ENCLOSURE 1

RESPONSES TO REQUESTS FOR ADDITIONAL INFORMATION

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Request (RAI 1)

Callaway's License Amendment Request (LAR), Section 2.0, states that "the proposed change would revise the FSAR description of Callaway's compliance with NRC Regulatory Guide (RG) 1.106, Revision 1, "Thermal Overload Protection for Electric Motors on Motor Operated Valves." Specifically, the FSAR will be revised to clarify how Callaway complies with RG 1.106 in regard to the control and/or bypassing of thermal overload protection (TOP) devices for motor-operated valves (MOVs) during routine testing/maintenance activities of such valves. The change would allow TOP devices to remain bypassed during certain routine valve stroke surveillance testing (such that the TOP bypass jumpers are not removed during such testing), which is not in compliance with RG 1.106.

Since the TOP devices will not be available for detection of MOV degradation (age related or other maintenance related issues that contribute to overheating the motor windings), the staff requests the following additional information on the affected safety-related MOVs covered by the Generic Letter (GL) 89-10 program.

a) The frequency of maintenance and maintenance testing (stroking) of the MOVs
b) The frequency of dynamic testing of the MOVs
c) The frequency of surveillance testing of a sample of MOVs in different systems
d) A summary of MOV diagnostic test results over last three operating cycles.
e) In response to GL 96-05, Callaway established a 25 percent margin criterion between the thrust required to operate individual torque-controlled and the thrust delivered by the MOV motor actuator to evaluate age-related valve degradation. Please provide details (failure modes and corrective actions) on any valves that failed this criterion since the closeout of GL 96-05.

Response to RAI 1

a) A list of all preventive maintenance activities on safety related MOVs, including frequencies, is provided in the document titled "Safety Related MOV PM List by Component." Due to the length of this listing, it is provided as Enclosure 2.
b) The Callaway MOV program does not require dynamic MOV testing on any specified frequency.
c) A list of surveillances on safety related MOVs, including frequencies, is provided in the document titled "Safety Related MOV Surveillance List by Component." Due to the length of this listing, it is provided as Enclosure 3.

d) Copies of the MOV Performance Indicator Reports (PIRs) for Cycles 19, 20, and 21 are provided. Due to the length of these documents, they are provided as Enclosures, 4, 5, and 6 respectively.

e) The Corrective Action Program data base and past PIRs were reviewed for any torque-controlled, rising stem valves that did not have the program-required 25% closing thrust margin at any point since issuance of the Safety Evaluation for Callaway's response to GL 96-05 on 5/30/2001. The following were identified.

- ALHV0007 – Motor Driven Auxiliary Feed Pump B to Steam Generator A
  - As-left closing thrust margin following Cycle 16 testing was 13.8%. This low margin condition was not discovered until Cycle 19.
  - As-left closing thrust margin following RF18 testing was 12.5% as documented in the Cycle 18 MOV PIR.
  - The stem nut was removed and the stem/stem nut thoroughly cleaned of degraded grease during Cycle 19 testing. The as-left margin was 48%.

  Note: The thermal overload protection devices for the Auxiliary Feedwater system flow control valves (including ALHV0007) are not bypassed during routine maintenance evolutions or surveillances. These valves are DC-operated and the thermal overload protection devices for these valves are integral to the valve assemblies. Consequently, the TOP devices for these valves are maintained in accordance with the Regulatory Position C.2 of Regulatory Guide 1.106 (Rev. 1).
- ALHV0035 – Condensate Storage Tank to Motor-Driven Auxiliary Feed Pump A
  - As-left closing thrust margin following Cycle 14 testing was 22.4% as documented in the Cycle 14 MOV PIR.
  - The torque switch was adjusted during Cycle 15 testing. The as-left margin was 88.7%.
  - Margin has remained consistent with the as-left value following Cycle 15 in all subsequent tests.
- BGHV8112 – Seal Water Return Inner Containment Isolation
  - As-left closing thrust margin following RF12 testing was 24% as documented in the Cycle 12 MOV PIR. This low margin was due to a lowered torque switch setting to avoid exceeding the actuator's reduced-voltage torque capability.
  - The valve was repacked in RF13 to regain margin. The as-left margin was 68.4%.

