AGENDA

NRC/JOG PUBLIC MEETING

MOTOR-OPERATED VALVE PROGRAM ON PERIODIC VERIFICATION

October 11, 2000

OWFN O-6B4

8:30 a.m.	Introductions (NRC and JOG)
8:35 a.m.	GL 96-05 Review Issues and Status (NRC)
9:00 a.m.	Status of Utility Testing and Data Submittals (JOG)
9:20 a.m.	JOG Test Program Results since previous meeting (JOG)
10:15 a.m.	BREAK
10:30 a.m.	Continue: JOG Test Program Results (JOG)
11:00 a.m.	Status of Utility Feedback Notices (JOG)
11:15 a.m.	Items of Interest (NRC) - BWROG dc motor performance methodology - Contramatic butterfly valve performance - JOG program schedule
11:45 a.m.	Action Items and Schedule for Next Meeting (NRC and JOG)
Noon	Closing (NRC)

STATUS OF GENERIC LETTER 96-05 REVIEW
(October 11, 2000)

96 REACTOR UNITS COMMITTED TO IMPLEMENT JOG PROGRAM IN GL 96-05 RESPONSE.

GL 96-05 SAFETY EVALUATION ISSUED FOR 72 UNITS:

ANO 1/2	Ginna	Prairie Island 1/2
Beaver Valley 1/2	Harris	Quad Cities 1/2
Braidwood 1/2	Hatch 1/2	River Bend
Browns Ferry 2/3	Hope Creek	Robinson
Brunswick 1/2	Indian Point 3	Salem 1/2
Byron 1/2	Kewaunee	Seabrook
Calvert Cliffs 1/2	LaSalle 1/2	Sequoyah 1/2
Catawba 1/2	McGuire 1/2	South Texas 1/2
Clinton	Millstone 2	Summer
Comanche Peak 1/2	Monticello	TMI-1
Cooper	Oconee 1/2/3	Waterford
Diablo Canyon 1/2	Palisades	Watts Bar
Dresden 2/3	Palo Verde 1/2/3	WNP-2
Duane Arnold	Perry	Wolf Creek
Fermi 2	Pilgrim	Vogtle 1/2
FitzPatrick	Point Beach 1/2	

GL 96-05 TECHNICAL REVIEW COMPLETE AND SAFETY EVALUATION IN PREPARATION FOR 23 UNITS:

Grand Gulf	North Anna 1/2	Susquehanna 1/2
Indian Point 2	Oyster Creek	Surry 1/2
Limerick 1/2	Peach Bottom 2/3	Turkey Point 3/4
Millstone 3	San Onofre 2/3	Vermont Yankee
Nine Mile Point 1/2	St. Lucie 1/2	

7 NON-JOG UNITS ADDRESSED SEPARATELY:

Callaway (inspection and followup information under review)
Crystal River (to submit JOG commitment)
Davis Besse (to submit JOG commitment)
Fort Calhoun (Request for Additional Information to be issued)
Palisades (inspection and SE issued)
San Onofre 2/3 (inspection and SE issued)

STAFF PLANS TO COMPLETE GL 96-05 REVIEWS IN 2000 (EXCEPT DC COOK UNDERGOING GL 89-10 REVIEW).

Joint Owners' Group (JOG)
MOV Periodic Verification (PV) Program

Status Update

JOG-NRC Meeting

October 11, 2000

MPR

JOG PV Program Participation

- Four Owners' Groups (B&WOG, BWROG, CEOG, & WOG)
  - 62 plants
  - 98 units
- Additional program participants
  - 1single-unit B&WOG plant addition. MPR and OG working with plant to identify test valves.
  - 1 two-unit WOG plant addition. 4 test valves identified and added to matrix.
- Current Test Matrix (196 total valves) is attached

Dynamic Test Program Results

Status of in-plant test data submittals (as of 10/3/00)

Valve Type	No. of Baseline Test Data Packages		No. of Second Test Data Packages		No. of Third Test Data Packages	
	Received	Approved	Received	Approved	Received	Approved
Gate	135	106	70	39	9	5
Butterfly	20	14	11	9	1	-
Balanced Globe	8	7	5	4	-	-
Unbalanced Globe	11	8	7	4	2	2
Total	174	135	93	56	12	7

Total test packages received (as of 10/3/00) = 279

Total test packages approved (as of 10/3/00) = 198

Note: The above totals do not include 15 test data packages which were evaluated and not accepted

JOG-MOV (Periodic Verification) UTILITY DYNAMIC TEST SCORECARD

195	ORIGINAL number of valves in JOG test program
196	CURRENT number of valves in JOG test program

	Tests Sch	Tests Perf	%	TP Sch	TP Sub	%	SEP 2000
JOG Test 1	190	187	98%	181	174	96%	95%
JOG Test 2	113	101	89%	96	93	97%	87%
JOG Test 3	9	12	133%	12	12	100%	133%
JOG Totals	312	300	96%	289	279	97%	93%
MAR 00	267	251	94%	231	217	94%	88%

VALVES IN PROGRAM vs VALVES TESTED

		TEST 1		TEST 2		TEST 3		CUM	
TOT	196	187	95%	101	52%	12	6%	300	51%
UnTested Valves		9		95		184		288	49%

X\VTRG\SCARD-JOG

Testing Progress

- Owners' Group Project Managers track testing status at each plant to ensure testing is completed and test packages are submitted.
- We have approximately reached the halfway point in test package submittals.
- As agreed upon last meeting, the 5 year test program will officially end October 2002.

Feedback to Program Participants

- Important Program issues and observations of valve test results are communicated back to plants via JOG Feedback Notices.
- Feedback Notice FN-01, Rev.1 issued April 1999 to communicate information on Aloyco split wedge gate valve with significant observed valve factor increase.
- Feedback Notice FN-02, Rev.0 issued October 1999 to address potential impact of under-filled matrix categories on Program coverage.
- Feedback Notice FN-03, Rev.0 issued February 2000 to address observed behavior of gate valves after valve disassembly.

FN-03: Gate Valve Disassembly/Reassembly

- Feedback Notice FN-03 addresses observed behavior of gate valves after valve disassembly.
  - Valve factors after valve re-assembly tend to be reduced
  - The reduced valve factors can increase back to level prior to valve disassembly (i.e., plants should not depend on a low, post-maintenance measured VF remaining low)
  - Several valves in the program have exhibited this behavior

Dynamic Test Program Results

Test data packages used to present results at this meeting:

Valve Type	No. of Baseline Test Data Packages	No. of Second Test Data Packages	No. of Third Test Data Packages
Gate	104	62	7
Butterfly	15	11	1
Balanced Globe	7	5	-
Unbalanced Globe	9	4	2
Total	135	82	10

Total packages included in presentation of results = 227

Evaluating Gate Valve Test Results to Focus on Seat and Guide Friction

Disk-to-Seat Friction

- Premise - Closing strokes from flow isolation to initial wedging (1st point), and opening strokes from just after cracking to flow initiation have a DP thrust that is controlled by sliding of the disk face on the seat ring. (*Note: for some data points on A/D double disk valves and Aloyco split wedge valves (closing strokes), mechanisms other than disk-to-seat sliding may be involved.)*
- Primary Influences - disk-to-seat material pair, number of DP strokes, fluid type and temperature
- Other Influences - Current valve factor, normal valve position, flowing vs. stagnant, system drained, disassembly/re-assembly before test.

Evaluating Gate Valve Test Results to Focus on Seat and Guide Friction (cont'd)

Disk-to-Seat Friction (cont'd)

- Approach
  - Screen out inapplicable A/D and Aloyco data.
  - Plot all data for specific disk-seat material combinations and fluid environments together (e.g., regardless of guide material, valve type, etc.) Use both opening and closing data (but identify).
  - Plot data in ways to reveal effects of specific mechanisms.

Evaluating Gate Valve Test Results to Focus on Seat and Guide Friction (cont'd)

Guide Friction

- Premise - Closing strokes before flow isolation and opening strokes after flow initiation have a DP thrust that is likely to be controlled by guide friction. Disk-to-seat sliding may also control some stroke portions in these ranges, thus it may be unclear. Stroke overlays might help to distinguish the phenomena. *(Note: A/D double disk valves have no guides, and Aloyco split wedge gate valves have an assortment of guides. Therefore, exclude data from these valve types.)*
- Primary Influences - guide material pair, number of DP strokes, fluid type and temperature.

Evaluating Gate Valve Test Results to Focus on Seat and Guide Friction (cont'd)

Guide Friction (cont'd)

- Approach
  - From MPR-1807, identify basic degradation mechanisms (wear, corrosion, galling)
  - Identify material and fluid combinations susceptible and not susceptible to each mechanism
  - Go through data to identify results applicable to guide friction (most results are likely to be from opening strokes).
  - Organize and plot results to show guide friction changes. Use overlays as appropriate to highlight behavior.

Gate Valve Test Results

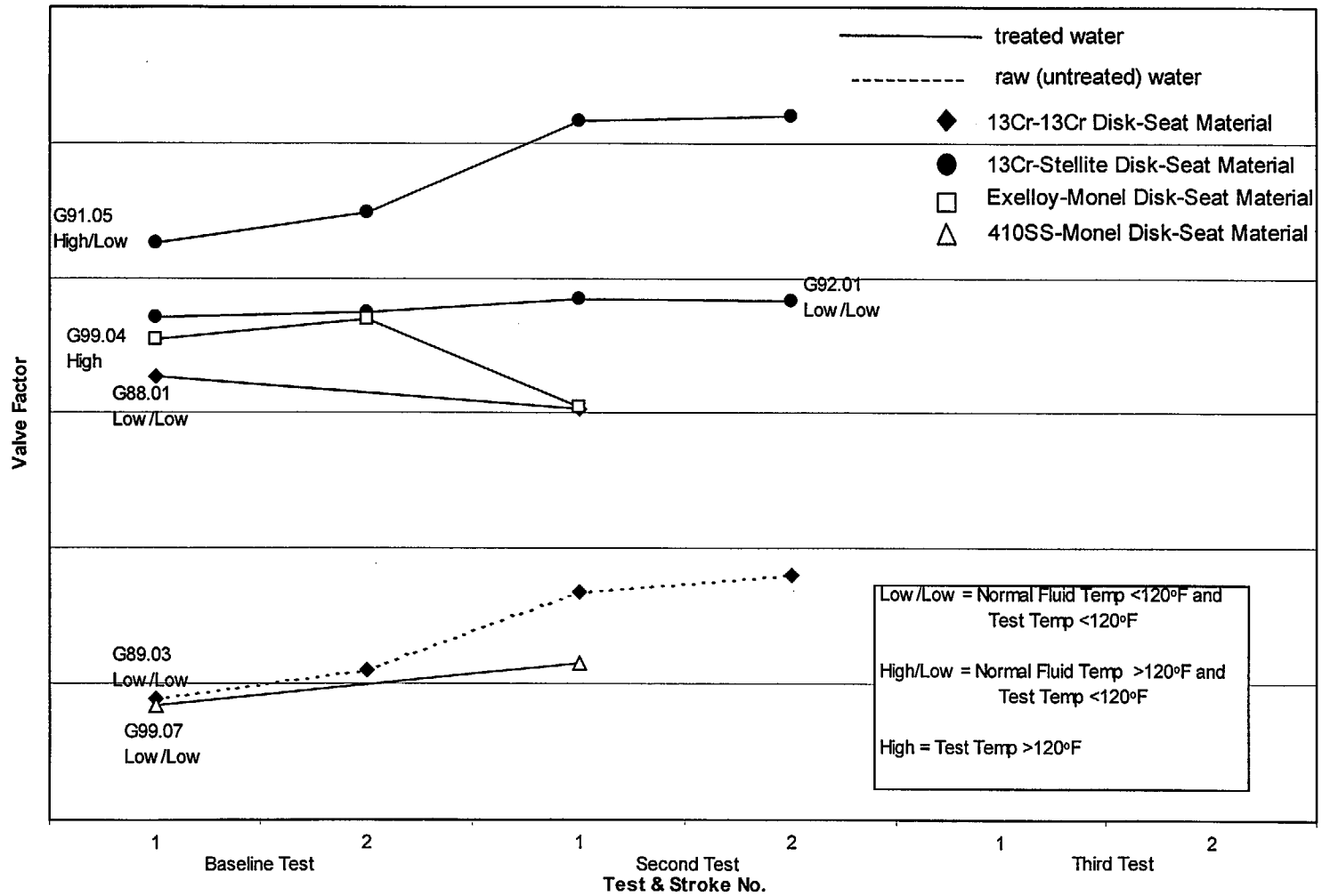
- Grouping of gate valves for presentation - focus on disk-to-seat friction and guide friction separately. Consider subdivisions by:
  - fluid medium
  - disk-to-seat material pair
  - design type
  - guide material pair
  - high/low DP stroking
  - drained/vented piping
  - stem orientation
  - normal valve position
  - valve disassembled/reassembled

Gate Valve Test Results (cont'd)

Seat Friction Evaluation

- Non-Stellite Seat Pairs
  - Most VFs relatively stable between DP tests
  - 2 valves show significant VF increases. Both repeat tests are unapproved -- additional information still being sought
    - G89.03 shows VFs increases opening and closing; low initial baseline VFs
    - G91.05 (new) shows significant VF increases opening and closing; high initial baseline VFs.

