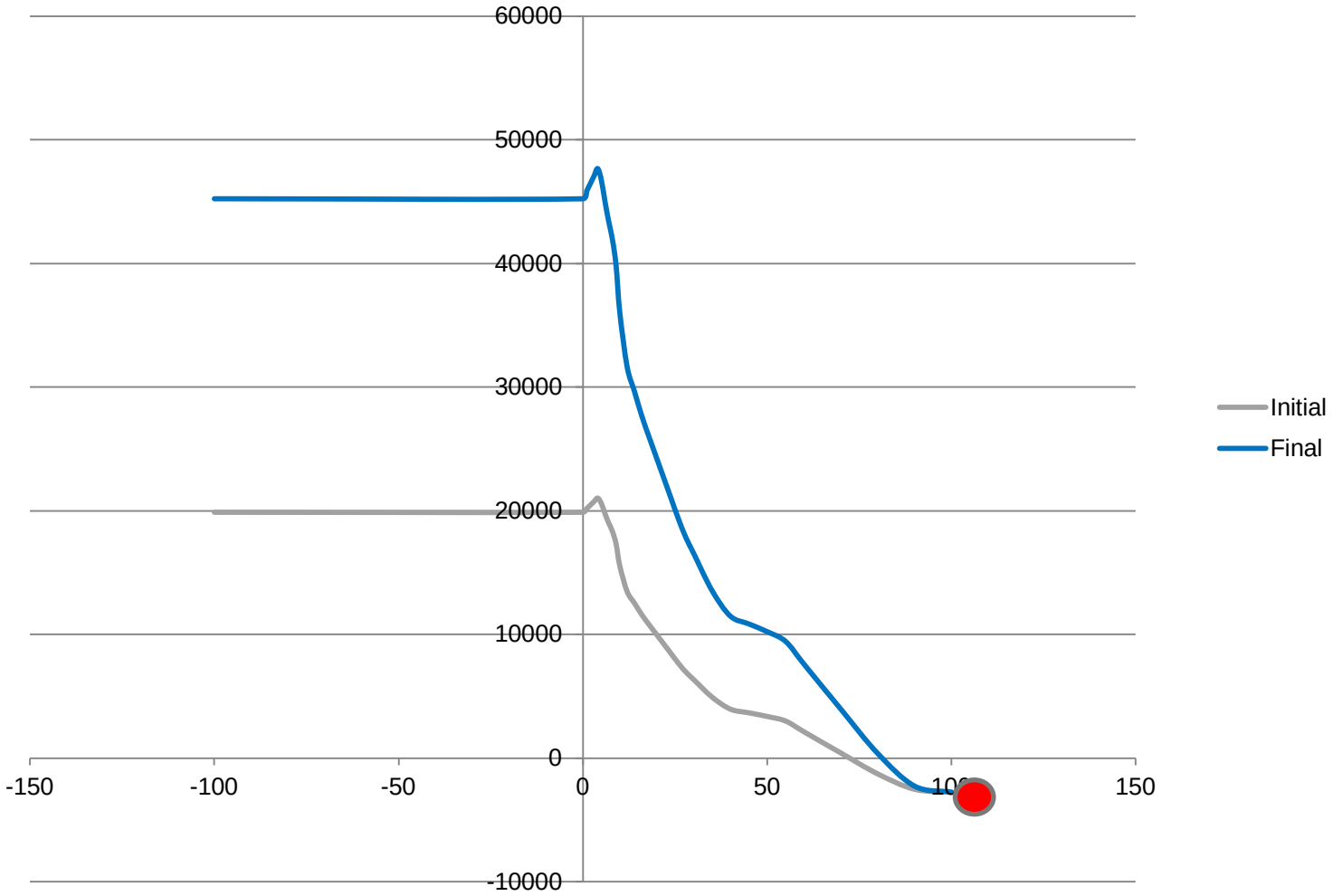
MIDAS BWROG DCM: FAC Iteration example Close

Test Case BWROG-08 Close Thrust Profile – Use Default



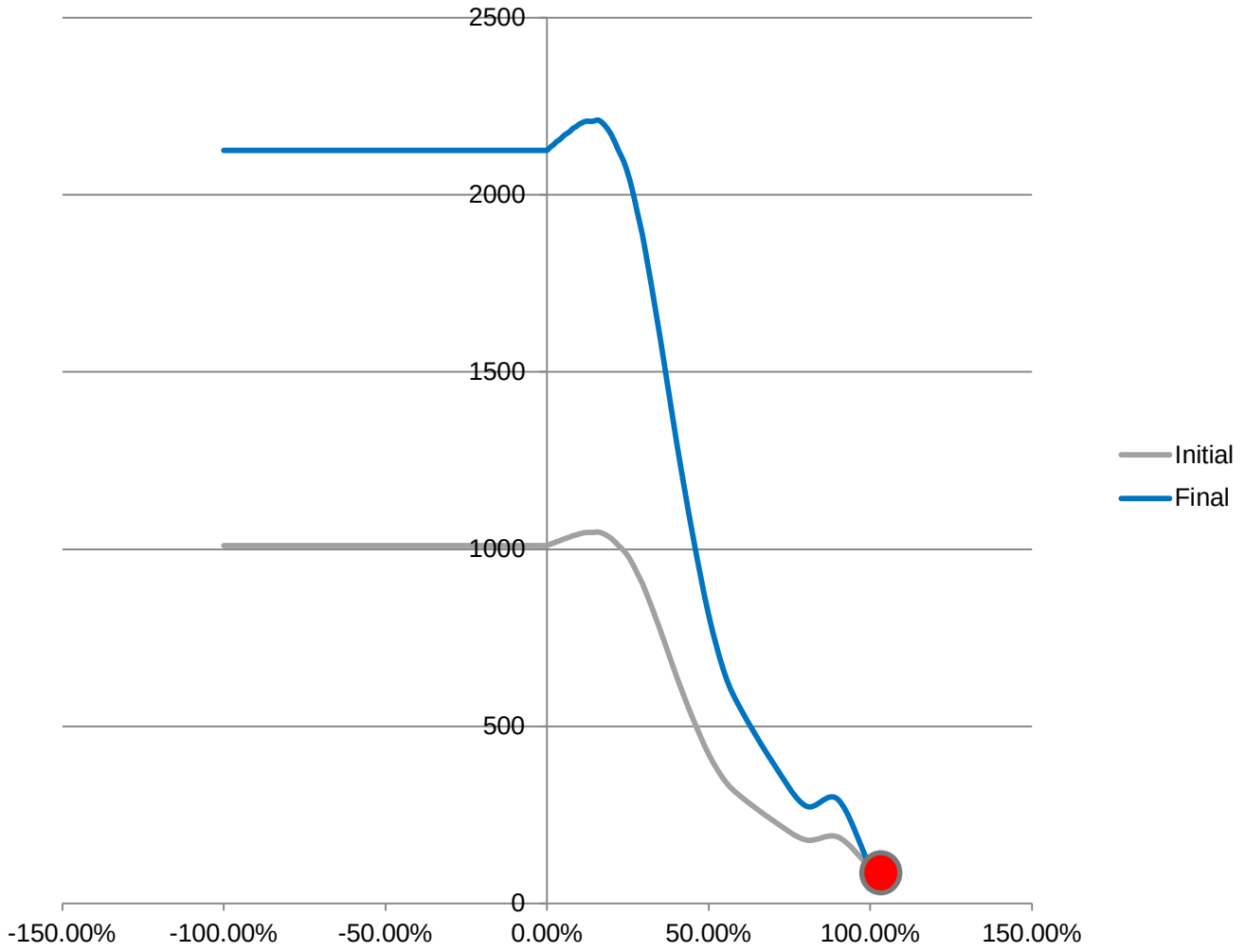
MIDAS BWROG DCM: FAC Iteration example Open