- EGHV0060 – Component Cooling Water from Reactor Coolant System In Containment Isolation
  - As-left closing thrust margin following RF21 testing was 16.8% as documented in the Cycle 21 MOV PIR. The closing thrust requirement was administratively raised during Cycle 21 as part of an extent-of-condition corrective action from CAR 201408399. Sufficient closing thrust could not be developed to achieve 25% margin over the increased thrust requirement without exceeding the actuator's reduced-voltage torque capability.
  - EGHV0060 was DP tested during RF22. The results were evaluated in accordance with plant procedures and used to establish a closing thrust requirement that will supersede the administrative change. The as-left closing thrust margin based on this requirement was 38%.
- EGHV0130 – Component Cooling Water from Reactor Coolant System In Containment EGHV0060 Bypass Isolation
  - As-left closing thrust margin following RF20 testing was 19% as documented in the Cycle 20 MOV PIR.
  - As-left closing thrust margin following RF21 testing was 11.9% as documented in the Cycle 21 MOV PIR. The closing thrust requirement was administratively raised during Cycle 21 as part of an extent-of-condition corrective action from CAR 201408399. Sufficient closing thrust could not be developed to achieve 25% margin over the increased thrust requirement without exceeding the actuator's reduced-voltage torque capability.
  - EGHV0130 was DP tested during RF22. The results were evaluated in accordance with plant procedures and used to establish a closing thrust requirement that will supersede the administrative change. The as-left closing thrust margin based on this requirement was 48%.
- KCHV0253 – Fire Protection Loop to Rector Building Outer Containment Downstream Isolation
  - As-left closing thrust margin following RF12 testing was 19.7% as documented in the Cycle 12 MOV PIR. The low margin was attributed to high packing load and a bent stem.
  - As-left closing thrust margin following RF13 trend testing was 16.1% as documented in the Cycle 13 MOV PIR. No corrective action was taken at that time.
  - The valve was repacked and the bent stem replaced in RF14. The as-left margin was 122.7%.

Request (RAI 2)

The LAR's Section 3, "Technical Evaluation," states "the proposed change (described in Section 2.1) would allow bypassing of TOPs during surveillance stroke tests of MOVs when the risk of motor damage to the valve is low." In Section B, RG 1.106, Revision 1, it states that "when TOP devices are bypassed, it is important to ensure that the bypassing does not result in jeopardizing the completion of the safety function or in degrading other safety systems because of any sustained abnormal motor circuit currents that may be present."

Please identify the type of surveillance (quarterly) tests during which the TOP devices will be bypassed.

Response to RAI 2

The thermal overload protection devices are bypassed during surveillances shown in the document titled "Safety Related MOV Surveillance List by Component." Additionally, they are bypassed during post-maintenance testing strokes for the preventive maintenance activities shown in the document titled "Safety Related MOV PM List by Component," with the exception of those activities that do not require valve strokes.

The following is a listing of the types of surveillance tests for which the TOP devices are bypassed:

- Stroke time testing
- Position indication testing
- Leak rate testing
- System flow testing
- Actuation testing
- Response time testing
- Interlock testing

Request (RAI 3)

The LAR's Technical Evaluation section states "the proposed change would allow bypassing of TOPs during surveillance stroke tests of MOVs when the risk of the motor damage is low." It also states "removing thermal overload bypass jumpers for surveillance stroke tests, during which motor damage is of low probability, may carry more risk with respect to ensuring that the valves can carry out their safety function of stroking as required during an accident."

Please provide a justification and basis for why the testing in maintenance activities will have a high risk of motor damage compared to surveillance tests having low risk of damage.