Progression of Closing Valve Factors at Initial Wedging - Non-Stellite Seat Pairs



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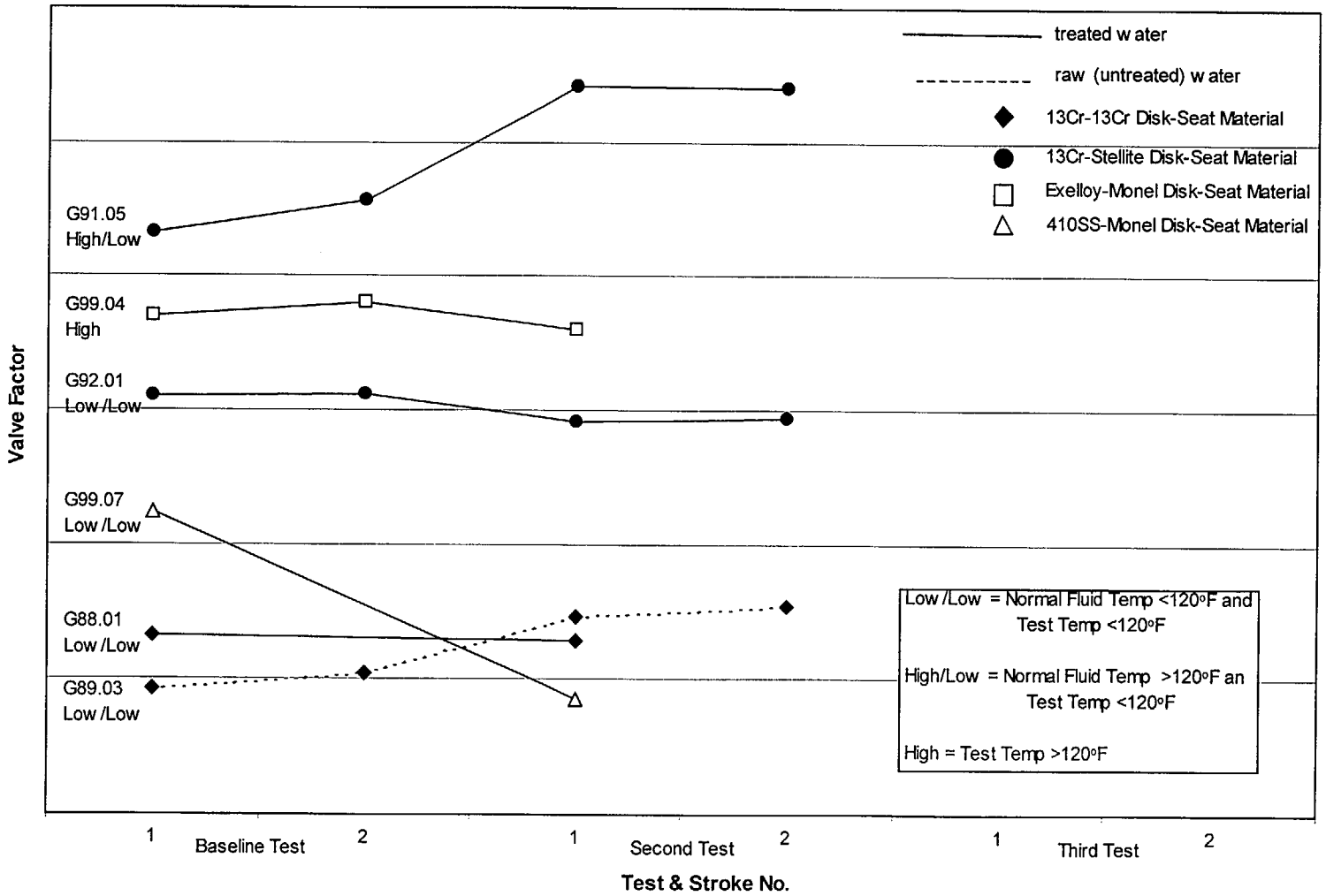
Progression of Opening Valve Factors at Flow Initiation - Non-Stellite Seat Pairs



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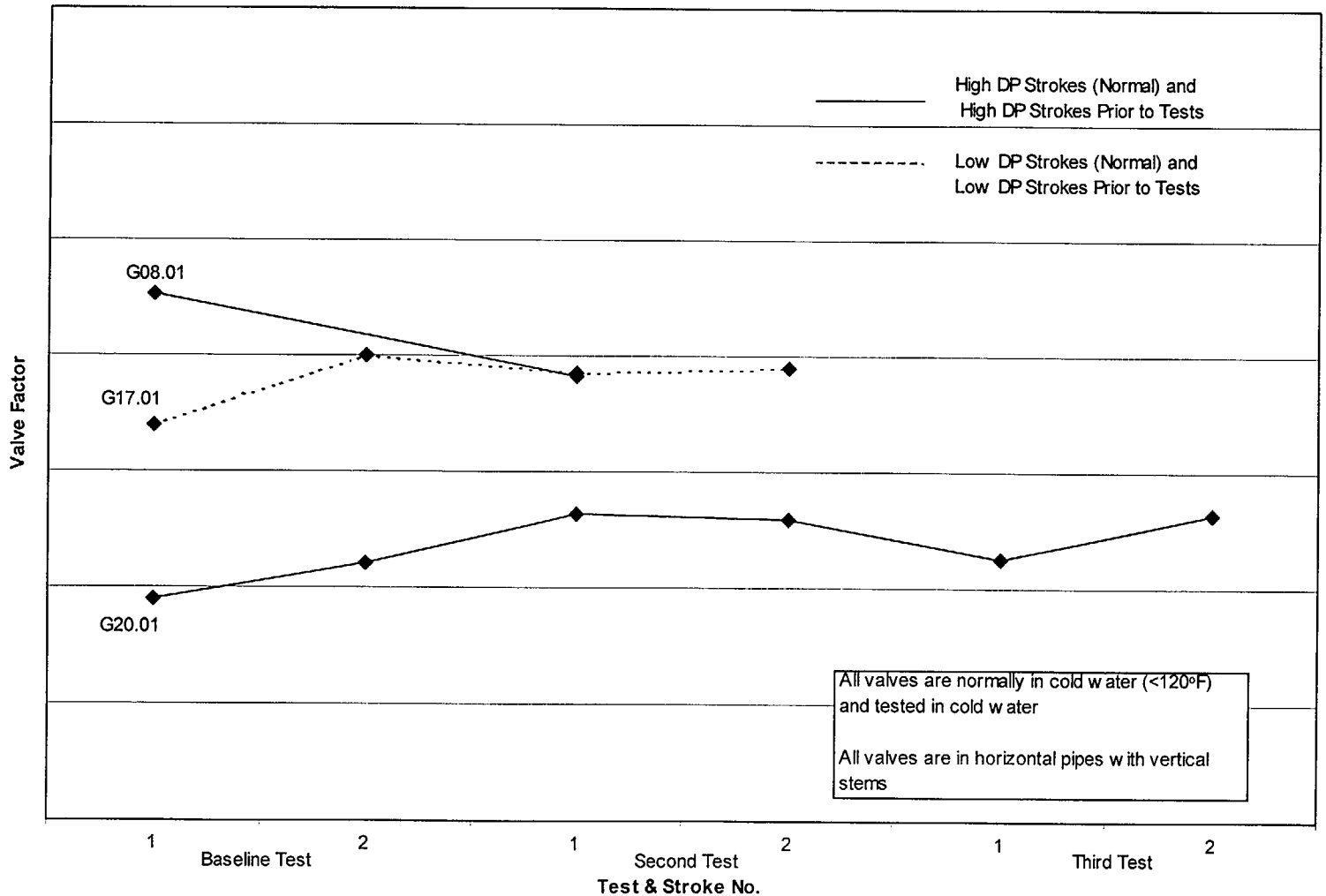
Gate Valve Test Results (cont'd)

- Stellite Seat Pairs in Untreated Water
  - limited data - only 4 repeat tests (3 second, 1 third)
  - VFs appear stable between DP tests
  - 2 new repeat tests since last meeting; both repeat packages not yet approved
    - G17.01 - second test: small changes
    - G20.01 - third test: small changes; repeatability conditions not met in second test, but returned in third test

Progression of Closing Valve Factors at Initial Wedging - Stellite Seats/Untreated Water



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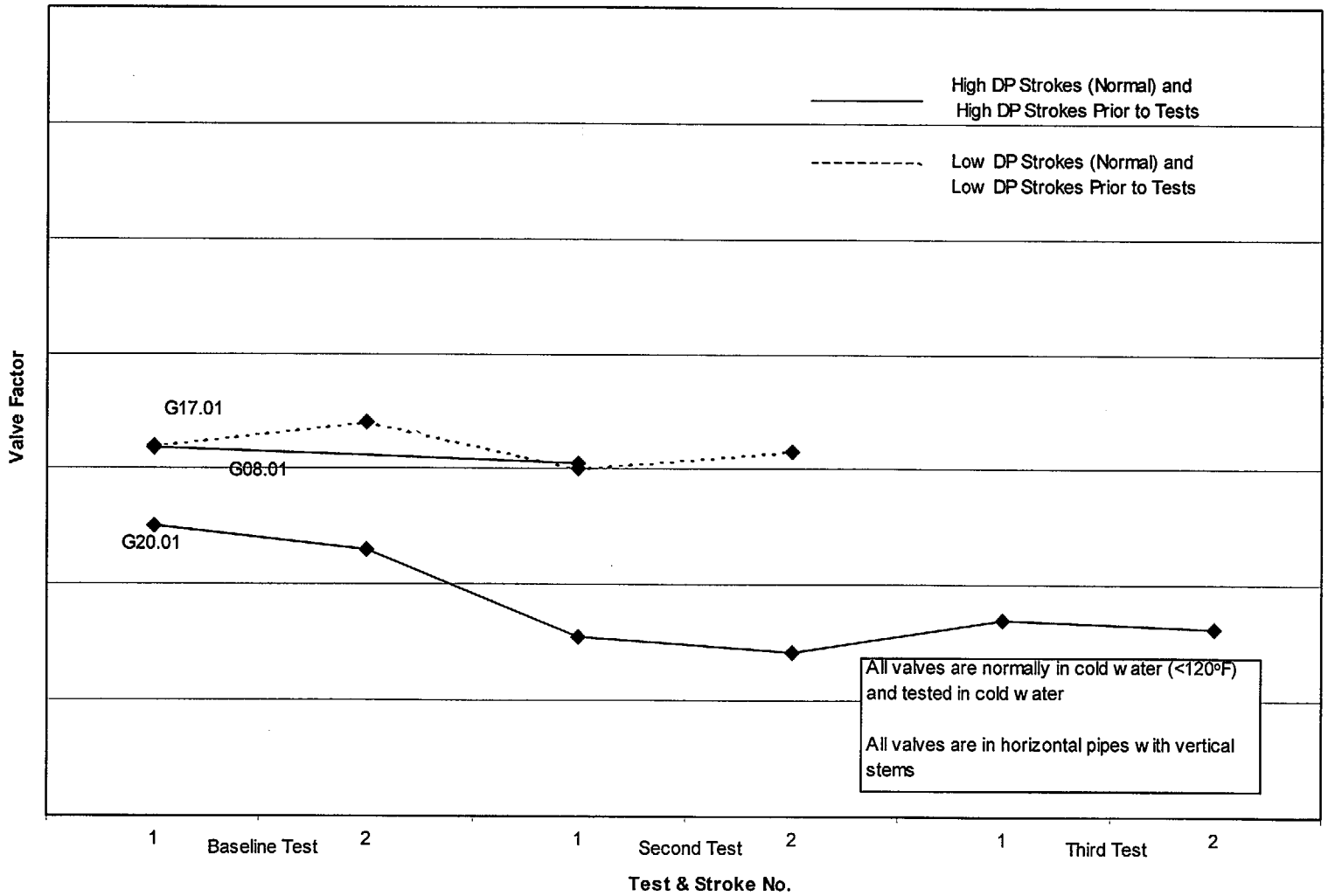
Progression of Opening Valve Factors at Flow Initiation - Stellite Seats/Untreated Water



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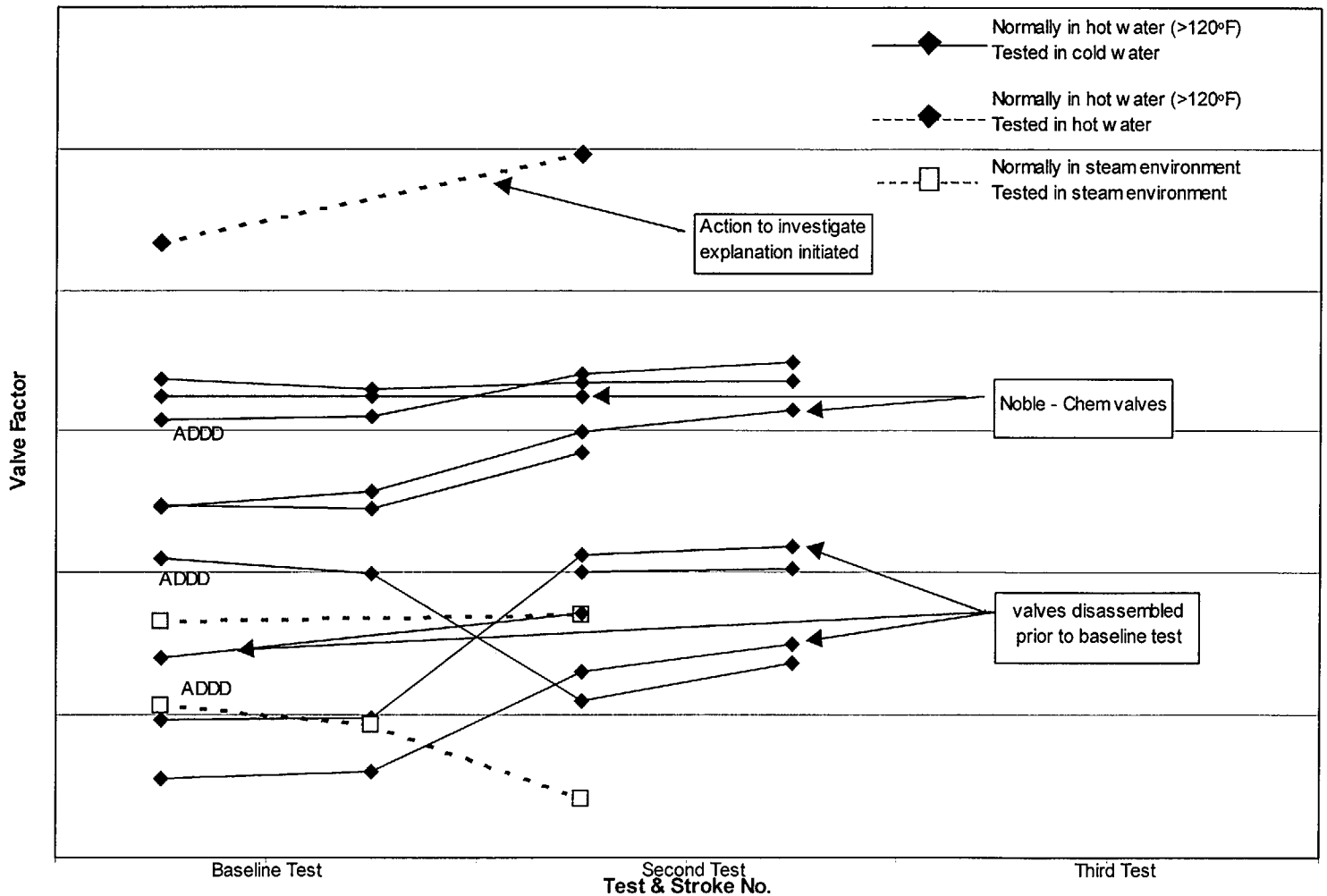
Gate Valve Test Results (cont'd)

- Stellite Seat Pairs in Hot Water/Steam
  - data considers normal fluid temperature and test temp
  - except as discussed below, data show a stable (or decreasing) valve factor
  - data includes 2 repeat tests with NobleChem injection prior to second test
    - G22.21: shows stable VFs or small decreases
    - G22.22: shows VF increases opening and closing; valve was disassembled one outage prior to baseline test -- potential FN-03 effect

Gate Valve Test Results (cont'd)

- Stellite Seat Pairs in Hot Water/Steam (cont'd)
  - data includes 3 repeat tests for valves disassembled prior to baseline test (FN-03 effect).
    - G49.01, G69.13, G83.03
    - low baseline VFs with large VF increases between baseline and second tests; all rapid attention
  - One other repeat test (G79.02) with significant VF increase between tests in close direction, stable in open direction; package just approved.