Test Case BWROG-08 Open Thrust Profile – Use Default

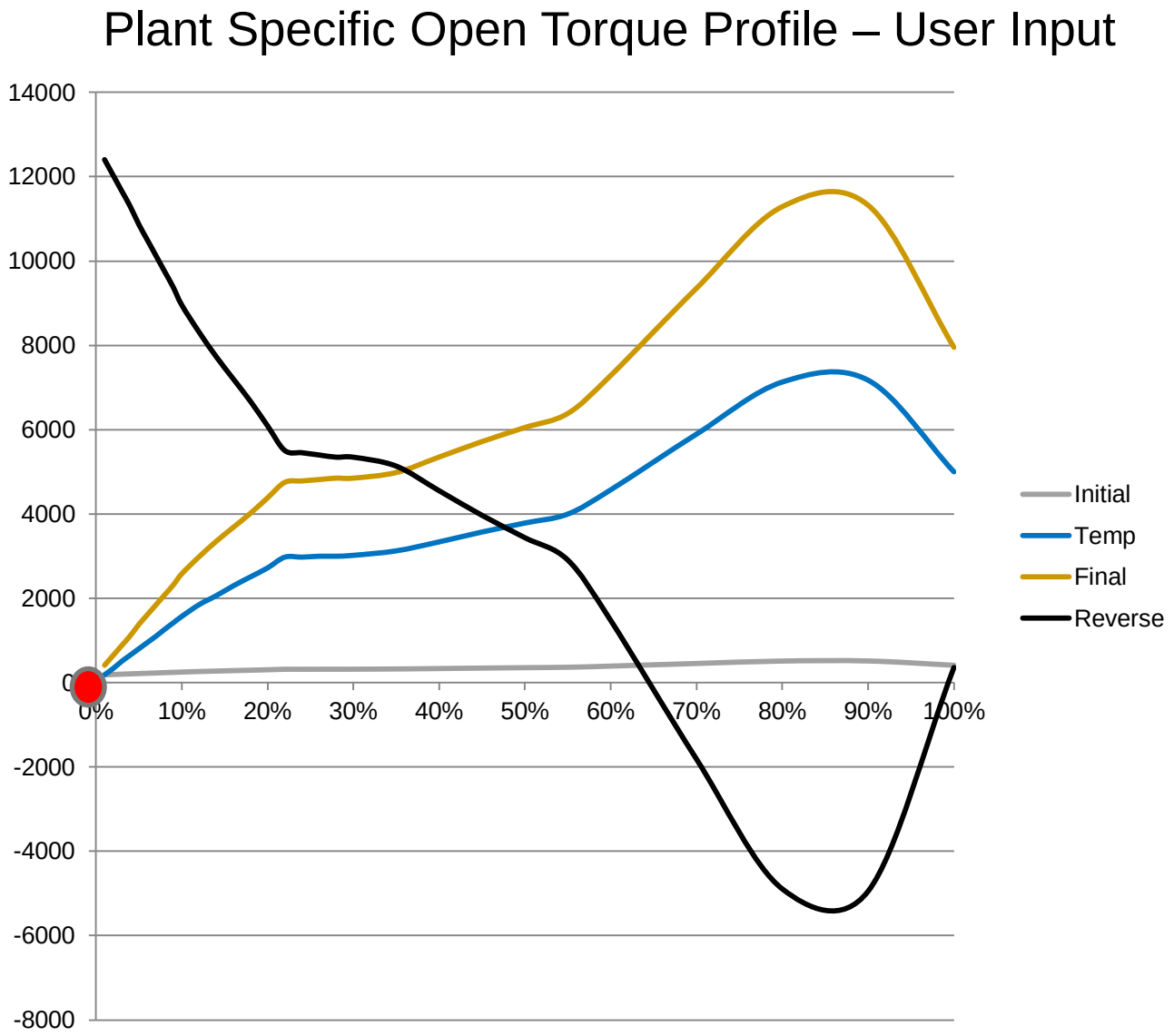


MIDAS BWROG DCM: FAC Iteration example Open

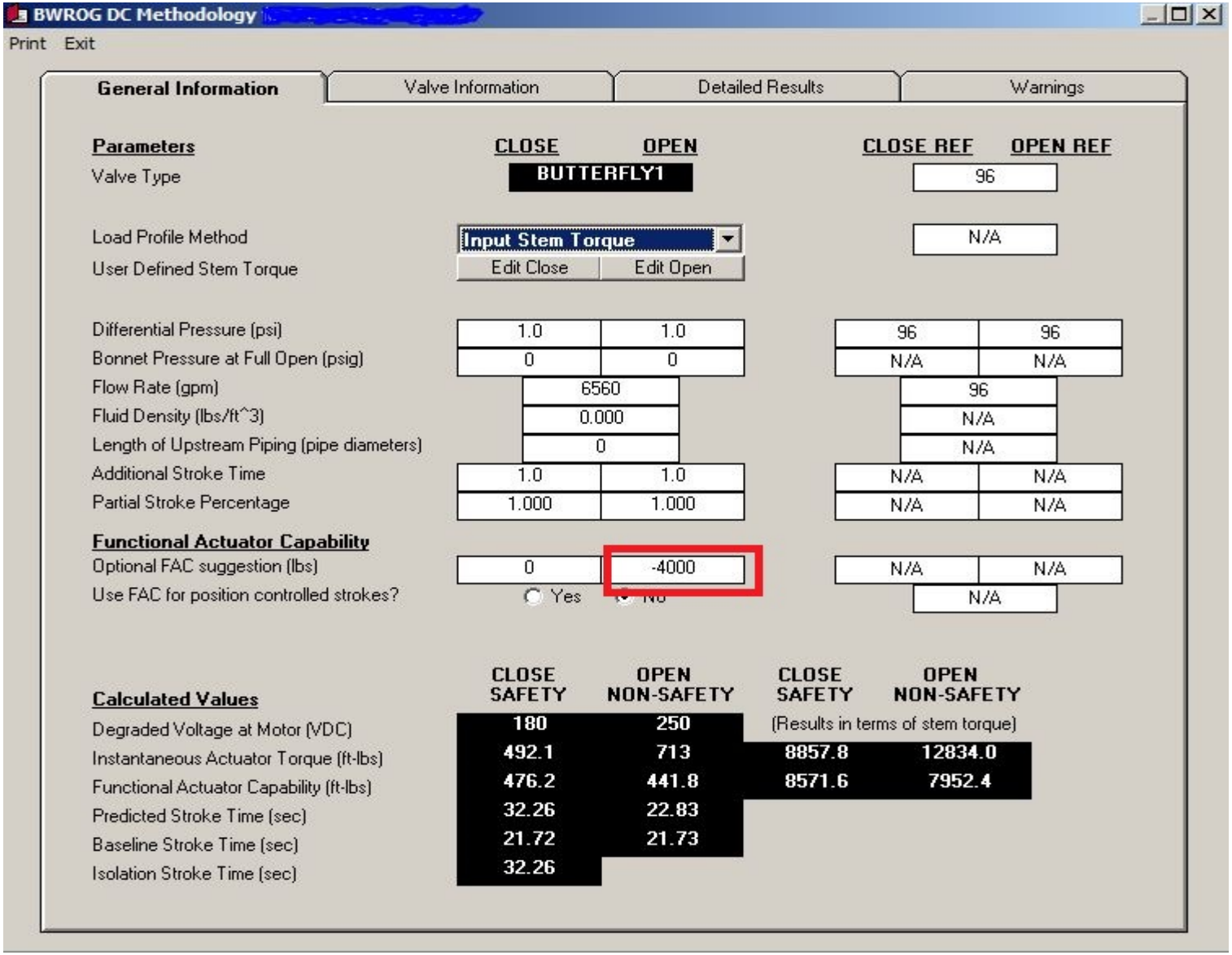
Test Case BWROG-21 Open Torque Profile – User Input



MIDAS BWROG DCM: FAC Iteration example Special



MIDAS BWROG DCM: FAC Iteration example Special



MIDAS BWROG DCM: Revised report

Exelon

BWROG/DC METHODOLOGY RESULTS
BWROG-13s (V&V-1)
DC MOTOR OPERATED GL96-05 GLOBE VALVE
PEERLESS 60 ft-lbs , Curve = K11851

BWROG-13s V&V - Rev. 4

General Information	***Close***	***Open***	***References***
Valve Type	GLOBE	GLOBE	[821]
Gate Valve Disc Type	N/A	N/A	[N/A]
Load profile method	Use Default	Use Default	[821]
Flow type	N/A	N/A	[N/A]
Fluid (blowdown only)	N/A	N/A	[N/A] [N/A]
Valve and Actuator Information			
Stem diameter at stem nut, D_{stem} (inches)	2.125	2.125	[821]
Stem diameter at packing, D_{stem} (inches)	2.125	2.125	[821]
Valve mean seat diameter, D_{mean} (inches)	5.734	5.734	[821]
Valve Seat ring inner diameter, D_{sr} (inches)	5.734	5.734	[821]
Globe valve stroke length, D (inches)	3.187	3.187	[821]
Globe valve flow coefficient, C_V ($gpm/psi^{1/2}$)	435	435	[821]
Packing load, F_{pack} (lbs)	1922	1922	[N/A] [821]
Required thrust (including water inertia), F_R (lbs)	1922	37508	Output
Required thrust due to water inertia, F_{WI} (lbs)	N/A	N/A	Output
Actuator overall ratio, OAR	76.99	76.99	[821]
Motor gear set ratio, MGSR	0.429	0.429	Output
Actuator rated torque, τ_{act}	1800	1800	Output
Stem factor, SF (ft-lbs/lb)	0.014	0.014	[821] [N/A]
Overhauling stem factor, SF_O (ft-lbs/lb)	0.00064	0.00064	Output
Voltage at MCC, V_{mcc} (volts)	210	210	[N/A] [821]
Cable resistance, R_{cable} (ohms)	0.026	0.026	Output
Thermal overload resistance, R_{tol} (ohms)	0.1441	0.1441	Output
Nominal voltage, V_{nom} (volts)	250	250	[7]
Motor Type: PEERLESS, Curve = K11851	60 ft-lb, 250 VDC	60 ft-lb, 250 VDC	[3] [7]
Valve stem lead, lead (inches)	0.5	0.5	[821]
Pullout efficiency, O_P	0.4	0.4	Output
Run efficiency, O	0.5	0.5	Output
Nominal motor speed (rpm), s_{nom}	1900	1900	[821]

MIDAS Methodology: EPRI Butterfly

- Methodology in MIDAS based on EPRI Report
  - TR-106563-V2, Revision 0, “Application Guide for Motor Operated Valves in Nuclear Power Plants (Revision of EPRI/NMAC NP-7501), Volume 2: Butterfly Valves, Final Report, October 1998
- EPRI Application Guide has been replaced by a new document which removed all equations, charts and supporting material in lieu of using EPRI PPM software
  - TR-1013463, Revision 2, “Nuclear Maintenance Applications Guide for Motor Operated Valves in Nuclear Power Plants, Volume 2: Butterfly Valves, Final Report, December 2006
- Comparison of MIDAS to EPRI PPM leaves unanswered questions. How to resolve this?