Response to RAI 3

The thermal overload relays are put into service (not bypassed) during maintenance and testing in which the primary protective devices, valve torque switches and limit switches, settings or operation are in question. This is typically for maintenance in which there is valve/operator repair or rework, or for valve operator setup/ diagnostic testing. This testing and maintenance involves operating the MOV when the primary protection may not yet be properly configured, thereby putting the motor at risk of an overload condition needing the thermal overload relays for protection of the motor. The surveillance testing for which the thermal overload jumpers will be in place, thus bypassing the thermal overload protection, is for situations where there has been no maintenance performed on the valve and the valve is being stroked to verify operation. The large majority of these tests are the quarterly valve stroke surveillances required by the Technical Specifications. This approach is also taken for final operational testing (post-maintenance testing), when the bypass jumpers have been re-terminated following other testing, in order to verify proper operation of the valve operator torque and limit switches. This final test proves the valve circuit wiring is functioning properly after the thermal overload bypass wiring has been reinstalled. For this testing, the surveillance test procedure is performed.

Request (RAI 4)

The LAR states that there is an inherent risk of removing and re-installing thermal overload jumpers in that they may not be re-installed properly. Removing thermal overload bypass jumpers for surveillance stroke tests, during which motor damage is of low probability, may carry more risk with respect to ensuring that the valves can carry out their safety function of stroking as required during an accident.

a) Please provide a discussion of the Callaway operating experience (OE) or industry OE regarding MOV (motor) failures during operation as a result of maintenance activities.

b) In your discussion, describe any actions (e.g., installation of switches to block the bypass circuit such that jumpers do not have to be installed or removed, etc.) that can be performed by the plant to alleviate concerns associated with removal and reinstallation of jumpers.

Response to RAI 4

The Institute of Nuclear Power Operation (INPO) operating experience website has multiple operating experience events of broken termination lugs. The #14 awg lugs are small and require a slight bend in them if there is more than one conductor on the terminal, which is often the case for the thermal overload bypass jumpers. When loosening and tightening these lugs, stress is placed on the termination lug which may result in failure if done repeatedly. Another failure may be to land the jumper in the wrong location, though precautions are taken to prevent this.

Notwithstanding the above, the post-maintenance test for an MOV to ensure proper configuration of the valve electrical circuit after the jumper has been reinstalled is to do a valve stroke. This cannot be effectively done with the jumper removed, and yet, doing this test in the described manner is in conflict of the RG 1.106 requirement to remove the bypass jumper for "valve motors undergoing periodic or maintenance testing."

The plant has not pursued installation of bypass switches or relays for the TOP bypass due to significant cost without a corresponding increase in safety. A switch alone could be problematic because the switch may be inadvertently placed in the wrong position, thereby leaving the thermal overload protection in force. The thermal overload settings are set to industry best practice; however, mis-operation of the thermal overload protection may cause the valve to not position properly when needed.

Summary of Callaway OE regarding MOV motor failures during operation as a result of maintenance activities:

- EJHV8716B – RHR Train B Safety Injection System Hot Leg Recirc Isolation
  - March 29, 1992 – CAR 199200427
    - A modification was performed to install a heavier spring pack but the torque switch setting had not been reduced nor the core load jumper removed because diagnostic testing had not yet been performed.
    - The valve was stroked electrically before the post-modification testing was completed.
    - The motor experienced a locked-rotor condition and failed.
    - Procedure changes were made to prevent recurrence. The change required that the torque switch setting be reduced during any major evolution that could cause damage if the valve is stroked prior to diagnostic testing.
- ALHV0032 – Essential Service Water to Turbine Driven Auxiliary Feedwater Pump
  - April 10, 1992 – CAR 199200642
    - The motor experienced a locked-rotor condition and failed upon receipt of an inadvertent actuation signal.
    - The cause of the locked-rotor condition was determined to be single phasing due to a broken terminal lug.
    - The cause of the broken lug was determined to be work hardening due to repeated bending during maintenance activities.
    - The Callaway Operational Quality Control Manual was revised to include inspection of terminal lugs.