Progression of Closing Valve Factor at Initial Wedging - Stellite Seats/ Hot Water/Steam



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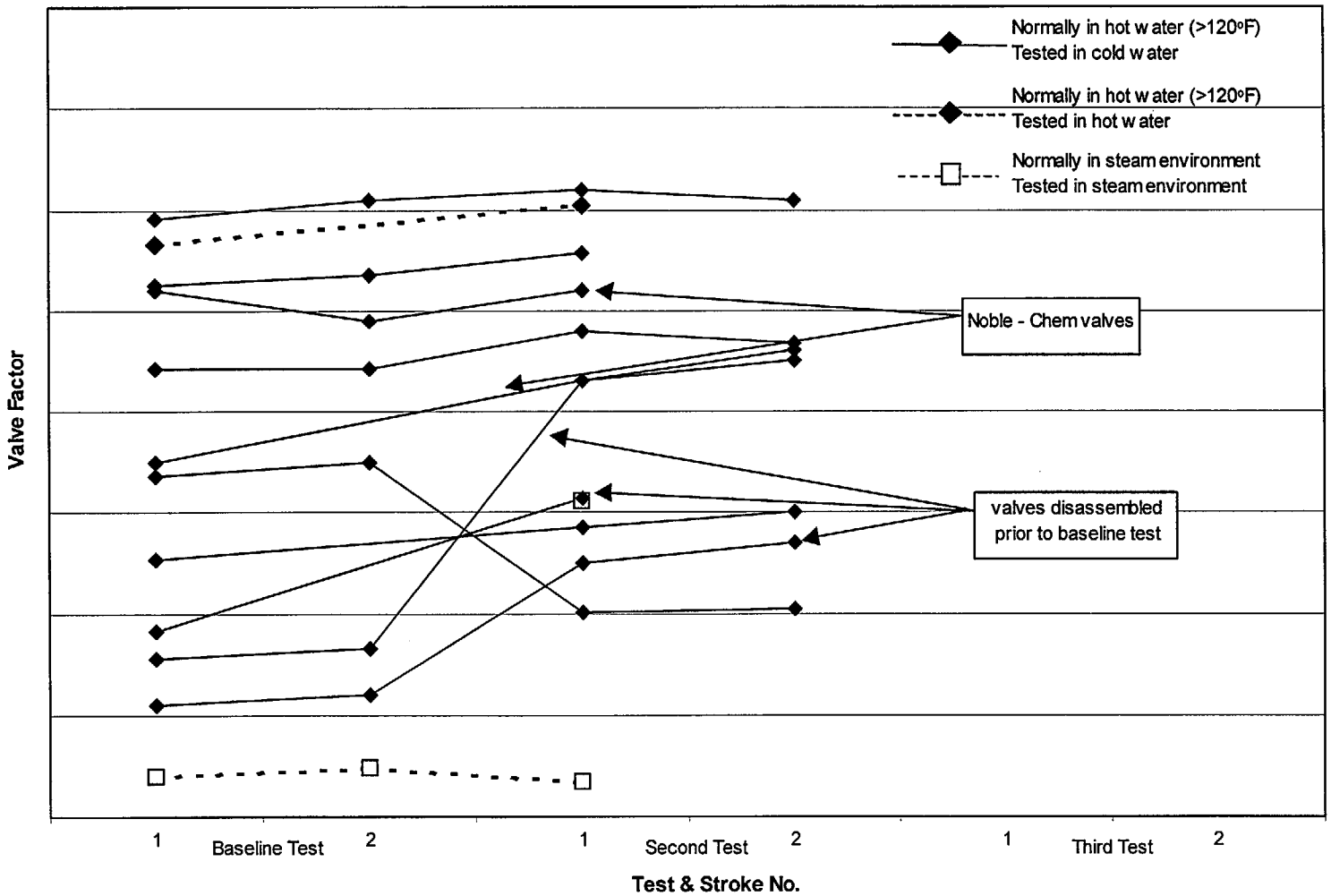
Progression of Opening Valve Factor at Flow Initiation - Stellite Seats/ Hot Water/Steam



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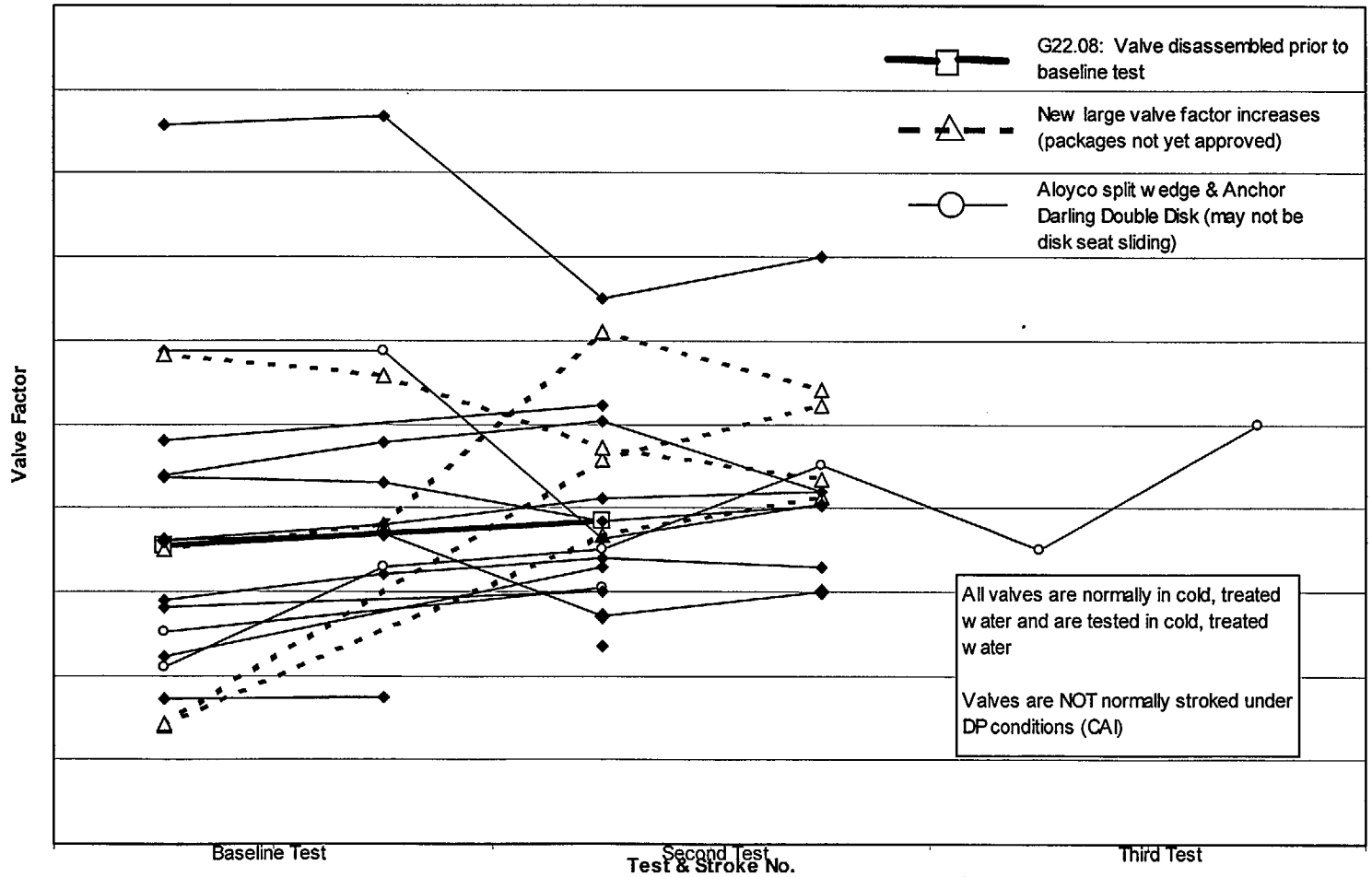
Gate Valve Test Results (cont'd)

- Stellite Seat Pairs/Cold Treated Water/No DP Strokes
  - data considers valves not typically DP stroked (based on CAI); some stroking may have occurred between tests
  - More than half of the valves have stable or decreasing VFs.
  - as valves are repeat tested, VFs for group appear to be coming together
  - several significant VF increases between tests
    - G22.08: valve disassembled prior to baseline test; rapid attention criteria exceeded and dispositioned by Core Group [FN-03 effect]
    - 4 new repeat tests indicate valves also disassembled at some point prior to the baseline test. Packages not yet approved - additional information still being sought [potentially FN-03 effect]

Progression of Closing Valve Factor at Initial Wedging - Stellite Seats/Cold Treated Water/No DP Strokes



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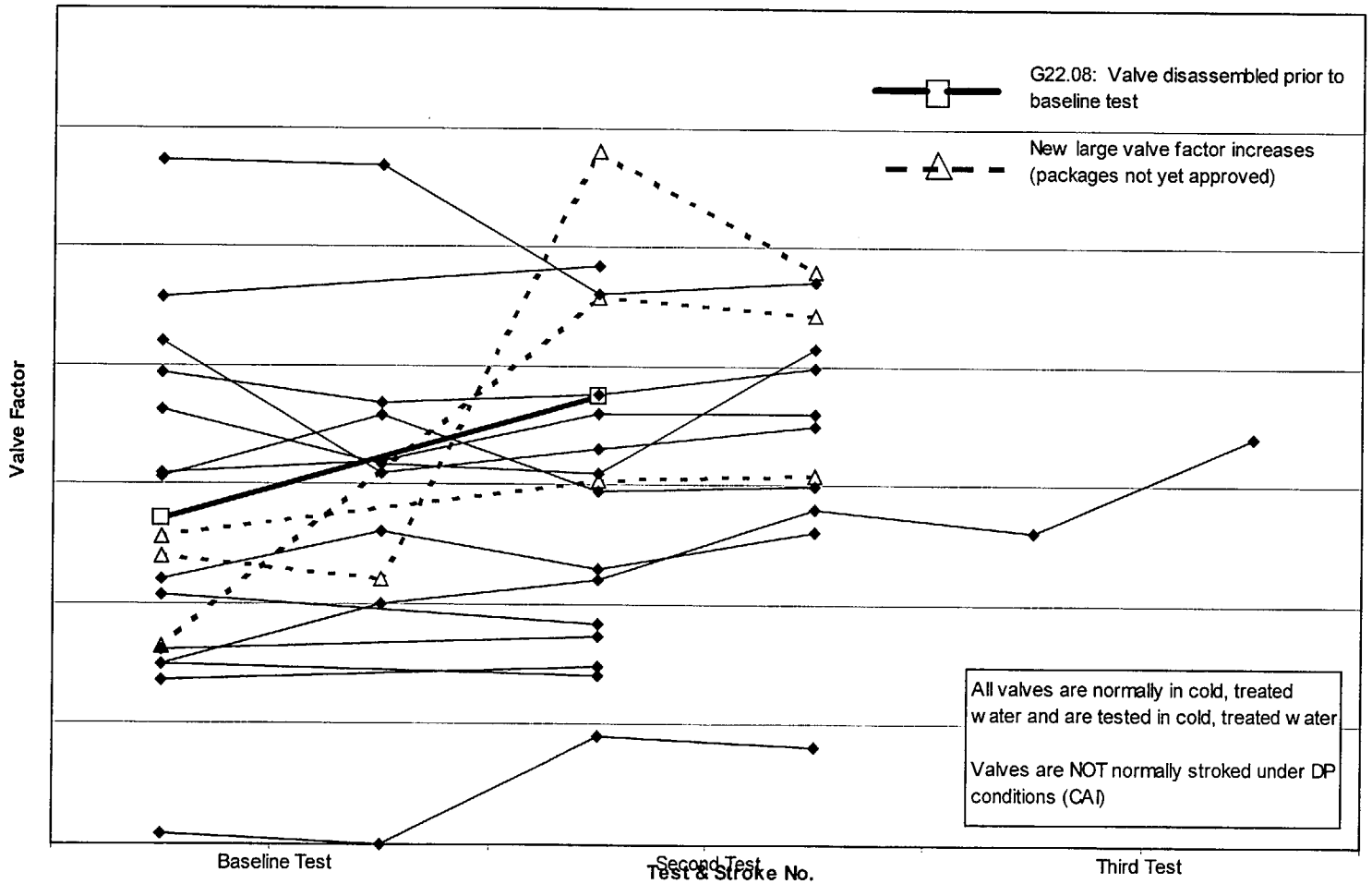
Progression of Opening Valve Factor at Flow Initiation - Stellite Seats/Cold Treated Water/No DP Strokes



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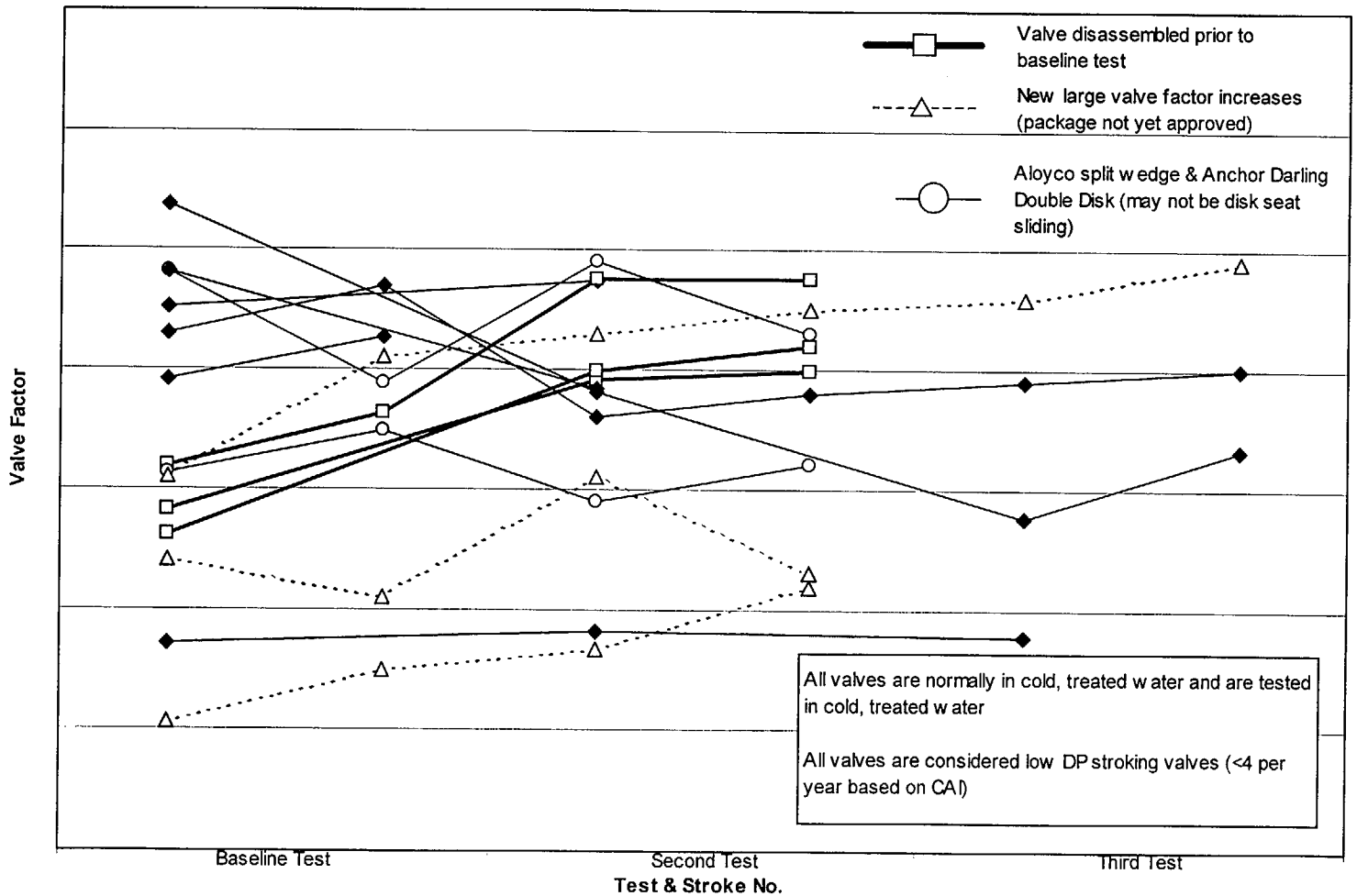
Gate Valve Test Results (cont'd)