MIDAS Methodology: STD Voltage Drop

Problem: Discrepancies in definition of motor reactance
Exelon model excludes temperature effects
FENOC model includes temperature effects

(b) Motor Impedance (Z_{motor})

$$Z_{motor} = \frac{V_{rated}}{\sqrt{3} \times LRA \times \left(1 - CL\% \frac{(T_{amb} - T_{rate})}{155\,^{\circ}C}\right)}$$

Where:
LRA = Rated Motor Locked Rotor Amps
V_{rated} = Rated Motor Voltage
T_{amb} = Maximum Motor Ambient Operating Temperature (°C)
T_{rate} = Motor Rated Operating Temperature (°C)
CL% = % Current Loss from 25°C to 180°C

(c) Motor Resistance (Rmotor)

$$Rmotor = Zmotor \times \cos\phi$$

Where:
$\cos\phi$ = Motor Power Factor (PF) @ LRA (See Table 4-4)
ϕ = Motor Phase Angle @ LRA

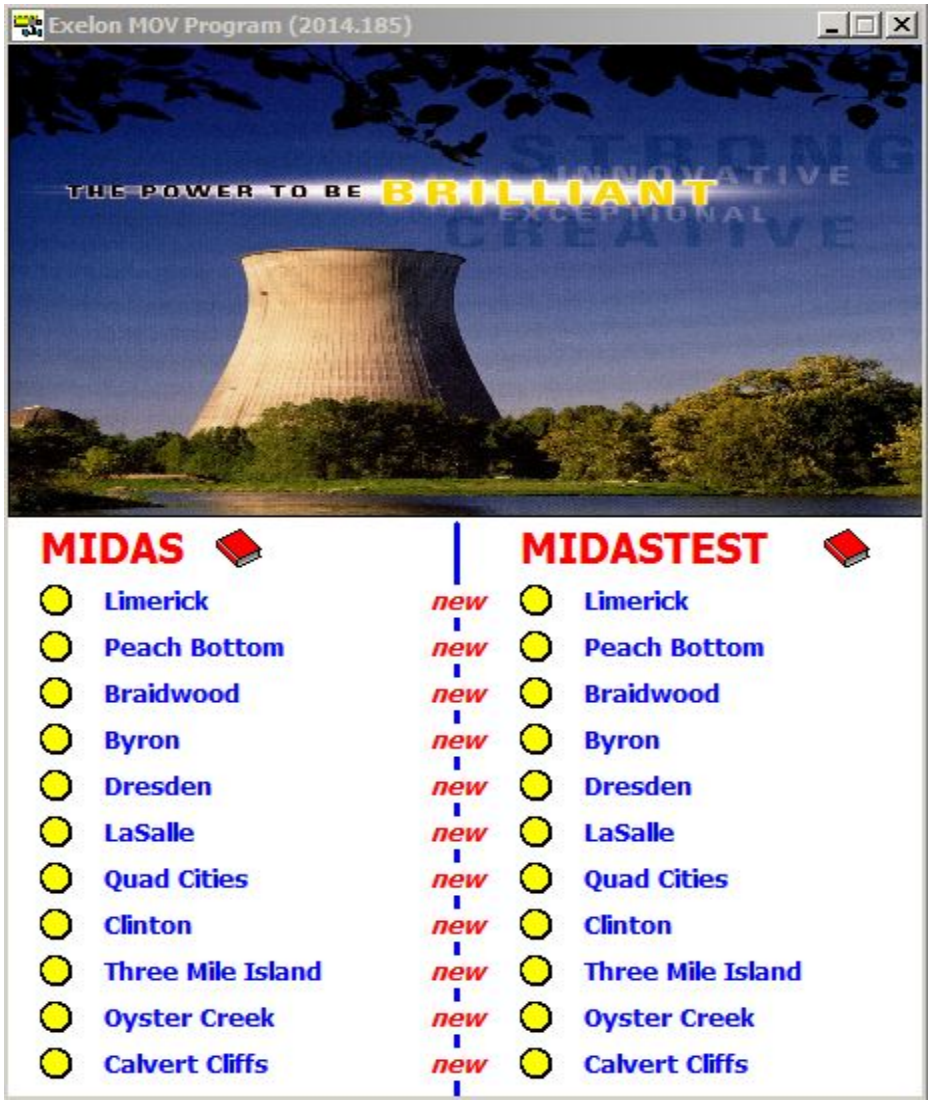
(d) Motor Reactance (Xmotor)

