

ENCLOSURE 6

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION (RAI) 1.d
(MOV Performance Indicator Report for Cycle 21)

NET20170002

1/23/2017

To: Eric Olson
Terry Becker

From: Derek Riegel

RE: Cycle 21 MOV Program Performance Indicator Report


The attached Motor Operated Valve (MOV) Program Performance Indicator Report for Cycle 21 was prepared in accordance with the provisions of EDP-ZZ-01114, Motor Operated Valve Program Guide.

Key Accomplishments:

- All of Callaway's safety related MOVs are properly set up and in good working condition. No adverse programmatic trends were identified in the Predictive Performance Reports. A discussion of the current set up of safety related MOVs can be found in Attachment 1 and is summarized below. Predictive Performance Reports for all MOVs tested in Cycle 21 can be found in Attachment 2.
 - All safety related torque controlled rising stem MOVs are set up to meet the 25% target margin with the exception of EGHV0060 and EGHV0130 (see discussion in Attachment 1). Having 25% margin allows a 4-cycle/6-year static testing interval rather than DP testing in order to meet the requirement for periodic verification of operability.
 - All rising stem MOVs with an active safety function using a limit switch to open and/or close have positive margin as required.
 - All safety related butterfly MOVs have had their torque switches removed from the control circuit. These MOVs must have positive margin in the opening or closing direction as required by their active safety functions. All butterfly MOVs meet the parameters required to eliminate the need for periodic differential pressure testing and maintain the 4-cycle/6-year interval for periodic verification testing.
- The results of testing performed on rising stem MOVs during Cycle 21 confirms that there is no significant lubrication degradation at the stem to stem nut interface over the 18 month lubrication interval.

Planned Enhancements

- Crane Easy Torque Thrust sensors (ETTs) will be used on butterfly valves to improve the quality of test data by directly measuring stem torque (Ref. CR 201608791).
- The implementation of an upgraded diagnostic test system, Crane Votes Infinity, is planned for Cycle 22.
- An additional MOV engineer has been hired and will be qualified as an MOV Analyst and MOV Engineer to increase bench strength.
- Health Issue 2016019 has been initiated to address Callaway's response to the longstanding industry issue of Magnesium alloy rotor MOV motor failures.
- Addendums will be issued for calculations BB-143, EJ-30, EJ-21 Add 3, EM-20, and EM-21 to determine the maximum allowable unseating force based on actuator capability as an enhancement action from CR 201608145.



110381
1/23/17

Derek Riegel
MOV Engineer

Attachment 1: Cycle 21 Performance Indicator Report

Attachment 2: Cycle 21 Predictive Performance Reports

Cc: File A160.0446
Darrell Heckel
Curtis Wood
Dirk Raebel

[CYCLE 21 MOV PROGRAM PERFORMANCE INDICATOR REPORT]

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Attachment 1

This report provides an overview of the activities carried out by the Callaway Motor Operated Valve (MOV) program during Cycle 21 in accordance with the requirements of EDP-ZZ-01114, Motor Operated Valve Program Guide. The period referred to as Cycle 21 began at the end of Refuel 20 on 11/22/2014 and ended at the finish of Refuel 21 on 5/10/2016.

The Performance Indicator Report is comprised of the following sections:

1. Summary of historical diagnostic testing performed and discussion of diagnostic testing performed in Cycle 21
2. Summary of the current setup of safety related MOVs in the GL 89-10 program
3. Summary of major work performed on safety related MOVs in Cycle 21
4. Summary of CARs/CRs on safety related MOVs written or closed during Cycle 21
5. Summary of trends identified from predictive performance reports
6. Actions to improve margin
7. Operating Experience Reviewed During Cycle 21
8. Planned actions to enhance the Callaway MOV program

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1. Summary of historical diagnostic testing performed and discussion of diagnostic testing performed in Cycle 21

- There are currently 144 valves in the Callaway MOV program. All 144 have been static baseline tested and 99 have been differential pressure tested.
- During Cycle 21, a total of 53 periodic verification tests were performed. These tests included a differential pressure test of ALHV0005 and 8 baseline tests. The following MOVs were baseline tested:
 - ALHV0034
 - BGHV8112
 - EFHV0031
 - EFHV0047
 - EFHV0048
 - EFHV0049
 - EFHV0050
 - KCHV0253
- During Cycle 21, 40 Service and Inspect PMs and 96 actuator grease inspections were performed on safety related MOVs.