- Stellite Seat Pairs/Cold Treated Water/Low DP Strokes
  - data considers valves that are typically stroked under DP $\leq$3 times per year (CAI)
  - 8 of 14 valves have stable or decreasing valve factors
  - 3 repeat tests for valves disassembled prior to baseline test (G44.10, G44.13, G44.14); all rapid attention [FN-03]
  - 3 new repeat tests with significant VF increases [potential FN-03 effect]
    - G22.03 & G69.03: low baseline VFs at all points; packages not yet approved
    - G85.01: all three tests completed; VF appears to stabilize in third test

Progression of Closing Valve Factors at Init Wedging - Stellite Seats/Cold Treated Water/Low DP Strokes



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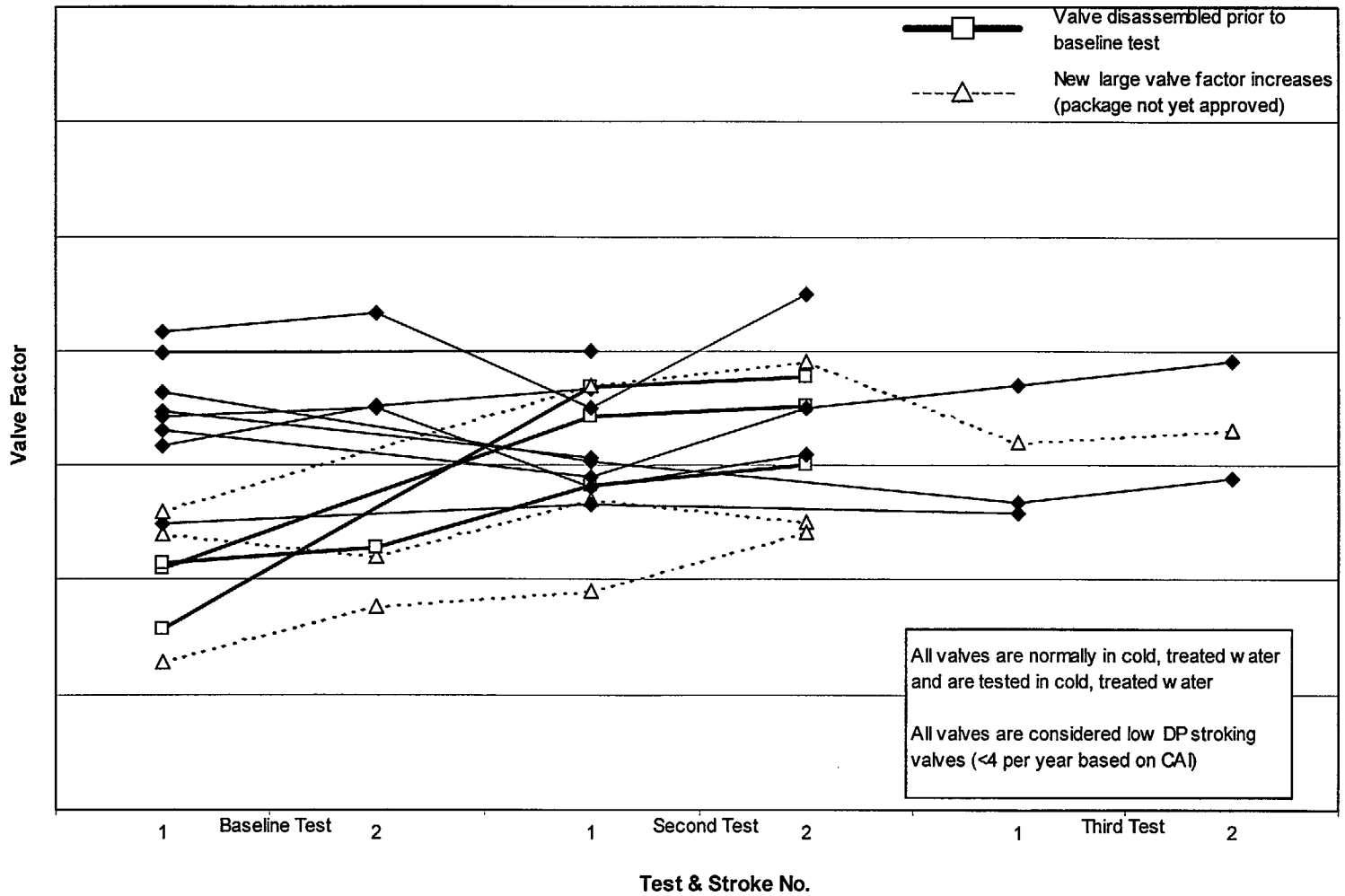
Progression of Opening Valve Factors at Flow Initiation - Stellite Seats/Cold Treated Water/Low DP Strokes



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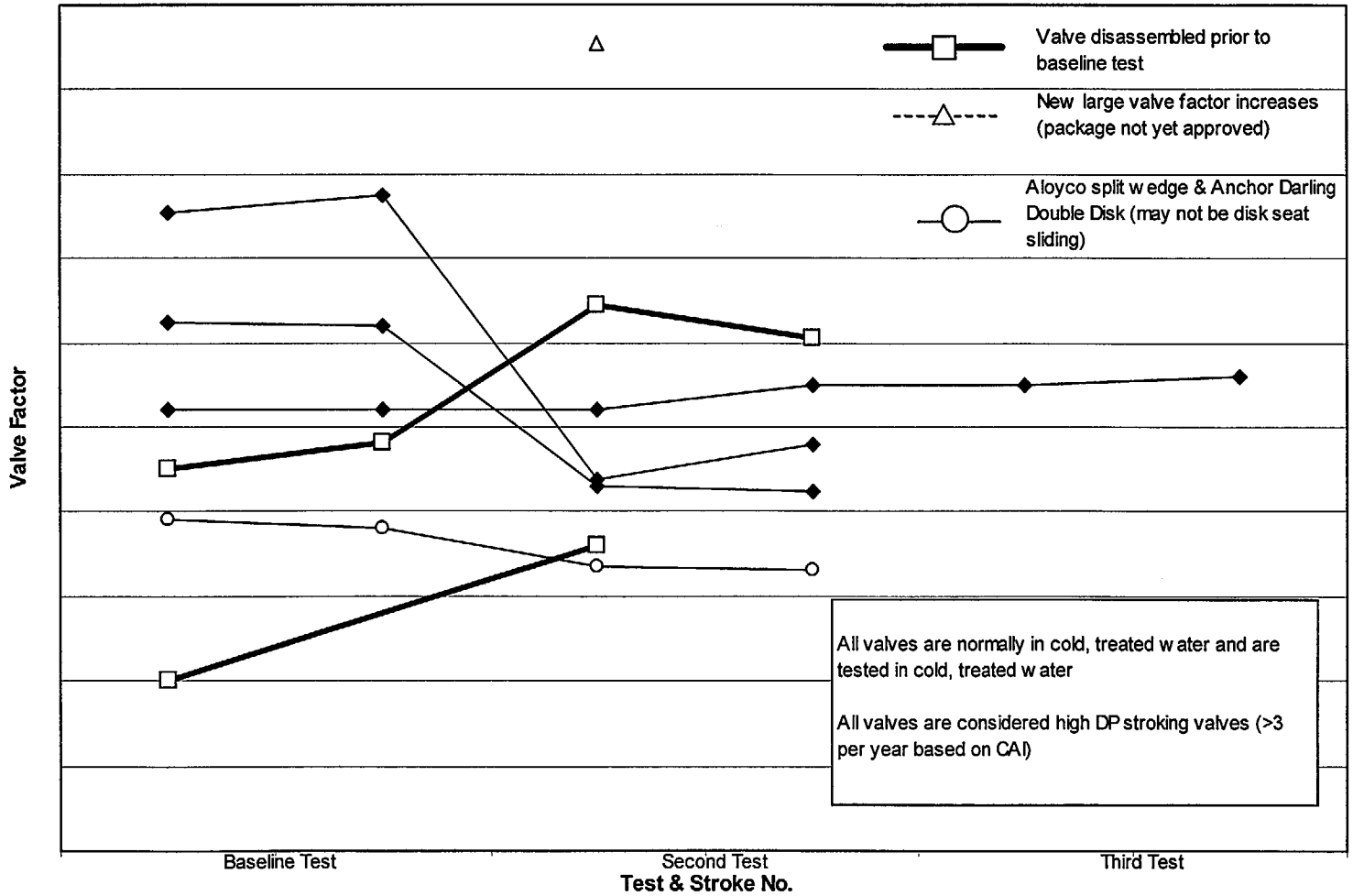
Gate Valve Test Results (cont'd)

- Stellite Seat Pairs/Cold Treated Water/High DP Strokes
  - data considers valves that are typically stroked under DP >3 times per year (CAI)
  - 4 of 7 valves have stable or decreasing valve factors
  - 2 approved repeat tests for valves (G22.08 and G27.08) known to have been disassembled prior to baseline test [potential FN-03 effect]
  - 1 new repeat test (G27.10) shows significant VF increase between tests in open direction
    - no baseline close data to evaluate (repeatability not met in closing direction)
    - disk replaced immediately prior to baseline test [potential FN-03 effect]

Progression of Closing Valve Factors at Initial Wedging - Stellite Seats/Cold Treated Water/High DP Strokes



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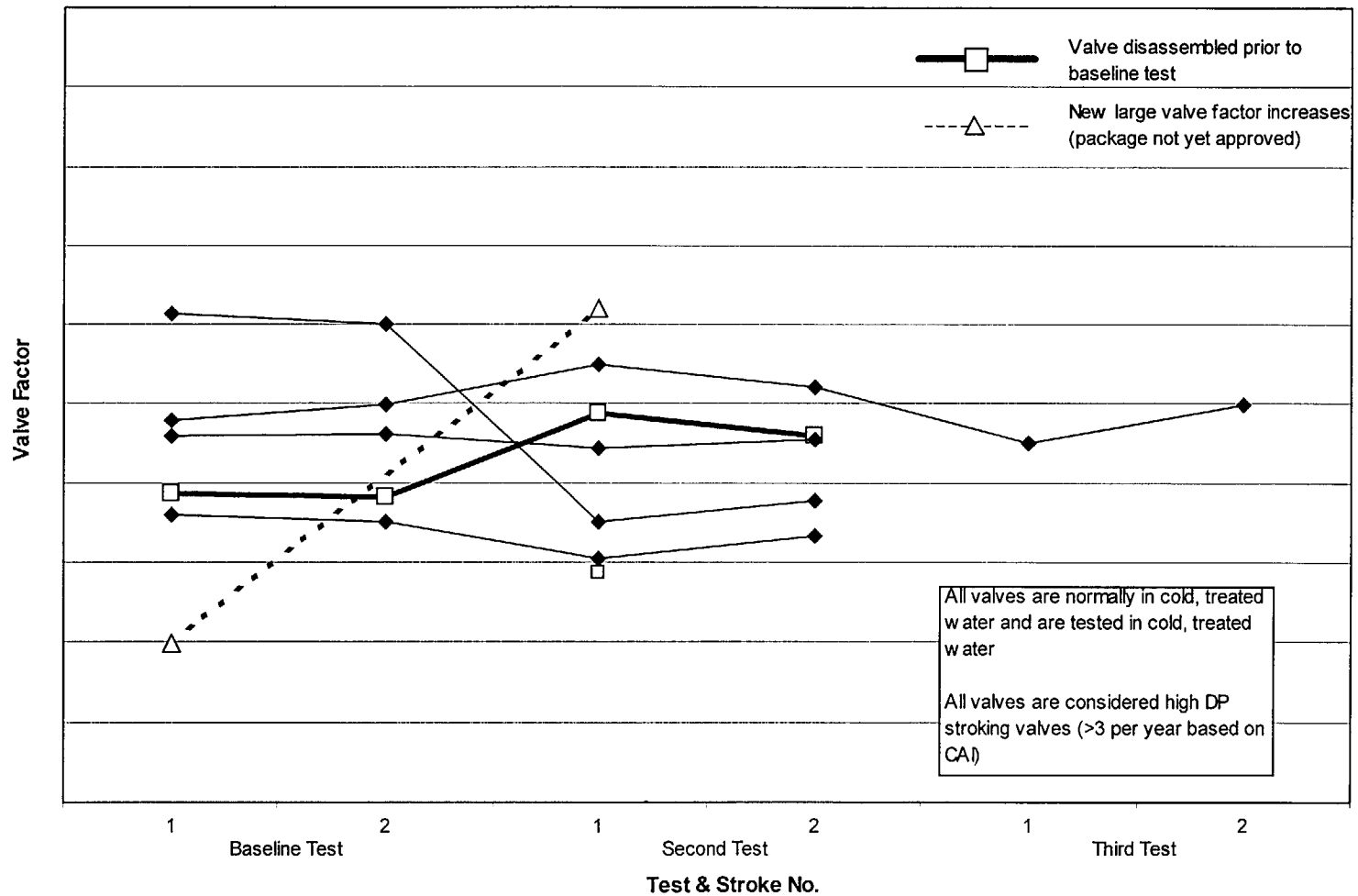
Progression of Opening Valve Factors at Flow Initiation - Stellite Seats/Cold Treated Water/High DP Strokes



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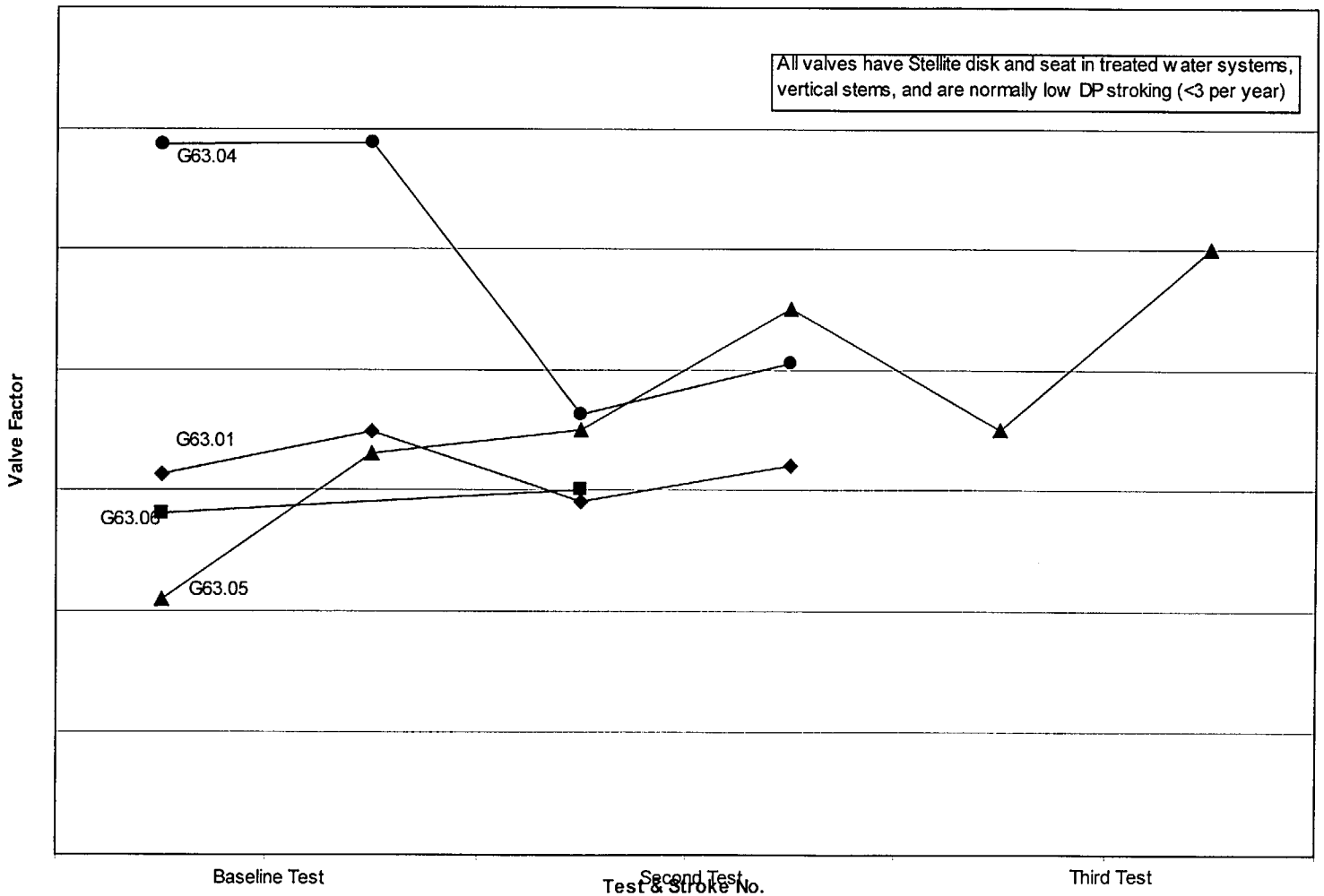
Gate Valve Test Results (cont'd)