$$Xmotor = Zmotor \times \sin\phi$$

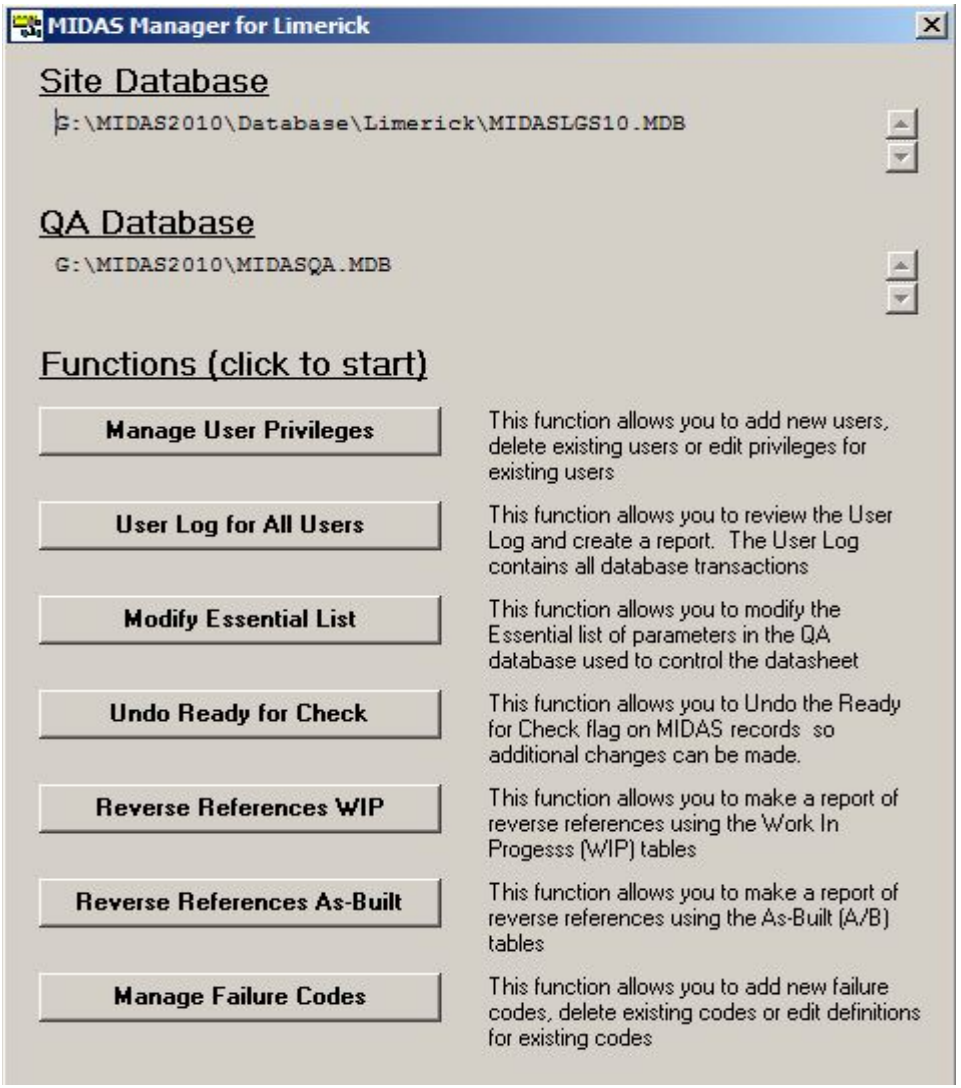
$$\sin\phi = \sqrt{1 - \cos^2\phi}$$

Where:
SINϕ = Motor Reactive Power Factor @ LRA

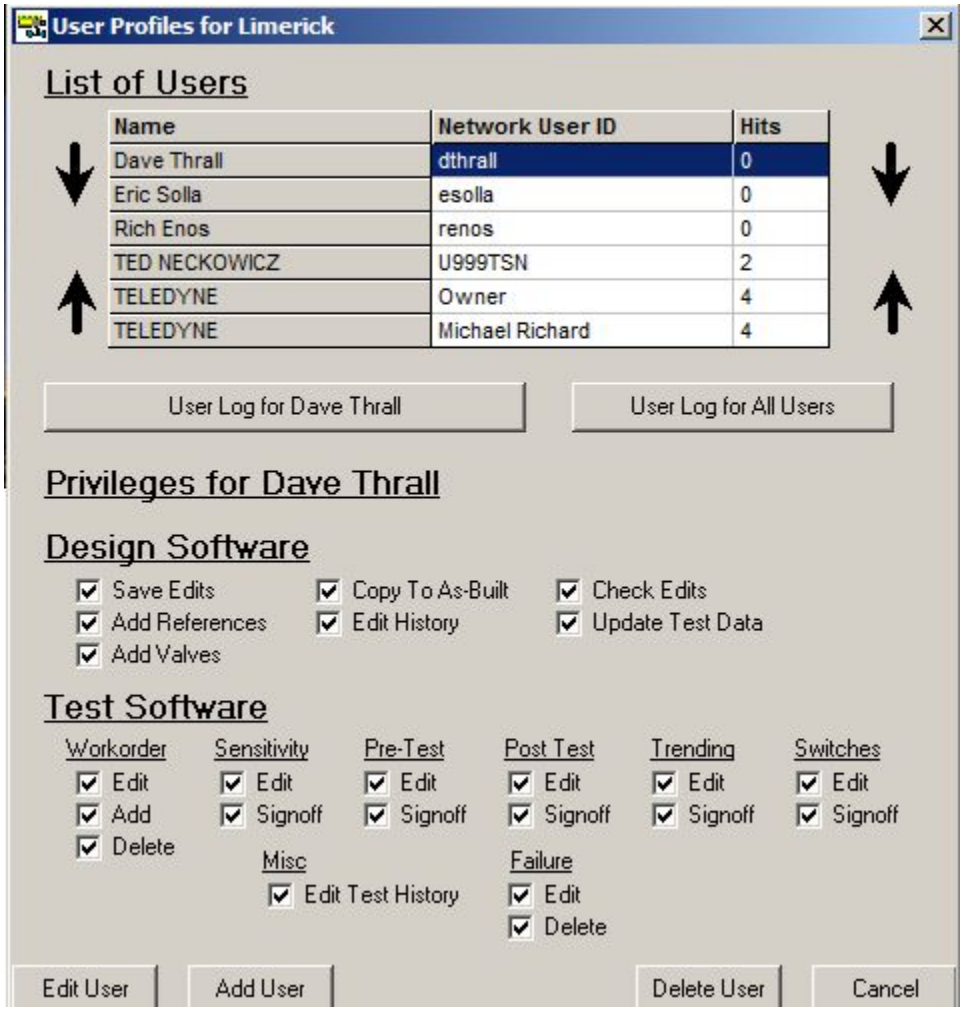
MIDAS Redirector



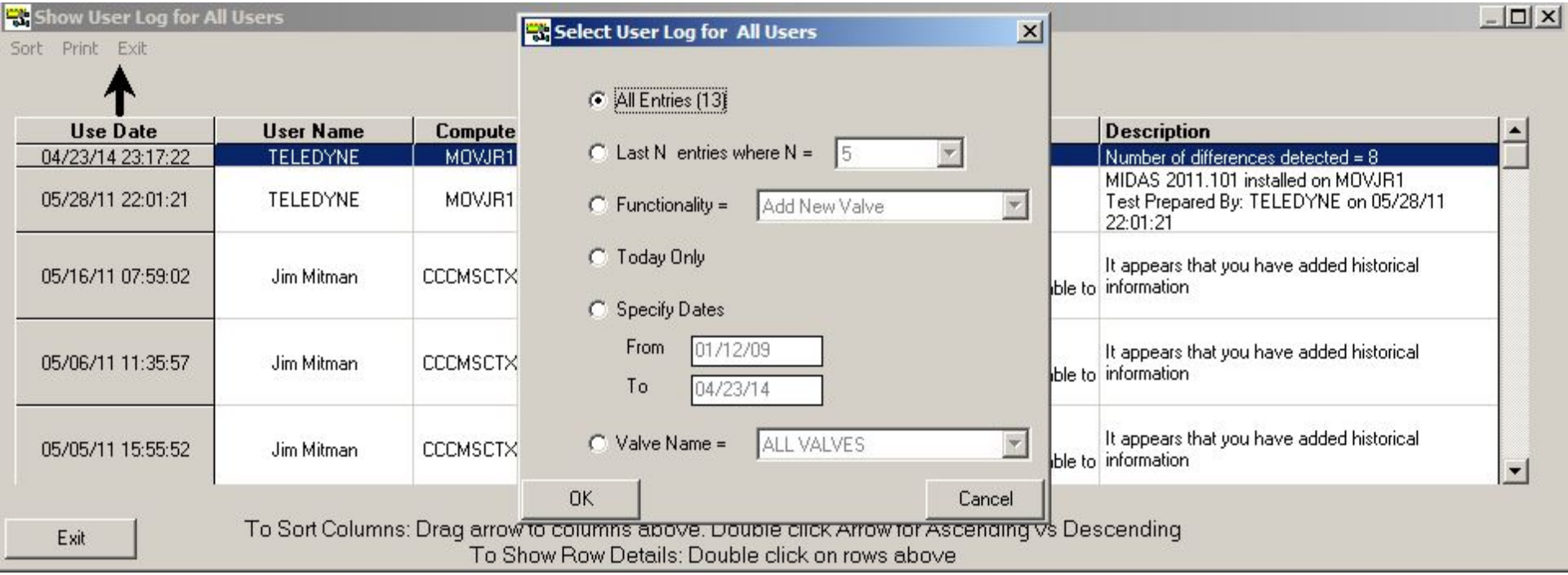
MIDAS Redirector – Additional Features



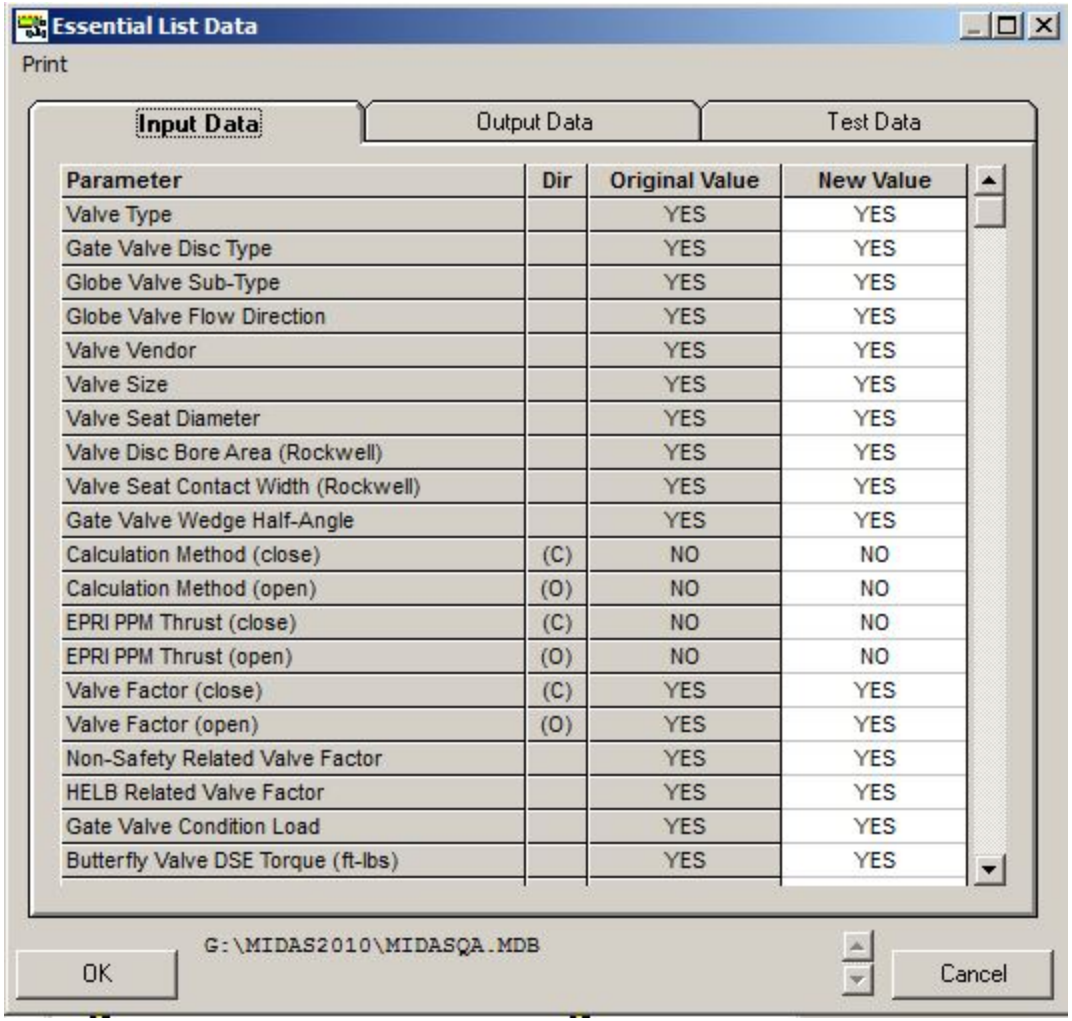
MIDAS Redirector – Manage User Privileges