2. Summary of the current setup of safety related MOVs in the GL 89-10 program

- All torque controlled rising stem MOVs with a safety function to close are set up to meet the 25% closing thrust margin requirement with the following exceptions:
 - EGHV0060 – 15% closing thrust margin; differential pressure testing is planned for RF22 per job 15005097
 - EGHV0130 - 4% closing thrust margin; differential pressure testing is planned for RF22 per job 15003121
- All rising stem limit closed MOVs are set up with the required positive margin.
- All butterfly MOVs are set up with positive closing margin as required.
- All MOVs at Callaway use limit switch control on the opening stroke. All MOVs are set up with positive opening margin.

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Location	Margin (%)	Location	Margin (%)	Location	Margin (%)
ALHV0005	28	EFHV0038	302	EGHV0101	207
ALHV0011	32	EFHV0045	156	EGHV0130	4
ALHV0032	535	EFHV0047	293	EGHV0132	5
ALHV0034	62	EFHV0048	231	EJHV8716A	103
ALHV0035	97	EFHV0049	271	EJHV8804A	10
BBHV8351B	61	EFHV0050	268	EJHV8809B	32
BBHV8351C	46	EFHV0052	207	EJHV8811A	173
BGHV8105	253	EFHV0060	2959	EMHV8802B	135
BGHV8111	27	EFHV0065	183	EMHV8807B	611
BGHV8112	71	EFHV0097	35	EMHV8814B	52
BGLCV0112B	79	EFHV0098	68	EMHV8821A	72
BNHV0004	123	EFPDV0019	282	EMHV8821B	141
BNHV8806A	110	EFPDV0020	201	EMHV8835	83
BNHV8813	135	EGHV0013	1636	EMHV8923A	235
BNLCV0112D	65	EGHV0015	368	EPHV8808C	1264
EFHV0031	384	EGHV0016	138	FCHV0312	100
EFHV0033	128	EGHV0059	29	KCHV0253	37
EFHV0034	162	EGHV0060	15		

Table 1: Margin for MOVs tested during Cycle 21

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3. Summary of major work performed on safety related MOVs in Cycle 21

Location	Periodic Verification Test	Service & Inspect PM	Packing Adjustment	Other	Location	Periodic Verification Test	Service & Inspect PM	Packing Adjustment	Other
ALHV0005	X			1	EFHV0066		X		
ALHV0011	X				EFHV0097	X	X		
ALHV0032	X				EFHV0098	X	X		
ALHV0034	X	X		2	EFPDV0019	X			
ALHV0035	X	X			EFPDV0020	X			
BBHV8351A			X		EGHV0013	X	X		
BBHV8351B	X	X	X	3	EGHV0015	X			
BBHV8351C	X	X	X		EGHV0016	X	X		
BGHV8100			X		EGHV0059	X	X		
BGHV8105	X				EGHV0060	X	X		
BGHV8111	X	X			EGHV0101	X	X		
BGHV8112	X			2, 7	EGHV0130	X			
BGLCV0112B	X	X	X	3	EGHV0132	X	X		
BGLCV0112C			X		EJFCV0611			X	3
BNHV0004	X	X	X		EJHV8701A			X	
BNHV8806A	X	X			EJHV8716A	X	X	X	
BNHV8812A			X	3	EJHV8804A	X	X		
BNHV8812B			X		EJHV8809B	X	X		3, 6
BNHV8813	X	X			EJHV8811A	X	X		
BNLCV0112D	X	X	X		EMHV8802B	X		X	
ECHV0011		X			EMHV8803B			X	
EFHV0023			X		EMHV8807B	X	X		
EFHV0031	X	X		5	EMHV8814B	X			
EFHV0033	X	X			EMHV8821A	X	X		
EFHV0034	X	X			EMHV8821B	X	X	X	
EFHV0038	X			8	EMHV8835	X	X		
EFHV0045	X	X			EMHV8923A	X			
EFHV0047	X	X		5	EMHV8923B		X		
EFHV0048	X	X		5	ENHV0006		X		
EFHV0049	X			5	EPHV8808B			X	
EFHV0050	X	X		5	EPHV8808C	X		X	
EFHV0052	X	X			FCHV0312	X			
EFHV0060	X	X			KCHV0253	X			4
EFHV0065	X	X							