- Split-Wedge Valves
  - attempt to evaluate closing VF behavior at seating due to ball and socket joint
  - G63.05 shows increase from baseline to second (FN-01); stabilizes from second to third
  - 3 other valves show stable or decreasing VFs

Progression of Closing Valve Factor at Initial Wedging - Split Wedge Valves



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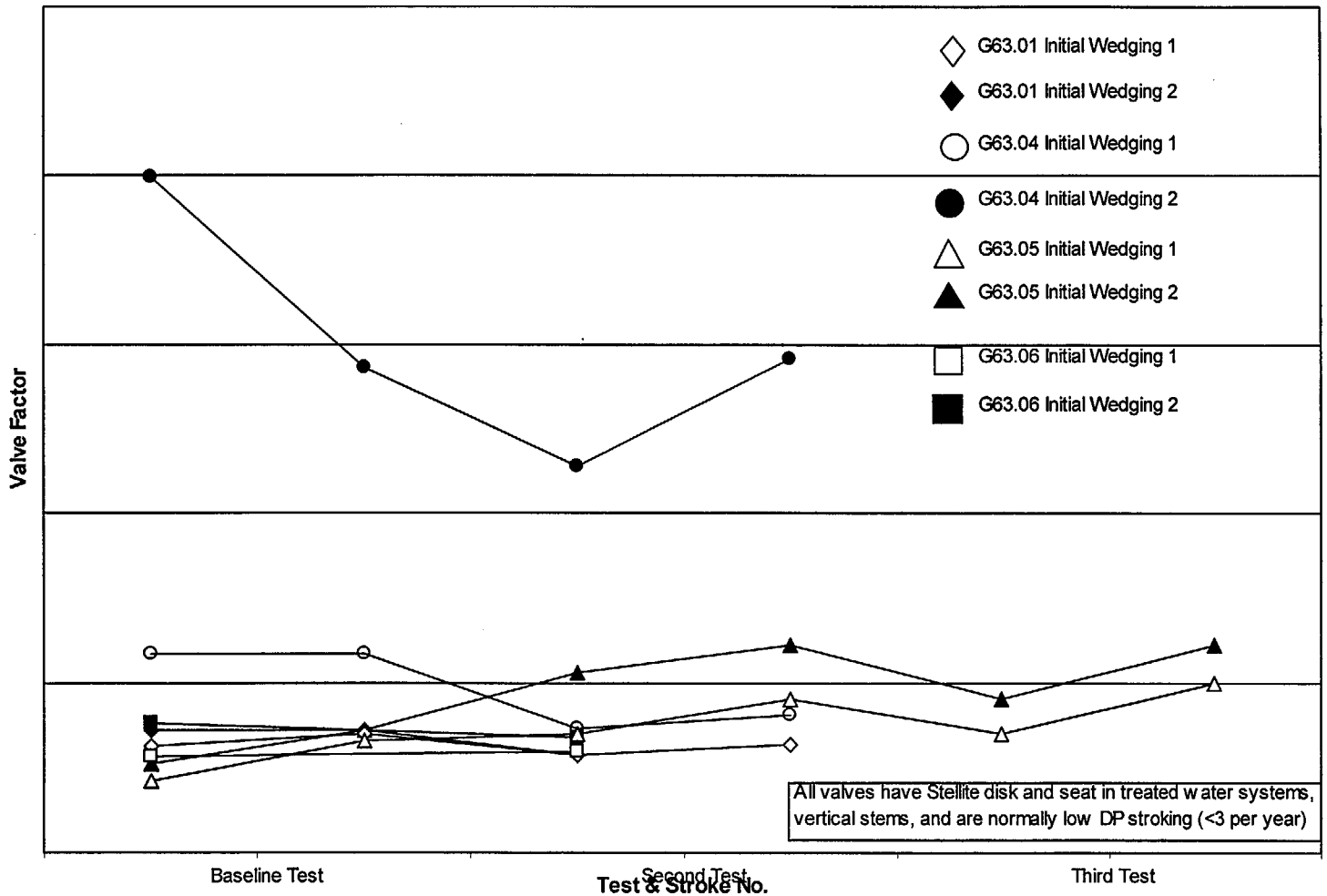
Progression of Closing Valve Factor at Initial Wedging, Points 1 & 2 - Split Wedge Valves



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Gate Valve Test Results (cont'd)

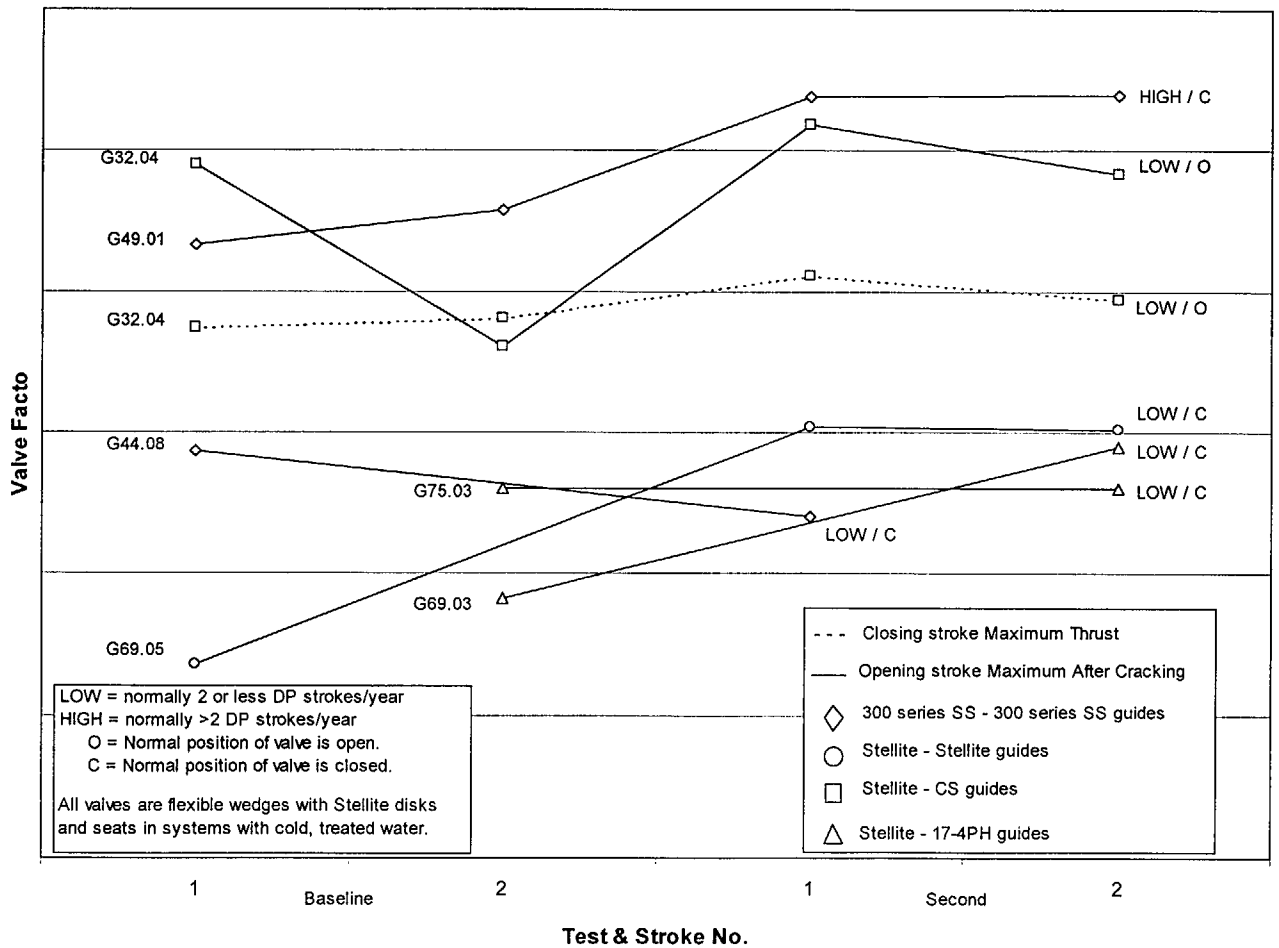
Guide Friction Evaluation

- Flexible and solid wedge gate valve repeat test data evaluated to identify instances of guide-controlled VFs
- 13 valves identified, but only six had repeated guide-controlled results (5 open-only, 1 open/close).
  - self-mated SS (2)
  - self-mated Stellite (1)
  - Stellite-CS (1)
  - Stellite - 17-4PH (2)

Gate Valve Test Results (cont'd)

- For self-mated Stellite, and Stellite - 17-4PH, the VFs are low, increases appear to be an initial rise in low values.
- For the Stellite-CS valve, the VFs are relatively stable.
- For the self-mated SS valve (G49.01), the rise is significant. This valve was disassembled before the baseline test and showed a significant increase in seat friction and a lesser increase in guide friction.

Progression of Valve Factors Attributable to Guide Friction



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Butterfly Valve Test Results

Results divided by bearing material

Bronze Bearings

- Bearing friction coefficient tends to decrease between DP strokes during a DP test sequence (14 of 15 occasions).

Treated Water Systems (4 repeat tests)

- Bearing friction coefficient increases slightly (2), decreases slightly (1) or decreases significantly (1) between DP tests (1st stroke to 1st stroke)
- One new repeat test (B15.1) - 14" Pratt (normally closed, vertical stem, low DP stroking) shows slight decrease in bearing friction coefficient.

Butterfly Valve Test Results (cont'd)

Untreated Water Systems (4 valves with repeat tests)

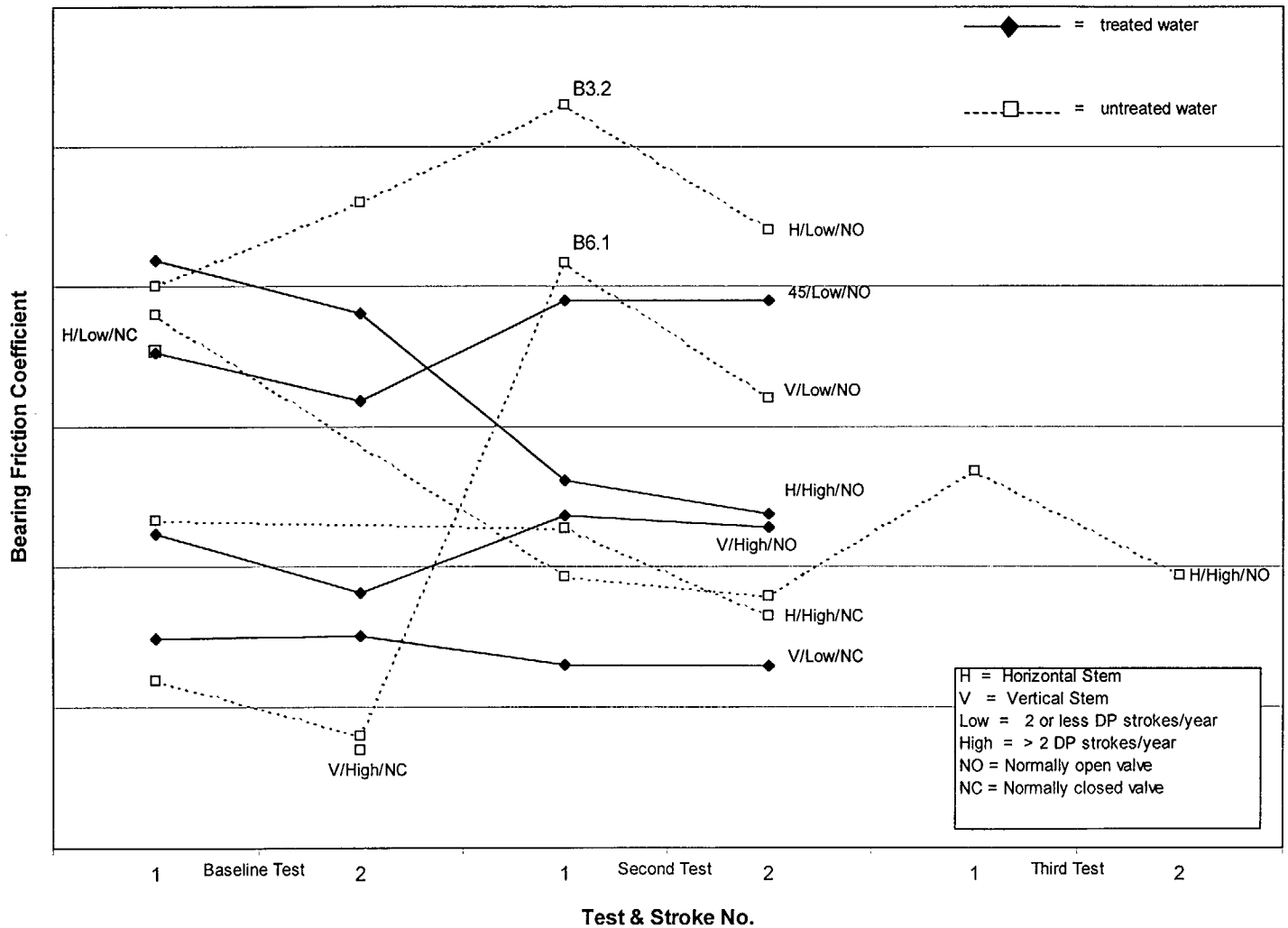
- Considerable variation in bearing mu values and changes.
- Two repeat tests have increases (B3.2, B6.1)
  - B3.2 - 20" Clow (triple offset, normally open, horizontal stem and pipe, high DP stroking) shows increase in bearing mu from first to second test. (Unapproved -- seeking additional information).
  - B6.1 - 6" Flowseal (double offset, normally open, vertical stem, high DP stroking) shows significant increase from first to second test. (Just approved -- valve installed new one outage prior to baseline test).