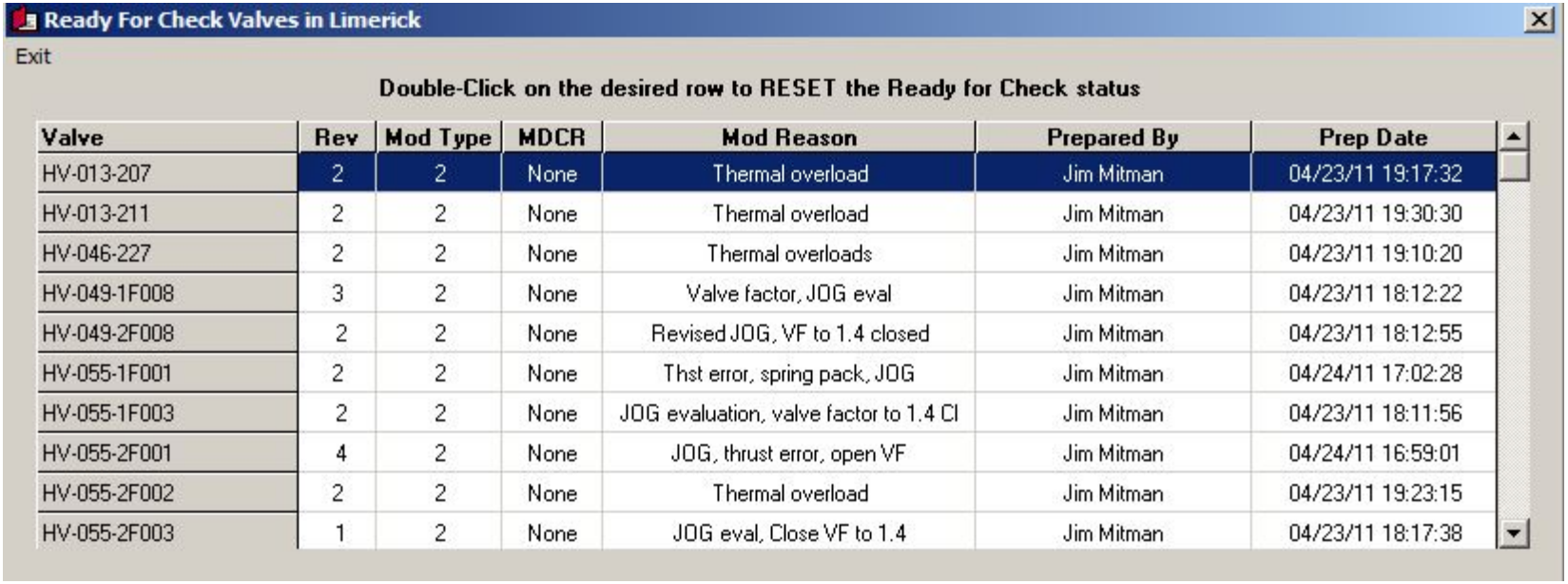
MIDAS Redirector – User Log for All Users