Other

- 1 - DP Test
- 2 - Grease Change
- 3 - Packing Force Test
- 4 - Valve Inspection
- 5 - Seat Ring Replacement
- 6 - Repack
- 7 - Motor Pinion Inspection
- 8 - Valve Replacement

Table 2: Major Work performed in Cycle 21

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4. Summary of CARs/CRs on safety related MOVs written or closed during Cycle 21

- Significance Level 1
 - 201505796 - ALHV0007, MDAFP B to SG A flow control valve, (obj.) did not operate electrically from the control room main control board (dev.), resulting in an inability to remotely feed the 'A' steam generator from the 'B' MDAFP and entry into Technical Specification 3.7.5
 - Root Cause - The reverse engineered design of the electronic positioner did not meet the original design specification for the bridge rectifier circuit.
 - Closed 4/9/2016
 - 201505332 - ALHV0011 (MDAFP to 'C' S/G HV) did not open on demand from the Main Control Board (MCB), resulting in manual local operator action and delay in steam generator level restoration.
 - Root Cause - The implementation and oversight of programmatic controls and programmatic changes to ALHV0005/7/9/11 did not ensure that the written instructions MTE-ZZ-QA033, MOVATS UDS Testing of Torque Controlled Modutronic Limitorque Motor Operated Rising Stem Valves, were accurate. This resulted in the feedback potentiometer not being calibrated, allowing it to go off scale.
 - Closed 6/9/2016
- Significance Level 2
 - 201408399 - ALHV0005, MDAFP B TO S/G D HV, would not full close, resulting in continued flow to EBB01D, the RCS steam generator D and the need to secure PAL01B, the 'B' MDAFP to prevent steam generator overfilling.
 - Root Cause – The Close Torque Switch was set too low based on historical DP Test data. This allowed the torque switch to open, preventing ALHV0005 from closing against pump flow.
 - LTCA approved 12/9/2015
- Significance Level 3
 - 201408399 - 201505965 - Cognitive trending has identified a potential adverse trend for air and motor operated valves in the Auxiliary Feedwater (AL) system. Continuing issues with system valves erode safety system health, and result in additional MSPI failures, AP-913 consequential events, or full or partial loss of safety function for the auxiliary feed water system.
 - Common cause evaluation found three distinct types of failures that caused the trend. No corrective action was determined beyond the CAs for the individual CARs that were identified as being part of the adverse trend.
- Significance Level 4: 31 CARs/CRs
- Significance Level 5: 20 CARs/CRs
- Other Issues: 29 CARs/CRs

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5. Summary of Trends Identified from Predictive Performance Reports

- There were no adverse programmatic trends identified in the Predictive Performance Reports (PPRs). A copy of each PPR can be found in Attachment 2.
- The average stem to stem nut coefficient of friction (COF) for rising stem MOVs tested during Cycle 21 is 0.080. See Table 3 for the as found and as left COF for MOVs tested in Cycle 21.
- The practice at Callaway is to initiate corrective action when an MOV's COF exceeds 0.15. A bounding COF of 0.20 is assumed in all of Callaway's MOV capability calculations.
 - EJHV8716A – As left COF is 0.16. Job 16004972 was initiated to correct this condition
 - KCHV0253 – As left COF is 0.175. Job 16006316 was initiated to correct this condition

Location	Prelube COF	Post-lube COF	Delta
ALHV0005	0.025	0.022	0.003
ALHV0011	0.061	0.046	0.015
ALHV0034	n/a	0.050	
BBHV8351B	0.124	0.123	0.001
BBHV8351C	0.092	0.099	0.007
BGHV8105	0.056	0.079	0.023
BGHV8111	0.113	0.115	0.002
BGHV8112	0.059	0.053	0.006
BGLCV0112B	0.083	0.056	0.027
BNHV0004	n/a	0.077	
BNHV8806A	0.038	0.036	0.002
BNHV8813	0.072	0.079	0.007
BNLCV0112D	n/a	0.119	
EFHV0097	0.101	0.108	0.007
EFHV0098	0.093	0.137	0.044
EFPDV0019	0.085	0.094	0.009
EFPDV0020	0.077	0.072	0.005
EGHV0059	0.093	0.083	0.010
EGHV0060	0.086	0.079	0.007
EGHV0130	0.090	0.092	0.002
EGHV0132	0.066	0.064	0.002
EJHV8716A	0.166	0.160	0.006
EJHV8804A	0.031	0.054	0.023
EJHV8809B	0.126	0.122	0.004
EJHV8811A	0.055	0.052	0.003
EMHV8802B	0.065	0.046	0.019
EMHV8807B	0.048	0.062	0.014
EMHV8814B	0.092	0.101	0.009
EMHV8821A	0.036	0.017	0.019
EMHV8821B	0.099	0.099	0.000
EMHV8835	0.076	0.070	0.006
EMHV8923A	0.059	0.058	0.001
EPHV8808C	0.033	0.028	0.005
KCHV0253	n/a	0.175	
Average	0.077	0.080	0.010