Butterfly Valve Test Results (cont'd)

Non-Bronze Bearings (Fiberglass, Teflon, Polyethylene, Tefzel)

- Bearing friction coefficient decreases between DP strokes during a DP test sequence (2 of 2 occasions).
- For all three repeat DP tests, bearing friction coefficient decreases between tests (1st stroke to 1st stroke).
- No new repeat tests

Progression of Bearing Friction Coefficient for Butterfly Valves - Bronze Bearings



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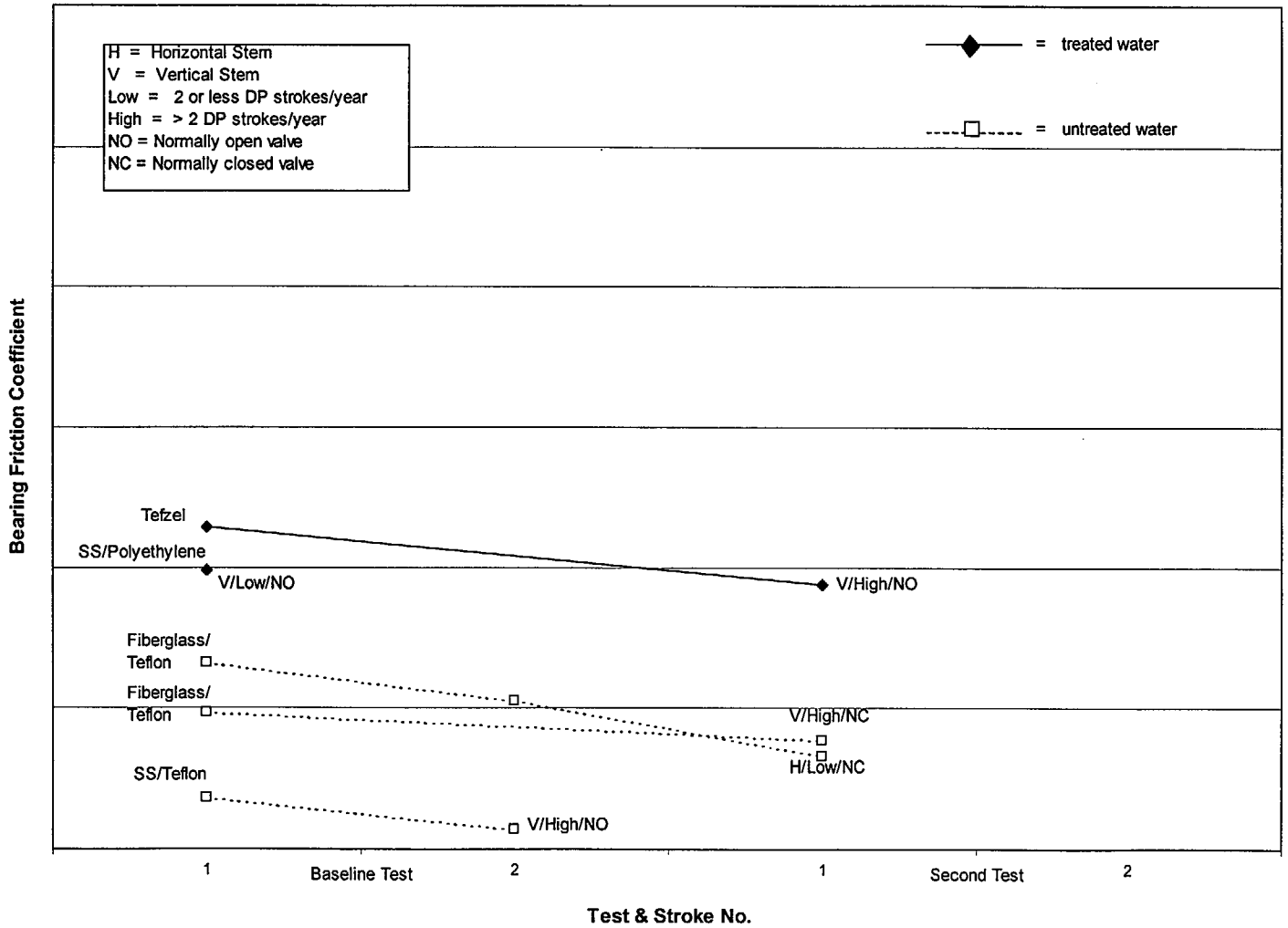
Progression of Bearing Friction Coefficient for Butterfly Valves - Non-Bronze Bearings



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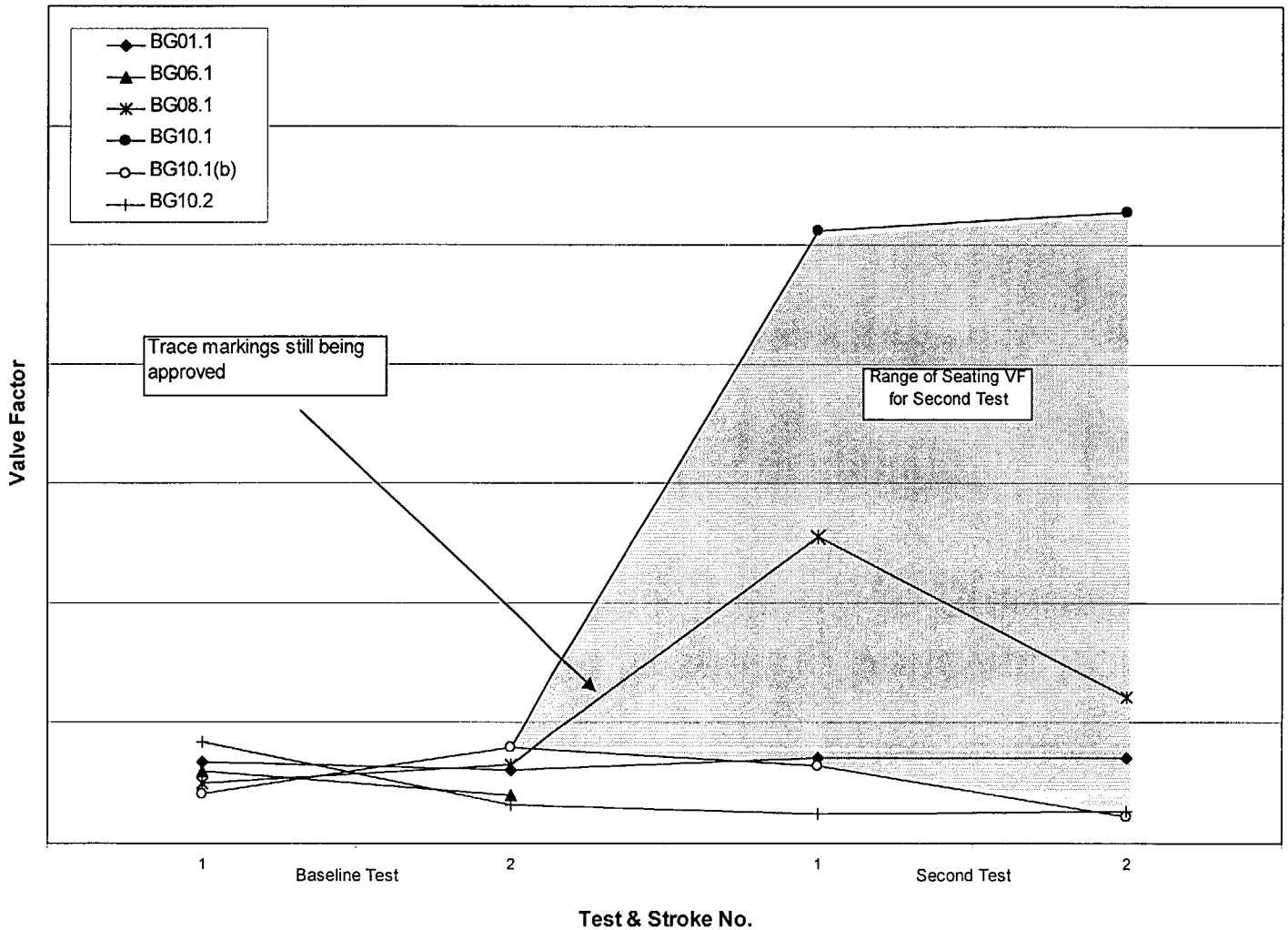
Balanced Disk Globe Valve Test Results

- Low thrust levels and low valve factors
- 5 valves with repeat test results (3 O/C, 1 O, 1 C)
  - In the open direction (max), VF changes slightly between first and second tests (1 increase, 2 decreases, 1 constant)
  - In the closing direction (seating), 2 of 4 valves potentially show VF increases; the other 2 are constant or decrease slightly.
    - BG08.1 - (unapproved) trace markings not consistent between tests -- still being reviewed.

Balanced Disk Globe Valve Test Results (cont.)

- BG10.1 - change in seating behavior from sharp seating point in baseline test to gradual gradual point in second test.
  - VF constant at "start of seating"
  - VF increases at "end of seating"
  - valve and (raw water) system "new" one outage preceding JOG test
  - third test results (not yet submitted) indicate behavior similar to second test; this behavior may be an initial "shakeout"

Progression of Valve Factor for Balanced Disk Globe Valves at Seating



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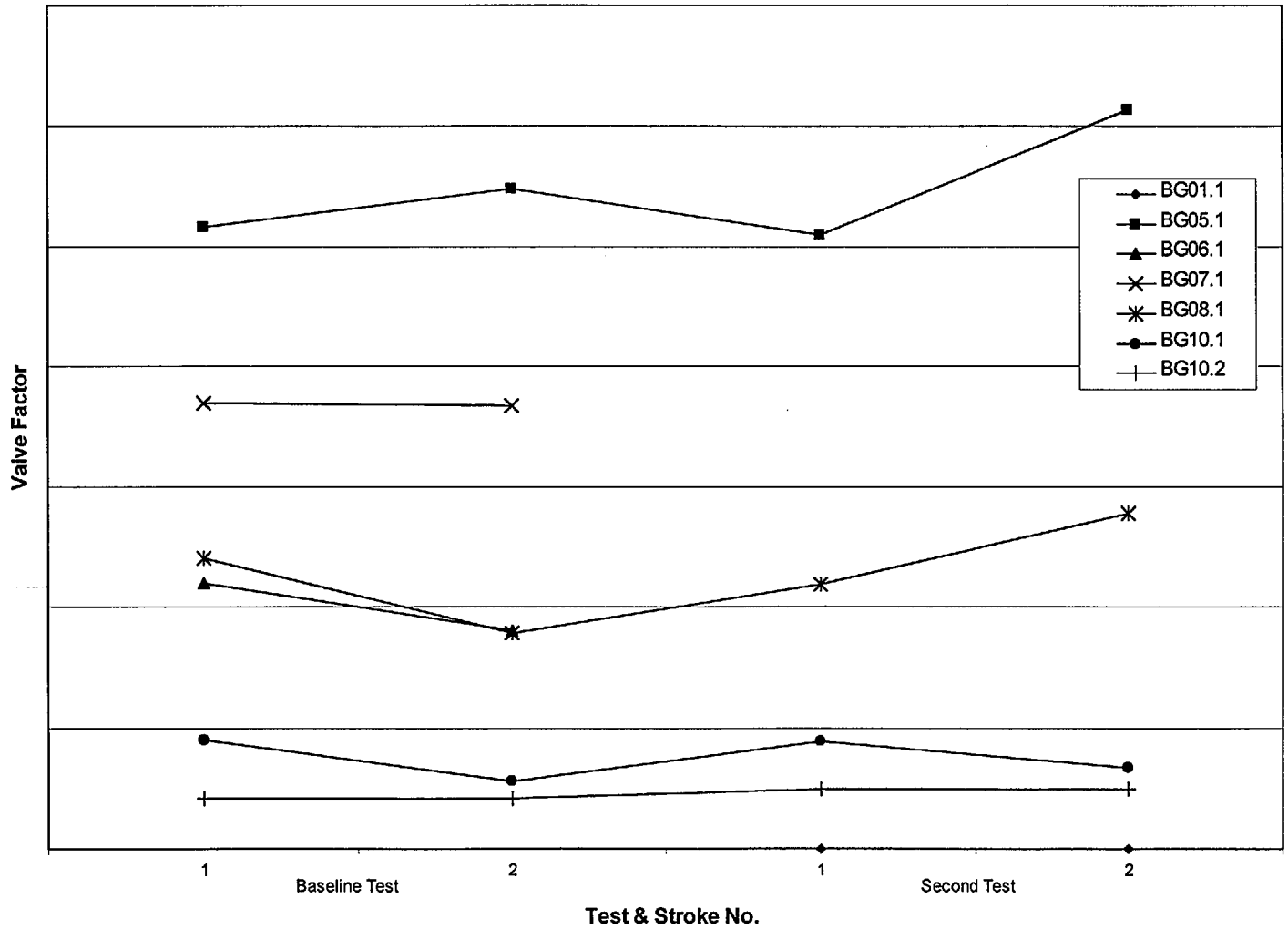
Progression of Valve Factor for Balanced Disk Globe Valves at Unseating



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Unbalanced Disk Globe Valve Test Results

- No new 2nd tests, 1 new 3rd test - underseat flow only
- Both valves with 3 tests show relatively constant VF
- 1 valve (UG08) shows 10% increase in seating VF between 1st and 2nd test; repeatability of test conditions not met. Preliminary information on 3rd test (not yet submitted) indicates VF returns to baseline level
- UG07-steam flow: different thrust sensors used in original baseline and subsequent test - large difference. Original baseline test set aside; new baseline test with higher VF.

Unbalanced Disk Globe Valve Test Results (cont.)