MIDAS Redirector – Modify Essential List

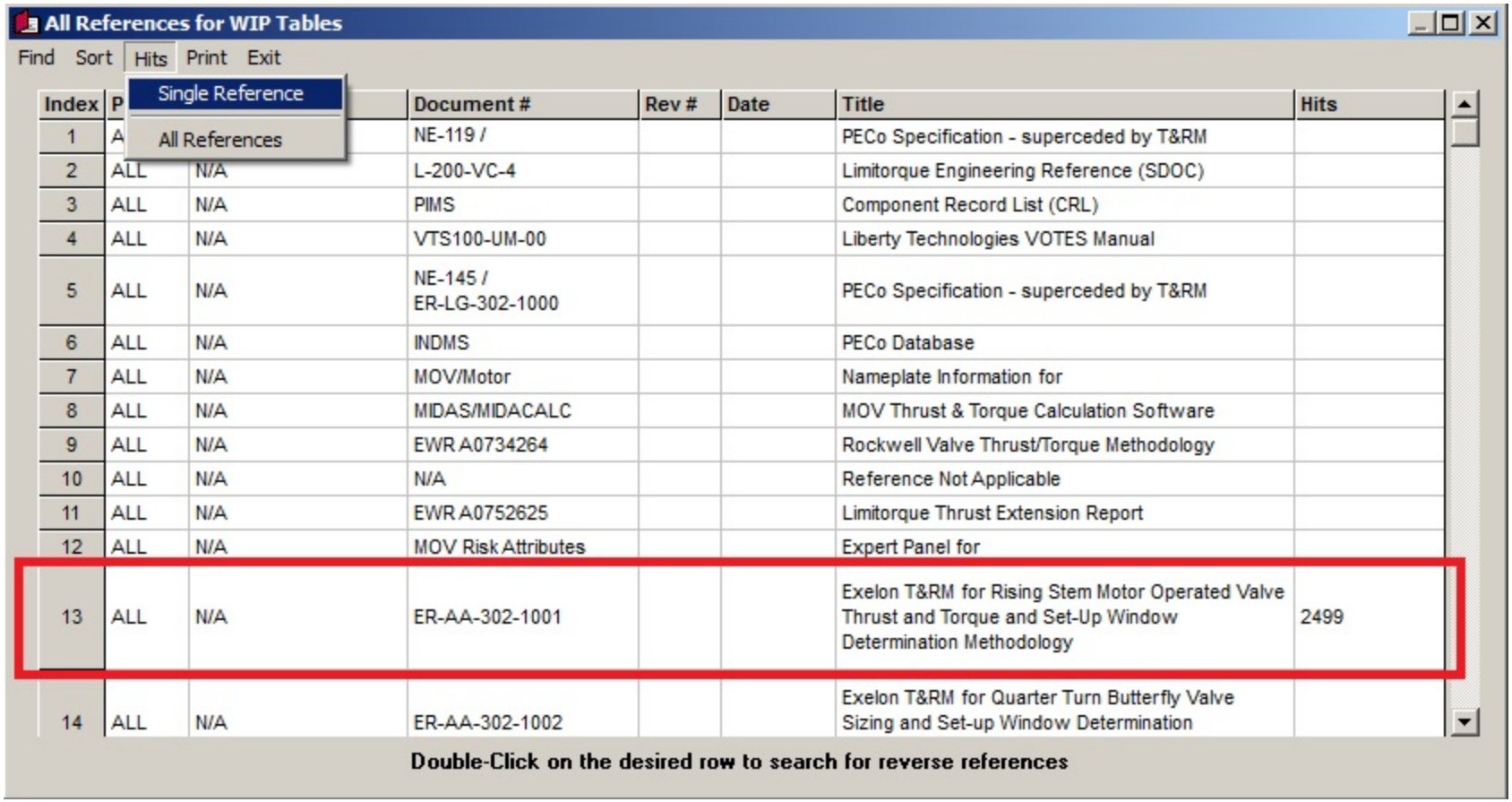


MIDAS Redirector – Undo Ready for Check

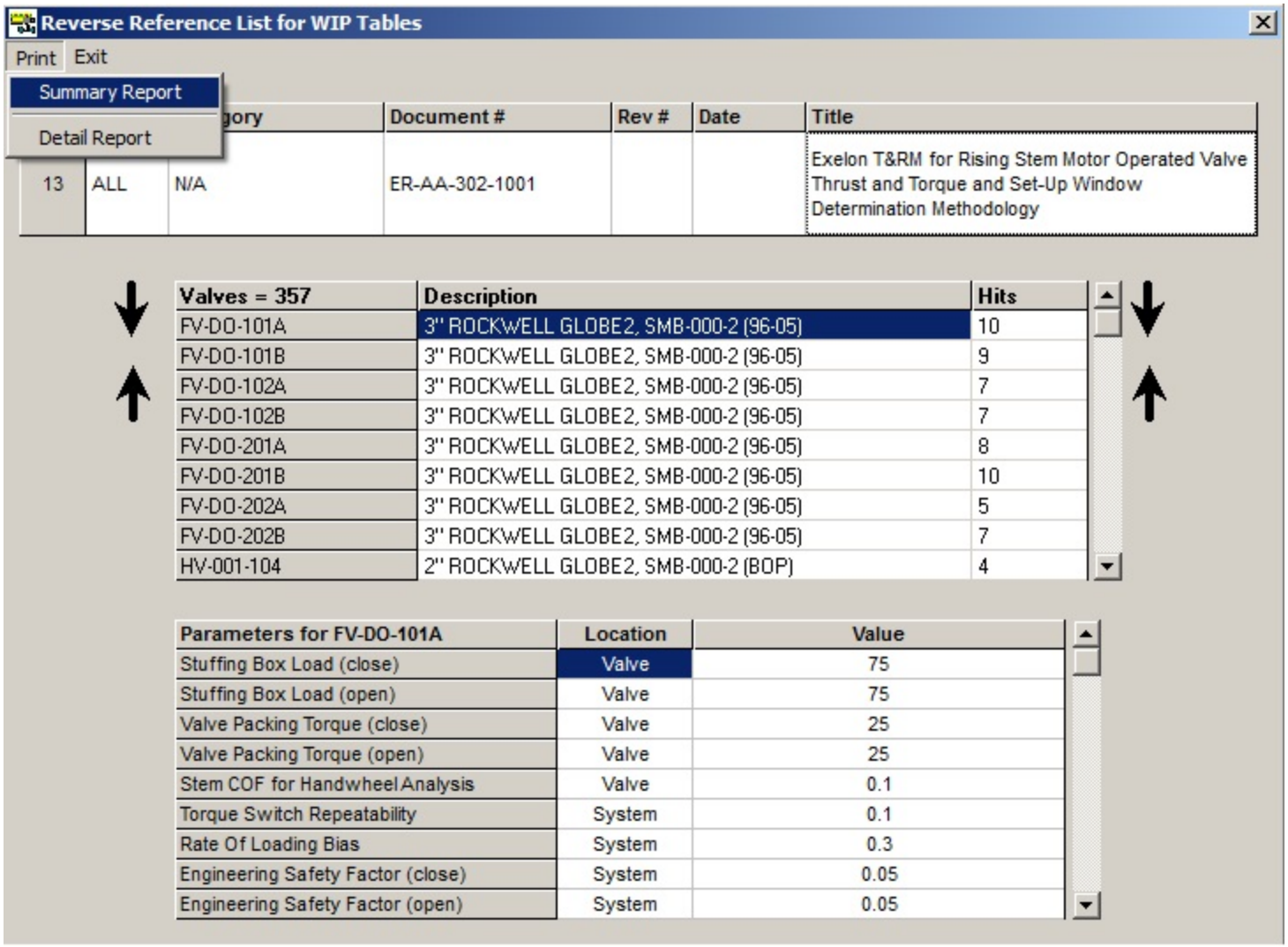


Valve	Rev	Mod Type	MDCR	Mod Reason	Prepared By	Prep Date
HV-013-207	2	2	None	Thermal overload	Jim Mitman	04/23/11 19:17:32
HV-013-211	2	2	None	Thermal overload	Jim Mitman	04/23/11 19:30:30
HV-046-227	2	2	None	Thermal overloads	Jim Mitman	04/23/11 19:10:20
HV-049-1F008	3	2	None	Valve factor, JOG eval	Jim Mitman	04/23/11 18:12:22
HV-049-2F008	2	2	None	Revised JOG, VF to 1.4 closed	Jim Mitman	04/23/11 18:12:55
HV-055-1F001	2	2	None	Thst error, spring pack, JOG	Jim Mitman	04/24/11 17:02:28
HV-055-1F003	2	2	None	JOG evaluation, valve factor to 1.4 Cl	Jim Mitman	04/23/11 18:11:56
HV-055-2F001	4	2	None	JOG, thrust error, open VF	Jim Mitman	04/24/11 16:59:01
HV-055-2F002	2	2	None	Thermal overload	Jim Mitman	04/23/11 19:23:15
HV-055-2F003	1	2	None	JOG eval, Close VF to 1.4	Jim Mitman	04/23/11 18:17:38

MIDAS Redirector – Reverse References WIP



MIDAS Redirector – Reverse References WIP (Single)



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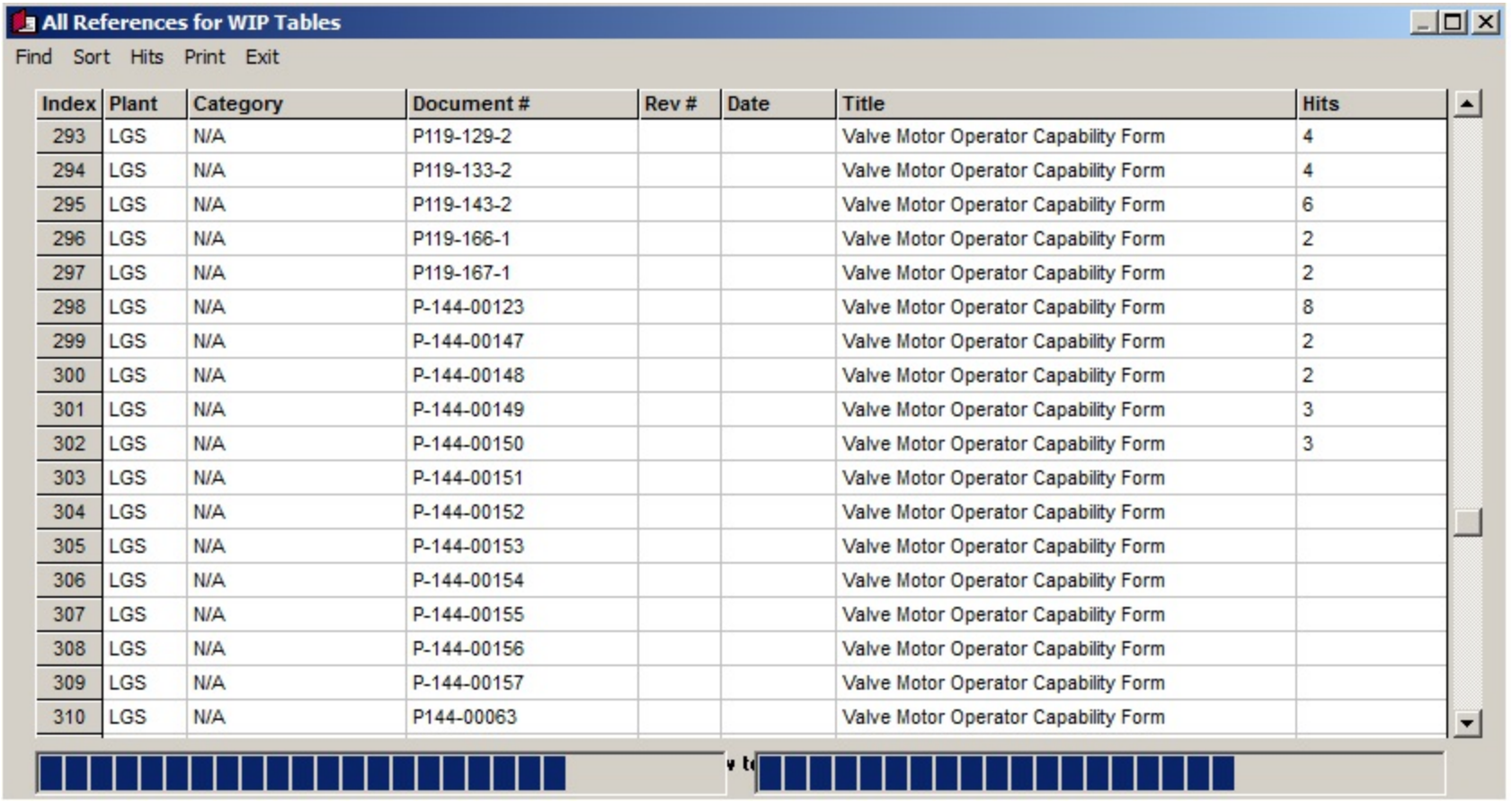
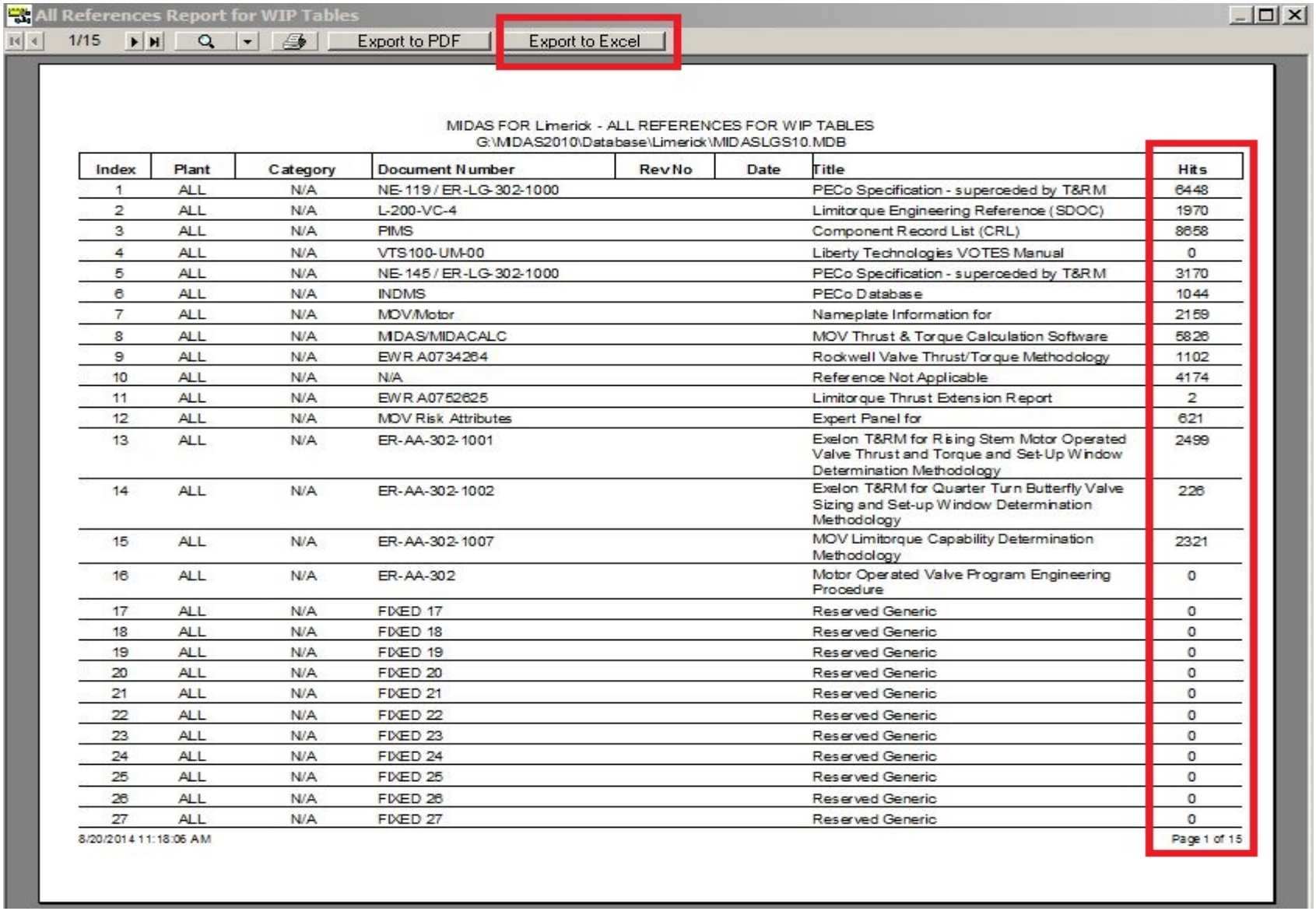