- BBHV8000B – Reactor Coolant System Pressurizer Power Operated Relief Valve Isolation
    - April 22, 1992 – CAR 199200802
        - The feeder breaker was restored closed, rather than open, when clearing tagging during a maintenance evolution.
        - The limit switches had not been engaged when the actuator was installed.
        - The motor experienced a locked-rotor condition when stroked without the limit switches engaged, and consequently failed.
        - A Night Order was issued for operations personnel to restore breakers in OFF position unless Electrical Maintenance confirms that the breaker can be restored in ON position.
    - September 4, 2003 – CAR 200306563
        - A minor modification made wiring changes at the main control board and motor control center that inadvertently bypassed the open limit and torque switches.
        - The motor experienced a locked-rotor condition and failed when the valve backseated during the post-maintenance stroke test due to the control switches being bypassed.
        - Corrective actions included additional training/qualification requirements for design engineers and construction supervisors as well as changes to the Callaway Valve Retest Manual and Retest Development procedure.

Request (RAI 5)

The LAR states that there are 670 valve strokes tests each operating cycle. Based on Callaway OE, how many of the stroke tests failed to meet the acceptance criteria and contributed to MOV motor degradation or caused motor damage during the last 5 years? How many safety-related MOVs will be involved in each operating cycle? How many safety-related MOVs will have a frequency of 18 months and quarterly?

Response to RAI 5

Based on the surveillance frequencies shown in the document titled "Safety Related MOV Surveillance List by Component," there are approximately 1400 valve strokes during the performance of surveillances assigned to safety related MOVs, during an operating cycle. Approximately 40 more strokes would be added for each start up following a shut down, during a cycle, due to surveillances with an "Every Refuel" frequency.

There are 141 safety related MOVs with Technical Specification required surveillances assigned to them, with each valve being tested at least once per 18-month operating cycle. 96 of these have surveillances performed on a 12-week frequency. All surveillances assigned to the remaining 45 valves are performed once per cycle.

There have not been any stroke tests where failure to meet the surveillance acceptance criteria resulted in MOV motor degradation or motor damage, in the last 5 years.

The following is a summary of failed MOV surveillances over the past 5 years (as of 12/19/2017):

- KCHV0253 – Fire Protection Loop to Reactor Building Outer Containment Downstream Isolation
  - April 16, 2013
    - KCHV0253 failed its Local Leak Rate Test.
    - The test was completed satisfactorily after the valve was rebuilt.
- BNHV8813 – Safety Injection Pumps Miniflow to Refueling Water Storage Tank
  - April 22, 2013
    - Test pressure could not be achieved during seat leakage test due to excessive leakby.
    - BNHV8813 had been manually closed because there was no power to the actuator. The test was performed satisfactorily on a later date when the valve was able to be closed electrically.

- EMHV8801B – Boron Injection Header Train B Out to Cold Legs Isolation
  - January 7, 2014
    - Full-open indication was not observed during stroke time testing.
    - Investigation found that the open torque switch had not been properly set following an actuator rebuild. The torque switch opened and stopped valve travel after the open torque switch bypass contacts opened.
    - Stroke time testing was completed satisfactorily after the torque switch was adjusted.
- EFHV0049 – Essential Service Water Train A from Containment Air Coolers Outer Containment Isolation
  - April 8, 2016
    - EFHV0049 failed its Local Leak Rate Test.
    - The test was completed satisfactorily after seat ring replacement.
- EFHV0047 – Essential Service Water Train A from Containment Air Coolers Bypass Isolation
  - September 6, 2016
    - EFHV0047 failed its position indication test. The local indication showed the valve position as 10 degrees beyond the fully closed position.
    - The indication discrepancy was caused by the position of the local indication scale. The scale was replaced.