- Topical Report indicates no degradation mechanisms for unbalanced disk globe valves and that data are confirmatory
- Water flow data to date support this conclusion
- By next NRC meeting (Spring 2001), if water data support this conclusion, JOG will consider documenting this conclusion and stopping remaining water testing (steam testing will continue)

Progression of Valve Factor for Unbalanced Disk Globe Valves at Seating (underseat flow)

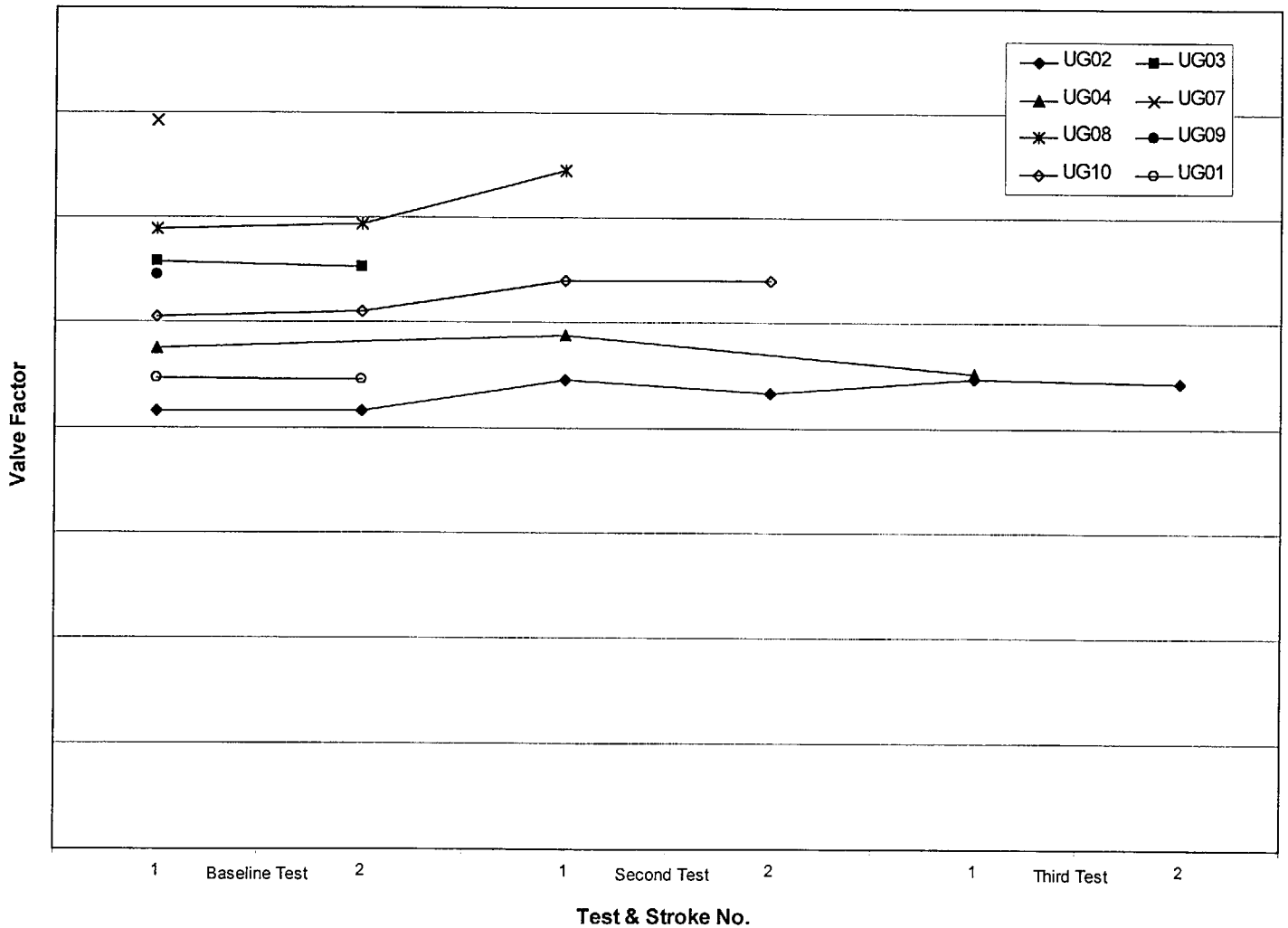

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Table 3-1: Gate Valve Test Matrix

JOG Test Matrix No	Reference	Manufacturer	Size (in)	Class (lb)	Disk Type	Disk Face Material	Seat Face Material	Disk Guide Face Material	Body Guide Face Material	Fluid	DP Strokes Per Year	Stem Orientation	As-Tested Valve Fac
G01.01	moved to G06.01												
G01.02		Velan	6	300	Flexible Wedge	Stellite	Stellite	Carbon Steel	Carbon Steel	untreated water	0	Vertical	High
G06.01		Velan	12	150	Flexible Wedge	Stellite	Stellite	Carbon Steel	Carbon Steel	untreated water	0	Horizontal	Low
G06.02		Velan	12	150	Flexible Wedge	Stellite	Stellite	Carbon Steel	Carbon Steel	untreated water	0	Horizontal	Low
G08.01		Anchor/Darling	16	150	Flexible Wedge	Stellite	Stellite	Carbon Steel	Carbon Steel	untreated water	4	Vertical	High
G08.02		Velan	8	150	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	untreated water	10	Vertical	High
G10.01		Anchor/Darling	18	150	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	untreated water	10	Horizontal	Low
G10.02		Anchor/Darling	18	150	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	untreated water	10	Horizontal	High
G10.03	replaced by G06.02												
G12.01		Velan	6	300	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	untreated water	0	Vertical	High
G15.01		Velan	12	150	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	untreated water	0	Horizontal	High
G15.02	moved to G10.03												
G17.01		Walworth	24	150	Solid Wedge	Stellite	Stellite	Stellite	Carbon steel	untreated water	1	Vertical	Low
G17.02		Walworth	20	150	Solid Wedge	Stellite	Stellite	Stellite	Carbon steel	untreated water	> 1	Vertical	Low
G20.01		Borg-Warner	4	300	Flexible Wedge	Stellite	Stellite	Carbon Steel	17-4 PH	untreated water	4	Vertical	
G22.01		Velan	6	150	Flexible Wedge	Stellite	Stellite	Carbon Steel	Carbon Steel	treated/closed loop water	0	Horizontal	High
G22.02	moved to G27.14												
G22.03		Borg-Warner	8	150	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	treated/closed loop water	1	Horizontal	High
G22.04	moved to G32.04												
G22.05	moved to G91.05												
G22.06	moved to G27.15												
G22.07		Anchor/Darling	12	900	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	treated/closed loop water	0	Horizontal	Low
G22.08		Anchor/Darling	12	900	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	treated/closed loop water	0	Horizontal	Low
G22.09		Walworth	10	150	Solid Wedge	Stellite	Stellite	Carbon Steel	Carbon Steel	treated/closed loop water	0	45 deg	Low
G22.10		Walworth	8	150	Solid Wedge	Stellite	Stellite	Carbon Steel	Carbon Steel	treated/closed loop water	0	45 deg	High
G22.11	moved to G99.07												
G22.12		Anchor/Darling	18	300	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	treated/closed loop water		Vertical	Low
G22.13	moved to G27.16												
G22.14		Anchor/Darling	18	300	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	treated/closed loop water		Vertical	High
G22.15	moved to G63.05												
G22.16	moved to G63.06												
G22.17		Anchor/Darling	18	300	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	reactor coolant water	0	20 deg	High
G22.18		Anchor/Darling	10	900	Flexible Wedge	Stellite	Stellite	Carbon Steel	Carbon Steel	reactor coolant water	0	Horizontal	High
G22.19		Crane	14	900	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	treated/closed loop water	0	120 deg	Low
G22.20		Crane	14	900	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	treated/closed loop water	0	120 deg	Low
G22.21		Powell	24	900	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	reactor coolant water	2	Vertical	High
G22.22		Crane	24	900	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	reactor coolant water	2	Vertical	High

Table 3-1: Gate Valve Test Matrix

JOG Test Matrix No	Reference	Manufacturer	Size (in)	Class (lb)	Disk Type	Disk Face Material	Seat Face Material	Disk Guide Face Material	Body Guide Face Material	Fluid	DP Strokes Per Year	Stem Orientation	As-Tested Valve Fac
G22.23		Anchor/Darling	18	300	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	reactor coolant water	0	20 deg	High
G22.24		Walworth	10	150		Stellite	Stellite	Carbon steel	Carbon steel	treated/closed loop water			
G27.01		Velan	6	150	Flexible Wedge	Stellite	Stellite	Carbon Steel	Carbon Steel	treated/closed loop water	4	Horizontal	High
G27.02	moved to G92.02												
G27.03	moved to G89.02												
G27.04		Velan	3	300	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	treated/closed loop water	16	Vertical	High
G27.05		Anchor/Darling	3	300	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	feedwater	6	Horizontal	High
G27.06		Velan	6	150	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	treated/closed loop water	4	45 deg	Low
G27.07		Anchor/Darling	12	300	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	treated/closed loop water	4	Horizontal	High
G27.08		Walworth	3	300	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	treated/closed loop water	12	Horizontal	High
G27.09		Anchor/Darling	4	300	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	reactor coolant water	<50	Vertical	Low/High
G27.10		Anchor/Darling	4	300	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	treated/closed loop water	20	Vertical	High
G27.11		Anchor/Darling	4	300	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	treated/closed loop water	20	Horizontal	Low
G27.12	moved to G22.17												
G27.13	replaced by G22.23												
G27.14		Velan	6	150	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	treated/closed loop water	4	Horizontal	High
G27.15		Velan	12	150	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	treated/closed loop water	8	Vertical	Low
G27.16		Anchor/Darling	4	600	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	treated/closed loop water	21	105	High
G27.17		Powell	3	300	Solid Wedge	Stellite	Stellite	Carbon steel	Carbon steel	treated/closed loop water	16	Horizontal	High
G27.18		Anchor/Darling	18	300	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	treated/closed loop water	10	Vertical	High
G32.01		Velan	6	150	Flexible Wedge	Stellite	Stellite	Stellite	Carbon steel	treated/closed loop water	2	Vertical	
G32.02		Velan	8	150	Flexible Wedge	Stellite	Stellite	Stellite	Carbon steel	treated/closed loop water	2	Vertical	
G32.03		Crane	16	300	Solid Wedge	Stellite	Stellite	Stellite	Carbon steel	treated/closed loop water	0	Horizontal	Low
G32.04		Velan	4	900	Flexible Wedge	Stellite	Stellite	Stellite	Carbon steel	feedwater	0	Vertical	
G36.01		Anchor/Darling	3	900	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	steam	2	Vertical	Low
G36.02	moved to G22.21												
G36.03	moved to G22.22												
G36.04	moved to G41.07												
G41.01	moved to G27.18												
G41.02		Powell	10	900	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	steam	12	Vertical	Low
G41.03	moved to G27.17												
G41.04		Anchor/Darling	8	600	Flexible Wedge	Stellite	Stellite	Carbon steel	Carbon steel	steam	12	Vertical	High
G41.06		Anchor/Darling	8	600	Flexible Wedge	Stellite	Stellite	Carbon Steel	Carbon Steel	steam	4	Horizontal	High
G41.07		Velan	4	600	Flexible Wedge	Stellite	Stellite	Carbon Steel	Carbon Steel	steam	12	Vertical	Low
G44.01	moved to G22.18												
G44.02		Walworth	4	900	Flexible Wedge	Stellite	Stellite	300 series SS	300 series SS	treated/closed loop water	1	Vertical	Low
G44.03		Walworth	4	900	Flexible Wedge	Stellite	Stellite	300 series SS	300 series SS	treated/closed loop water	1	Vertical	Low

Table 3-1: Gate Valve Test Matrix

JOG Test Matrix No	Reference	Manufacturer	Size (in)	Class (lb)	Disk Type	Disk Face Material	Seat Face Material	Disk Guide Face Material	Body Guide Face Material	Fluid	DP Strokes Per Year	Stem Orientation	As-Tested Valve Fac
G44.04		Powell	4	300	Solid Wedge	Stellite	Stellite	300 series SS	300 series SS	reactor coolant water	0	Horizontal	High
G44.05		Powell	4	300	Solid Wedge	Stellite	Stellite	300 series SS	300 series SS	reactor coolant water	0	Horizontal	High
G44.06		Powell	4	300	Solid Wedge	Stellite	Stellite	300 series SS	300 series SS	reactor coolant water	0	Horizontal	Low
G44.07		Walworth	24	600	Flexible Wedge	Stellite	Stellite	300 series SS	300 series SS	treated/closed loop water	0	Vertical	Low
G44.08		Walworth	12	600	Flexible Wedge	Stellite	Stellite	300 series SS	300 series SS	treated/closed loop water	0	Vertical	Low
G44.09		Anchor/Darling	6	900	Flexible Wedge	Stellite	Stellite	300 series SS	300 series SS	feedwater	0	Vertical	High
G44.10		Anchor/Darling	6	900	Flexible Wedge	Stellite	Stellite	300 series SS	300 series SS	feedwater	0	Vertical	High
G44.11		Anchor/Darling	6	900	Flexible Wedge	Stellite	Stellite	300 series SS	300 series SS	feedwater	1	Vertical	High
G44.12		Anchor/Darling	6	900	Flexible Wedge	Stellite	Stellite	300 series SS	300 series SS	feedwater	1	Vertical	High
G44.13		Anchor/Darling	6	900	Flexible Wedge	Stellite	Stellite	300 series SS	300 series SS	feedwater	1	Vertical	High
G44.14		Anchor/Darling	6	900	Flexible Wedge	Stellite	Stellite	300 series SS	300 series SS	feedwater	1	Vertical	High
G44.15		Anchor/Darling	8	150	Flexible Wedge	Stellite	Stellite	300 series SS	300 series SS	reactor coolant water	0	Vertical	
G44.16	moved to G75.11												
G44.17		Anchor/Darling	4	900	Flexible Wedge	Stellite	Stellite	300 series SS	300 series SS	reactor coolant water	0	Vertical	Low
G49.01		Anchor/Darling	6	300	Flexible Wedge	Stellite	Stellite	300 series SS	300 series SS	treated/closed loop water	5<X<10	Vertical	Low
G49.02		Anchor/Darling	6	300	Flexible Wedge	Stellite	Stellite	300 series SS	300 series SS	untreated water	12	45 deg	Low
G49.03	moved to G44.17												
G52.01	moved to G44.16												
G54.01		Anchor/Darling	3	1500	Double Disk	Stellite	Stellite			treated/closed loop water	0	Vertical	Low
G54.02		Anchor/Darling	6	150	Double Disk	Stellite	Stellite			treated/closed loop water	0	Vertical	Low
G54.03		Anchor Darling	3	1500	Double Disk	Stellite	Stellite			reactor coolant	0	Vertical	Low
G54.04		Anchor/Darling	4	900	Double Disk	Stellite	Stellite			reactor coolant water	0	Vertical	Low
G55.01		Anchor/Darling	4	1500	Double Disk	Stellite	Stellite			reactor coolant water	10	Vertical	Low
G56.01		Anchor/Darling	4	1500	Double Disk	Stellite	Stellite			reactor coolant water	0	Vertical	Low
G56.02		Anchor/Darling	6	150	Double Disk	Stellite	Stellite			treated/closed loop water	0	Vertical	Low
G56.03		Anchor/Darling	4	1500	Double Disk	Stellite	Stellite			reactor coolant water	0	Vertical	Low
G57.01		Anchor/Darling	6	300	Double Disk	Stellite	Stellite			treated/closed loop water	1.5	Horizontal	High
G57.02		Anchor/Darling	8	300	Double Disk	Stellite	Stellite			reactor coolant water	0	45 deg	High
G57.03		Anchor/Darling	8	300	Double Disk	Stellite	Stellite			reactor coolant water	0	Vertical	High
G58.01		Anchor/Darling	4	300	Double Disk	Stellite	Stellite			treated/closed loop water	4	Vertical	High
G58.02		Anchor/Darling	8	150	Double Disk	Stellite	Stellite			untreated water	6	Vertical	Low
G59.01		Anchor/Darling	4	900	Double Disk	Stellite	Stellite			feedwater	0	Horizontal	High
G59.02		Anchor/Darling	6	300	Double Disk	Stellite	Stellite			reactor coolant water	0	Horizontal	High
G60.01		Anchor/Darling	10	600	Double Disk	Stellite	Stellite			steam	10	Vertical	
G60.02		Anchor/Darling	4	900	Double Disk	Stellite	Stellite			steam	12	Vertical	Low
G60.03		Anchor/Darling	4	600	Double Disk	Stellite	Stellite			steam	6	Horizontal	High
G60.04		Anchor/Darling	10	900	Double Disk	Stellite	Stellite			steam	8	Vertical	High