Index	Plant	Category	Document #	Rev #	Date	Title	Hits
293	LGS	N/A	P119-129-2			Valve Motor Operator Capability Form	4
294	LGS	N/A	P119-133-2			Valve Motor Operator Capability Form	4
295	LGS	N/A	P119-143-2			Valve Motor Operator Capability Form	6
296	LGS	N/A	P119-166-1			Valve Motor Operator Capability Form	2
297	LGS	N/A	P119-167-1			Valve Motor Operator Capability Form	2
298	LGS	N/A	P-144-00123			Valve Motor Operator Capability Form	8
299	LGS	N/A	P-144-00147			Valve Motor Operator Capability Form	2
300	LGS	N/A	P-144-00148			Valve Motor Operator Capability Form	2
301	LGS	N/A	P-144-00149			Valve Motor Operator Capability Form	3
302	LGS	N/A	P-144-00150			Valve Motor Operator Capability Form	3
303	LGS	N/A	P-144-00151			Valve Motor Operator Capability Form	
304	LGS	N/A	P-144-00152			Valve Motor Operator Capability Form	
305	LGS	N/A	P-144-00153			Valve Motor Operator Capability Form	
306	LGS	N/A	P-144-00154			Valve Motor Operator Capability Form	
307	LGS	N/A	P-144-00155			Valve Motor Operator Capability Form	
308	LGS	N/A	P-144-00156			Valve Motor Operator Capability Form	
309	LGS	N/A	P-144-00157			Valve Motor Operator Capability Form	
310	LGS	N/A	P144-00063			Valve Motor Operator Capability Form	

MIDAS Redirector – Reverse References WIP (All)



MIDAS FOR Limerick - ALL REFERENCES FOR WIP TABLES
G:\MIDAS2010\Database\Limerick\MIDASLGS10.MDB

Index	Plant	Category	Document Number	Rev No	Date	Title	Hits
1	ALL	N/A	NE-119 / ER-LG-302-1000			PECo Specification - superceded by T&RM	6448
2	ALL	N/A	L-200-VC-4			Limitorque Engineering Reference (SDOC)	1970
3	ALL	N/A	PIMS			Component Record List (CRL)	8658
4	ALL	N/A	VTS100-UM-00			Liberty Technologies VOTES Manual	0
5	ALL	N/A	NE-145 / ER-LG-302-1000			PECo Specification - superceded by T&RM	3170
6	ALL	N/A	INDMS			PECo Database	1044
7	ALL	N/A	MOV/Motor			Nameplate Information for	2159
8	ALL	N/A	MIDAS/MIDACALC			MOV Thrust & Torque Calculation Software	5826
9	ALL	N/A	EWR A0734264			Rockwell Valve Thrust/Torque Methodology	1102
10	ALL	N/A	N/A			Reference Not Applicable	4174
11	ALL	N/A	EWR A0752625			Limitorque Thrust Extension Report	2
12	ALL	N/A	MOV Risk Attributes			Expert Panel for	621
13	ALL	N/A	ER-AA-302-1001			Exelon T&RM for Rising Stem Motor Operated Valve Thrust and Torque and Set-Up Window Determination Methodology	2499
14	ALL	N/A	ER-AA-302-1002			Exelon T&RM for Quarter Turn Butterfly Valve Sizing and Set-up Window Determination Methodology	226
15	ALL	N/A	ER-AA-302-1007			MOV Limitorque Capability Determination Methodology	2321
16	ALL	N/A	ER-AA-302			Motor Operated Valve Program Engineering Procedure	0
17	ALL	N/A	FIXED 17			Reserved Generic	0
18	ALL	N/A	FIXED 18			Reserved Generic	0
19	ALL	N/A	FIXED 19			Reserved Generic	0
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26	ALL	N/A	FIXED 26			Reserved Generic	0
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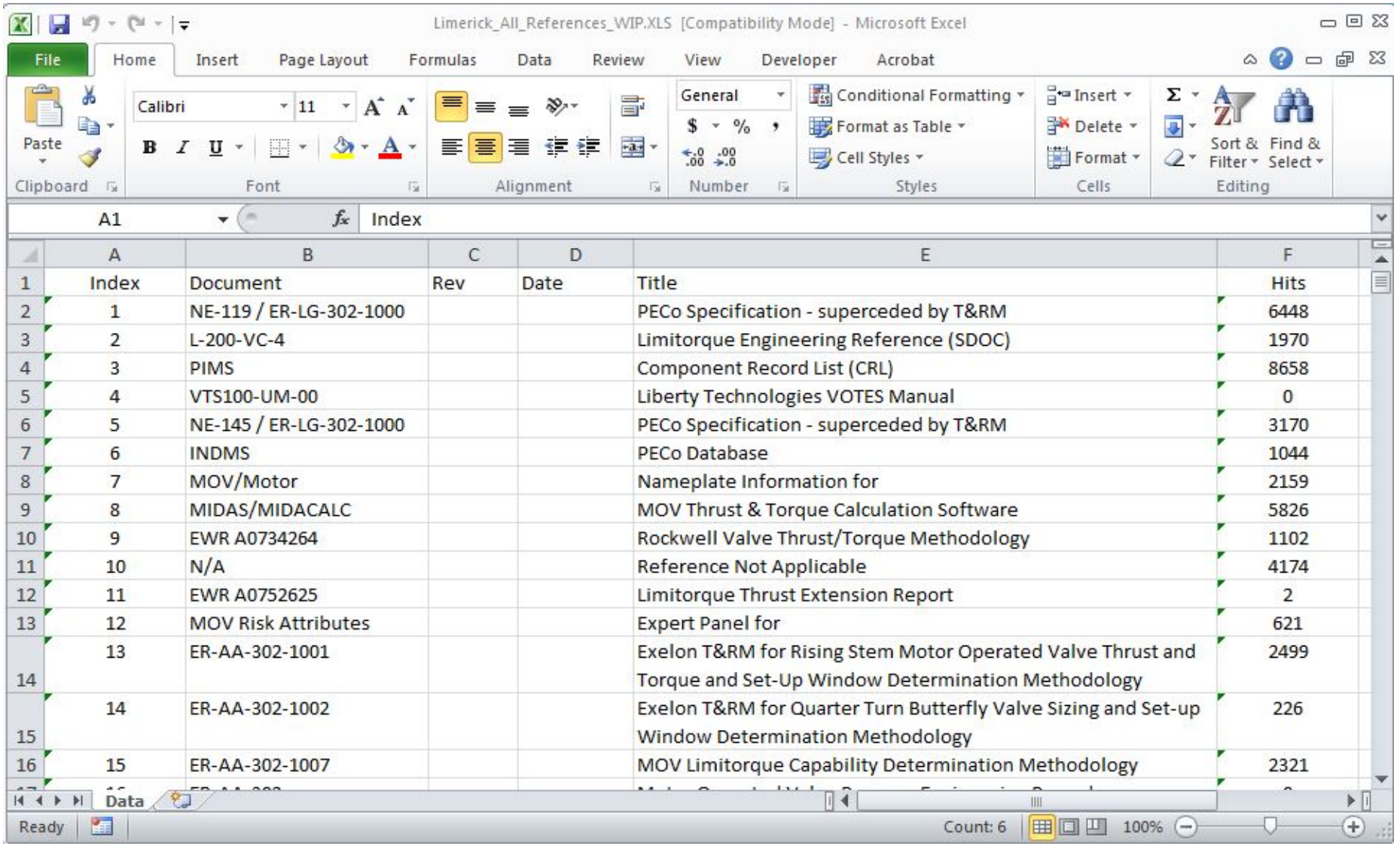
MIDAS Redirector – Reverse References WIP (Export)