Table 3: Cycle 21 Rising Stem MOV COF

6. Actions to Improve Margin

- DP Testing – As a corrective action for CAR 201408399, 13 torque controlled rising stem MOVs had their required DP Thrust to Close administratively raised to match that of their sister valve with the highest requirement (Ref. RFR 201505952). DP testing will be performed on each of these MOVs to verify the thrust required to close against design basis differential pressure and flow.
 - The following MOVs are impacted:
 1. ALHV0005 – completed in RF21
 2. ALHV0009 – Job 15005094
 3. BGHV8111 – Job 15003115
 4. EFHV0097 – Job 15003116
 5. EGHV0058 – Job 15005095
 6. EGHV0059 – Job 15005096
 7. EGHV0060 – Job 15005097
 8. EGHV0061 – Job 15003120
 9. EGHV0130 – Job 15003121
 10. EGHV0131 – Job 15005098
 11. EJHV8809B – Job 15003117
 12. EMHV8802B – Job 15003118
 13. EMHV8923A – Job 15003119
- Coefficient of Friction – As discussed above, Jobs 16004972 and 16006316 have been written to correct the high COF for EJHV8716A and KCHV0253, respectively. Reducing the COF will allow the valve to achieve a higher thrust for a given amount of torque produced by the Limitorque actuator.

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7. Operating Experience Reviewed During Cycle 21

ICES 253636 (OE36346)	Hope Creek 1	High torque switch contact resistance (dirty contacts on new switch) prevented valve from closing. No procedural guidance to inspect new electrical components from stores and clean as necessary.	Revise maintenance procedure to inspect new torque/limit switches prior to installation. Ref. CAR 201507996
ICES 318359	Columbia	Walworth flex wedge gate valve. Stem/Disc separation due to pressure locking or stress corrosion cracking. Valve was opened with a hot tap pushrod. Will repair in next outage.	No action. Callaway does not have any MOVs made by Walworth. Follow up review may be required after Columbia repairs valve and determines cause.
ICES 311018	Catawba	Foam vapor corrosion inhibitor devices found in actuator during bench test. Vendor requires removal to maintain EQ.	Revise procedure to remove foam vapor corrosion inhibitor devices if found. Ref. CAR 201501750
ICES 321415	McGuire 1	Rotork actuator motor shorted to ground when the handswitch was actuated for stroke time test. Most likely cause determined to be motor quality.	No action. Callaway does not have any Rotork actuators, making this quality concern not applicable.
ICES 321599	Limerick 2	Valve failed to fully open during testing. Cause determined to be excessive running torque in both directions due to packing load. Stem cleaned/lubed, open torque switch adjusted.	No action. Covered by existing program requirements. Also, MOVs at Callaway open on limit; full actuator torque capability is available on open stroke.
ICES 320599	Browns Ferry 3	Motor pinion key came out. Setscrew backed off. Key wasn't adequately staked and motor shaft was not drilled/dimpled.	No action. Motor pinion key/setscrew installation is adequately covered in MTM-ZZ-QA006 Attachment 8.

Table 4: Cycle 21 OE Reviewed

8. Planned actions to enhance the Callaway MOV program

- Crane Easy Torque Thrust sensors (ETTs) will be used on butterfly valves to improve the quality of test data by directly measuring stem torque (Ref. CR 201608791).
- The implementation of an upgraded diagnostic test system, Crane Votes Infinity, is planned for Cycle 22.
- An additional MOV engineer has been hired and will be qualified as an MOV Analyst and MOV Engineer to increase bench strength.
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