Table 3-1: Gate Valve Test Matrix

JOG Test Matrix No	Reference	Manufacturer	Size (in)	Class (lb)	Disk Type	Disk Face Material	Seat Face Material	Disk Guide Face Material	Body Guide Face Material	Fluid	DP Strokes Per Year	Stem Orientation	As-Tested Valve Fac
G63.01		Aloyco	6	150	Split Wedge	Stellite	Stellite	Stellite	300 series SS	treated/closed loop water	1.5	Vertical	Low
G63.02		Aloyco	6	300	Split Wedge	Stellite	Stellite			reactor coolant water	1	Horizontal	Low
G63.03		Crane-Aloyco	8	300	Split Wedge	Stellite	Stellite	300 series SS	300 series SS	reactor coolant water	0	Vertical	Low
G63.04		Aloyco	6	150	Split Wedge	Stellite	Stellite		300 series SS	reactor coolant water	0	Vertical	High
G63.05		Crane-Aloyco	6	300	Split Wedge	Stellite	Stellite			reactor coolant water	0	Vertical	Low
G63.06		Crane-Aloyco	6	300	Split Wedge	Stellite	Stellite			reactor coolant water	0	Vertical	Low
G65.01		Aloyco	8	150	Split Wedge	Stellite	Stellite	300 series SS	Stellite	treated/closed loop water	0	Vertical	High
G65.02		Crane-Aloyco	8	300	Split Wedge	Stellite	Stellite	300 series SS	300 series SS	reactor coolant water	0		High
G65.03		Aloyco	6	300	Split Wedge	Stellite	Stellite	300 series SS	300 series SS	reactor coolant water	0	Vertical	High
G69.01		Westinghouse	8	316	Flexible Wedge	Stellite	Stellite	Stellite	17-4 PH	treated/closed loop water	0	45 deg	Low
G69.02		Westinghouse	6	150	Flexible Wedge	Stellite	Stellite	Stellite	17-4 PH	treated/closed loop water	0	Vertical	Low
G69.03		Westinghouse	3	1500	Flexible Wedge	Stellite	Stellite	Stellite	17-4 PH	reactor coolant water	1	Vertical	High
G69.04		Westinghouse	3	2035	Flexible Wedge	Stellite	Stellite	Stellite	17-4 PH	reactor coolant water	1	Vertical	Low
G69.05		Velan	4	1500	Flexible Wedge	Stellite	Stellite	Stellite	Stellite	reactor coolant water	0	Vertical	Low
G69.06		Westinghouse	6	900	Flexible Wedge	Stellite	Stellite	Stellite	17-4PH	reactor coolant water	0.7	Vertical	High
G69.07		Westinghouse	3	2035	Flexible Wedge	Stellite	Stellite	Stellite	17-4 PH	reactor coolant water	0	Vertical	Low
G69.08		Velan	12	300	Flexible Wedge	Stellite	Stellite	Stellite	300 series SS	reactor coolant water	0	Vertical	Low
G69.09		Velan	6	1500	Flexible Wedge	Stellite	Stellite	Stellite	300 series SS	reactor coolant water	0	Vertical	Low
G69.10		Velan	3	1500	Flexible Wedge	Stellite	Stellite	Stellite	300 series SS	reactor coolant water	0	Vertical	Low
G69.11		Velan	3	1500	Flexible Wedge	Stellite	Stellite	Stellite	300 series SS	reactor coolant water	0	Vertical	Low
G69.12		Westinghouse	10	300	Flexible Wedge	Stellite	Stellite	Stellite	17-4 PH	treated/closed loop water	0	Vertical	Low
G69.13		Anchor/Darling	12	900	Flexible Wedge	Stellite	Stellite	Stellite	Carbon steel	reactor coolant water	0	Vertical	Low
G69.14		Velan	16	150	Flexible Wedge	Stellite	Stellite	Stellite	Carbon steel	treated/closed loop water	0	Horizontal	Low
G73.01	moved to G69.12												
G73.02		Velan	4	1500	Flexible Wedge	Stellite	Stellite	Stellite	300 series SS	reactor coolant water	10	Vertical	High
G75.01		Westinghouse	8	1525	Flexible Wedge	Stellite	Stellite	Stellite	17-4 PH	treated/closed loop water	0	Vertical	High
G75.02		Westinghouse	8	316	Flexible Wedge	Stellite	Stellite	Stellite	17-4 PH	treated/closed loop water	0	45 deg	Low
G75.03		Westinghouse	4	900	Flexible Wedge	Stellite	Stellite	Stellite	17-4 PH	treated/closed loop water	0	Vertical	High
G75.04		Westinghouse	3	2035	Flexible Wedge	Stellite	Stellite	Stellite	17-4 PH	reactor coolant water	1	Vertical	High
G75.06		Westinghouse	6	1525	Flexible Wedge	Stellite	Stellite	Stellite	17-4 PH	reactor coolant water	0.7	Vertical	High
G75.07		Westinghouse	6	150	Flexible Wedge	Stellite	Stellite	Stellite	17-4 PH	treated/closed loop water	1	Vertical	High
G75.08		Velan	12	300	Flexible Wedge	Stellite	Stellite	Stellite	300 series SS	reactor coolant water	0	Vertical	High
G75.09		Westinghouse	3	2035	Flexible Wedge	Stellite	Stellite	Stellite	17-4 PH	reactor coolant	0	Vertical	High
G75.10		Velan	16	150	Flexible Wedge	Stellite	Stellite	Stellite	Carbon steel	treated/closed loop water	0	Horizontal	High
G75.11		Velan	14	900	Flexible Wedge	Stellite	Stellite	Stellite	300 series SS	reactor coolant water	0	Horizontal	High
G79.01	moved to G69.13												
G79.02		Westinghouse	12	1525	Flexible Wedge	Stellite	Stellite	Stellite	17-4 PH	hot water	0	Vertical	High

Table 3-1: Gate Valve Test Matrix

JOG Test Matrix No	Reference	Manufacturer	Size (in)	Class (lb)	Disk Type	Disk Face Material	Seat Face Material	Disk Guide Face Material	Body Guide Face Material	Fluid	DP Strokes Per Year	Stem Orientation	As-Tested Valve Fac
G81.01		Ring-O	8	900	Flexible Wedge	Stellite	Stellite	Stellite	Stellite	steam	5<X<10	Vertical	High
G83.01		Borg-Warner	3	1500	Flexible Wedge	Stellite	Stellite	300 series SS	17-4 PH	treated/closed loop water	0	Horizontal	Low
G83.02		Borg-Warner	4	1500	Flexible Wedge	Stellite	Stellite	300 series SS	17-4 PH	treated/closed loop water	1	Horizontal	Low
G83.03		Borg-Warner	4	900	Flexible Wedge	Stellite	Stellite	316 Stainless Steel	17-4 PH	feedwater	0	Vertical	High
G84.01	moved to G83.03												
G85.01		Borg-Warner	4	1500	Flexible Wedge	Stellite	Stellite	300 series SS	17-4 PH	hot water	1	Horizontal	High
G88.01		Powell	8	150	Solid Wedge	13Cr	13Cr	Carbon steel	Carbon steel	treated/closed loop water	0	Horizontal	High
G88.02	moved to G89.03												
G89.01		Powell	8	150	Solid Wedge	13Cr	13Cr	Stainless Steel	Carbon steel	untreated water/treated	10	Vertical	Low
G89.02		Powell	4	300	Solid Wedge	13Cr	13Cr	13Cr	Carbon steel	treated/closed loop water	16	Vertical	Low
G89.03		Walworth	12	150	Solid Wedge	13Cr	13Cr	Carbon steel	Carbon steel	untreated water	4	Horizontal	
G90.01		Powell	8	150	Solid Wedge	13Cr	13Cr	Stainless Steel	Carbon steel	untreated water/treated	10	Vertical	Low
G91.01	moved to G22.19												
G91.02	moved to G22.20												
G91.03		Powell	4	150	Flexible Wedge	13Cr	Stellite	13Cr	Carbon Steel	treated/closed loop water	<2	Horizontal	High
G91.04		Crane	18	300	Solid Wedge	13Cr	Stellite	Carbon steel	Carbon steel	treated/closed loop water	0	Horizontal	High
G91.05		Powell	6	150	Solid Wedge	13Cr	Stellite	Carbon steel	Carbon steel	treated/closed loop water	0	Vertical	
G92.01		Powell	18	300	Flexible Wedge	13Cr	Stellite	Carbon steel	Carbon steel	reactor coolant water	12 - 15	Horizontal	High
G92.02		Walworth	18	300	Solid Wedge	13Cr	Stellite	Carbon steel	Carbon steel	treated/closed loop water	4	Horizontal	Low
G92.03		Powell	3	900	Solid Wedge	13Cr	Stellite	Carbon steel	Carbon steel	feedwater	6	Vertical	High
G96.01		Crane	16	900	Flexible Wedge	Stellite	Stellite	Stellite	Malcolmized type 410	treated/closed loop water	0	70 deg	High
G96.02		Crane	16	900	Flexible Wedge	Stellite	Stellite	Stellite	Malcolmized type 410	treated/closed loop water	0	70 deg	Low
G98.01		Anchor/Darling	16	300	Double Disk	Deloro 50	Deloro 50			treated/closed loop water	0	Horizontal	Low
G99.01		Crane	3	300	Solid Wedge	410 Stainless St	Monel	Carbon steel	Carbon steel	treated/closed loop water	12	Vertical	High
G99.02		Crane	3	300	Solid Wedge	410 Stainless St	Monel	Carbon steel	Carbon steel	treated/closed loop water	12	Vertical	High
G99.03		Crane	6	600	Solid Wedge	Exelloy	Monel	300 series SS	Carbon steel	treated/closed loop water	0	Horizontal	Low
G99.04		Crane	6	600	Solid Wedge	Exelloy	Monel	300 series SS	Carbon steel	treated/closed loop water	0	Horizontal	High
G99.05		Crane	6	600	Solid Wedge	Exelloy	Monel	300 series SS	Carbon steel	treated/closed loop water	0	Horizontal	High
G99.06		Pacific	6	150	Flexible Wedge	12Cr	Monel	Carbon steel	Carbon steel	treated/closed loop water	0	Vertical	High
G99.07		Walworth	8	150	Solid Wedge	410 Stainless St	Monel	Carbon steel	Carbon steel	treated/closed loop water	1	Horizontal	Low

Table 3-2: Butterfly Valve Test Matrix

06-Oct-00

JOG Test Matrix No.	Reference	Manufacturer	Size (in)	Bearing Material	Fluid	Total Strokes Per Year	DP Strokes Per Year	Stem Orientation	Normal Position
B01.1		Clow	10	Bronze	untreated water	10	10	Horizontal	Open
B01.2		Clow	10	Bronze	untreated water	10	10	Horizontal	Open
B03.1	moved to B20.2								
B03.2		Clow	20	Bronze	untreated water	1	1	Horizontal	Open
B05.1	moved to B25.3								
B06.1		Crane/Flowseal	6	Bronze	untreated water	2	0	Vertical	Open
B07.1		Henry Pratt	30	Bronze	untreated water	8	8	Horizontal	Closed
B08.1		Contromatics	14	Bronze	untreated water	4	1	Horizontal	Closed
B09.1		ACE	20	Bronze/Graphite	untreated water	40	15	Vertical	Closed
B09.2		Henry Pratt	6	Bronze	untreated water	12	12	Vertical	Closed
B09.3		Henry Pratt	6	Bronze	untreated water	12	12	Vertical	Closed
B09.4		Henry Pratt	6	Bronze	untreated water	12	12	Vertical	Closed
B09.5		Henry Pratt	6	Bronze	untreated water	12	12	Vertical	Closed
B10.1	replaced by B09.2								
B10.2	moved to B08.1								
B11.1		Contromatics	10	Bronze	treated/closed loop water	20	10	Horizontal	Open
B12.1		Fisher Controls	8	Bronze/Graphite	treated/closed loop water	4	2	Horizontal	Open
B12.2		Henry Pratt	12	Bronze	treated/closed loop water	4	4	Horizontal	Open
B13.1		Contramatics	10	Bronze	treated/closed loop water	10	10	Vertical	Open
B15.1		Henry Pratt	14	Bronze	treated/closed loop water	2	0	Vertical	Closed
B16.1		Henry Pratt	24	Fiberglass/Teflon	untreated water	16	12	Vertical	Closed
B16.2		Pratt	96	Fiberglass/Teflon	untreated water	12.3	12.3	Vertical	Open
B16.3		Henry Pratt	18	Nylatron	untreated water	4	4	Vertical	Open
B20.1		Henry Pratt	24	Fiberglass/Teflon	untreated water	2	2	Horizontal	Closed
B22.1		Henry Pratt	10	Fiberglass/Teflon	treated/closed loop water	8	8	Vertical	Open
B22.2		Henry Pratt	10	Fiberglass/Teflon	treated/closed loop water	8	8	Vertical	Open
B22.3		Jamesbury	16	Fiberglass/Teflon	treated/closed loop water	50	50	Vertical	Open
B22.4		Hills-Mccanna	16	Tefzel	treated/closed loop water	4	4	Vertical	Open
B24.1	moved to B22.4								
B25.1	replaced by B09.3								
B25.2	replaced by G57.03								
B25.3		Allis-Chalmers	24	SS/Teflon	untreated water	5.5	5.5	Vertical	Open
B28.1	replaced by B09.4								
B29.1		Jamesbury	10	SS/Teflon	reactor coolant water	8	4	Horizontal	Closed
B30.1	replaced by B09.5								
B30.2		Henry Pratt	12	SS/Teflon	treated/closed loop water	6	0	Vertical	Open
B30.3		Jamesbury	12	SS/Polyethylene	treated/closed loop water	6	0	Vertical	Open
B30.4	moved to B29.1								

Table 3-3: Balanced Disk Globe Valve Test Matrix

06-Oct-00

JOG Test Matrix No	Manufacturer	Reference	Size (in)	Class (lb)	Disk Guide Material	Body Guide Material	Fluid	DP Strokes Per Year
BG01.1	Fisher Controls		4	900	Stellite	17-4 PH	feedwater	75
BG02.1		moved to BG01.1						
BG05.1	Fisher Controls		4	300	300 series Stainless Steel	400 series Stainless Steel	treated/closed loop water	6
BG05.2	CCI		8	300	410 Stainless Steel	300 series Stainless Steel	reactor coolant water	12
BG06.1	Copes-Vulcan		10	150	400 series Stainless Steel	400 series Stainless Steel	untreated water	1
BG07.1	Valtek		10	900	316 Stainless Steel	Bronze	feedwater	4
BG08.1	CCI		2	900	410 Stainless Steel	Carbon steel	feedwater	0
BG10.1	Copes-Vulcan		12	150	17-4 PH	Stainless Steel	untreated water	4
BG10.2	Copes-Vulcan		16	150	17-4 PH	Stainless Steel	untreated water	4

Table 3-4: Unbalanced Disk Globe Valve Test Matrix

JOG Test Matrix	Manufacturer	Size (in)	Class (lb)	Fluid
UG01	Valtek	16	300	feedwater
UG02	Fisher Controls	6	300	untreated water
UG03	Powell	4	600	feedwater
UG04	Anchor/Darling	18	300	reactor coolant water
UG05	Yarway	1.5	1500	reactor coolant water
UG06	Yarway	1.5	1500	reactor coolant water
UG07	Walworth	4	600	steam
UG08	Velan	2	1500	reactor coolant water
UG09	Anchor/Darling	18	300	suppression pool
UG10	Velan	2	1500	reactor coolant water
UG11	Velan	2	1500	reactor coolant water
UG12	Velan	2	1500	treated/closed loop water
UG13	Walworth	4	600	steam
UG14	Powell	3	600	steam