	A	B	C	D	E	F
1	Index	Document	Rev	Date	Title	Hits
2	1	NE-119 / ER-LG-302-1000			PECo Specification - superceded by T&RM	6448
3	2	L-200-VC-4			Limitorque Engineering Reference (SDOC)	1970
4	3	PIMS			Component Record List (CRL)	8658
5	4	VTS100-UM-00			Liberty Technologies VOTES Manual	0
6	5	NE-145 / ER-LG-302-1000			PECo Specification - superceded by T&RM	3170
7	6	INDMS			PECo Database	1044
8	7	MOV/Motor			Nameplate Information for	2159
9	8	MIDAS/MIDACALC			MOV Thrust & Torque Calculation Software	5826
10	9	EWR A0734264			Rockwell Valve Thrust/Torque Methodology	1102
11	10	N/A			Reference Not Applicable	4174
12	11	EWR A0752625			Limitorque Thrust Extension Report	2
13	12	MOV Risk Attributes			Expert Panel for	621
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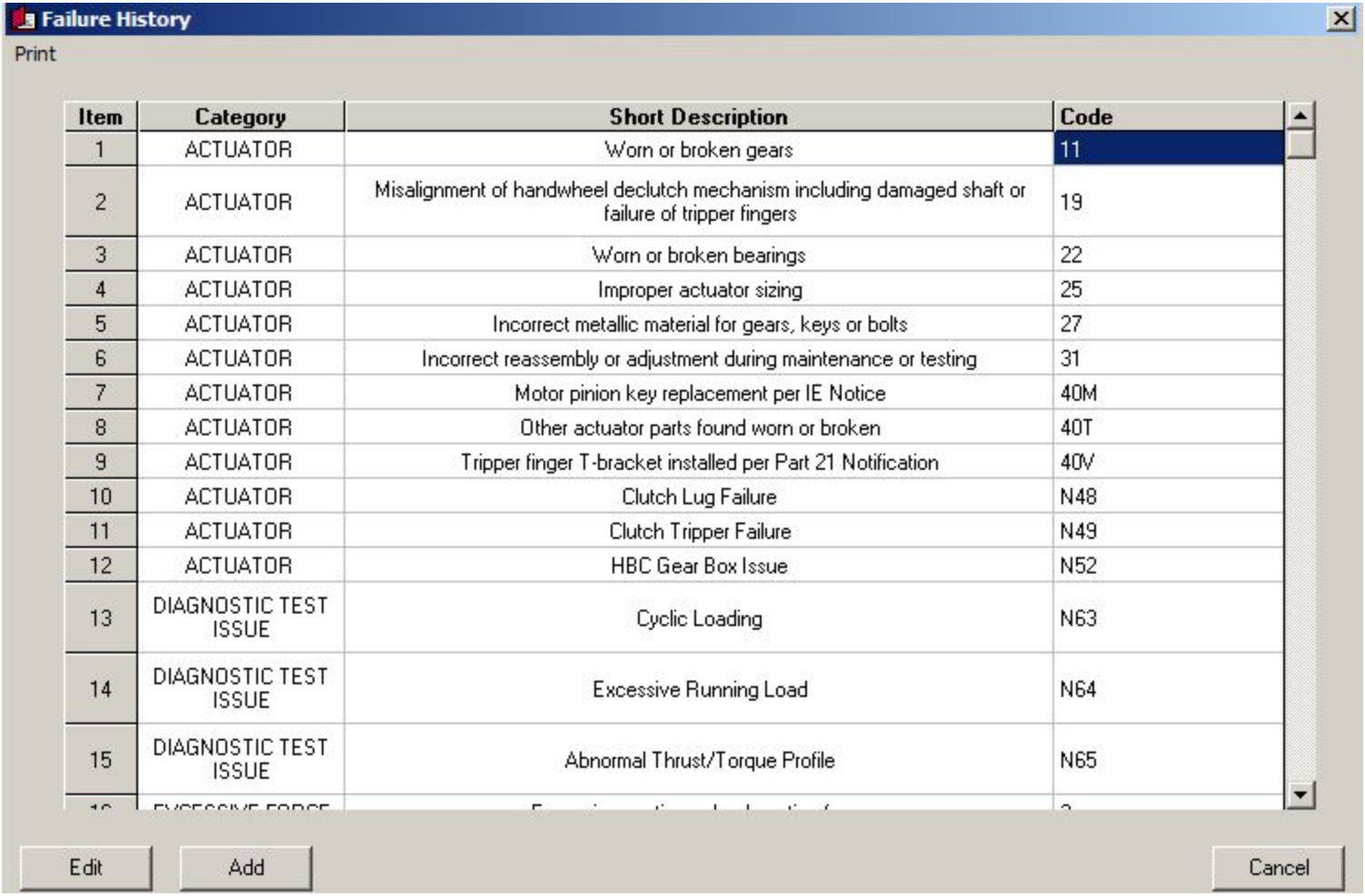
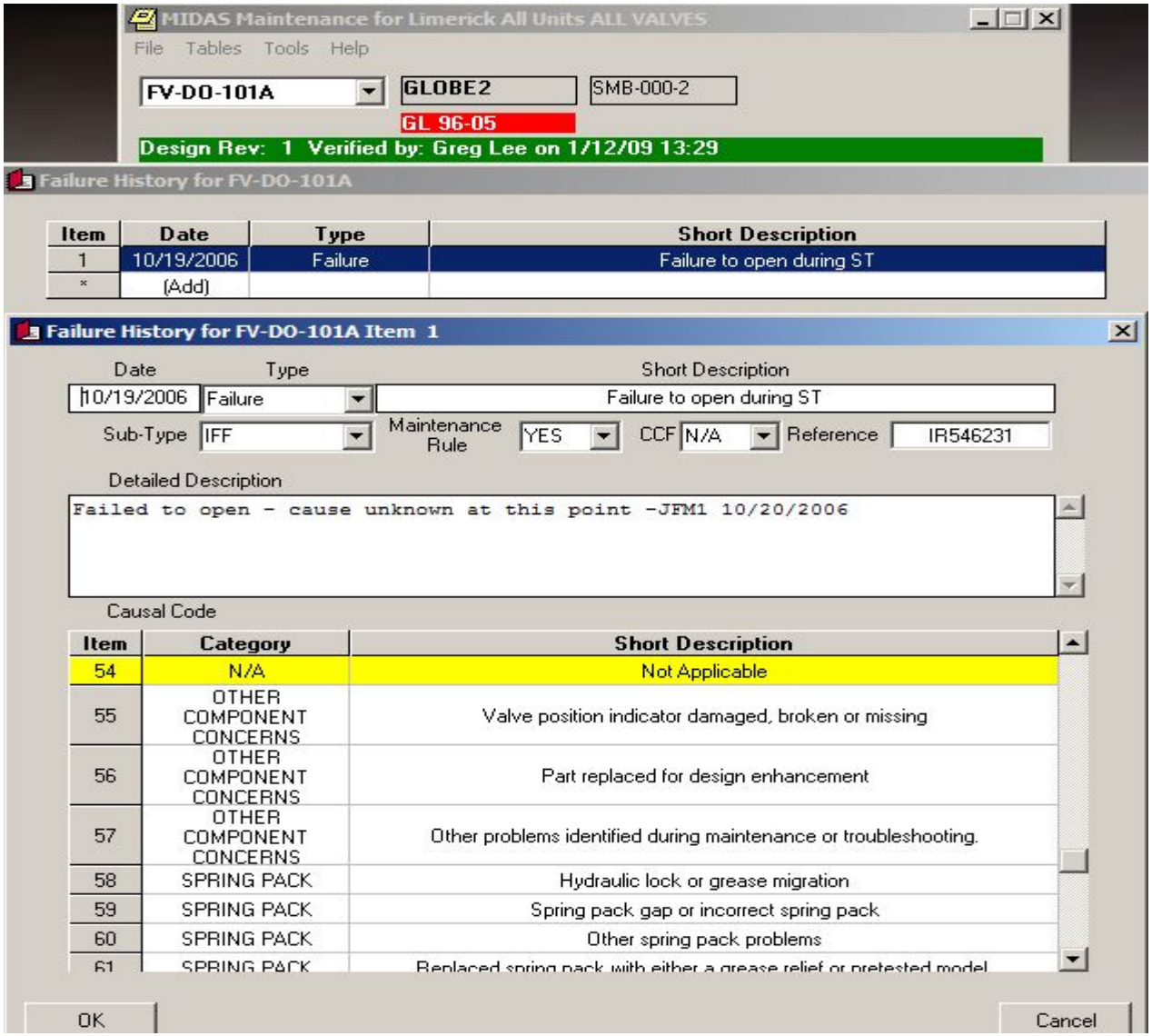
15	14	ER-AA-302-1002			Exelon T&RM for Quarter Turn Butterfly Valve Sizing and Set-up Window Determination Methodology	226
16	15	ER-AA-302-1007			MOV Limitorque Capability Determination Methodology	2321

MIDAS Redirector – Manage Failure Codes



MIDASTEST – Failure Code Process



Any Questions?

THANK YOU

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