U-600429
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ILLINOIS POWER COMPANY

CLINTON POWER STATION, P.O. BOX 678, CLINTON, ILLINOIS 61727

February 14, 1986

Docket No. 50-461

Director of Nuclear Reactor Regulation
Attention: Dr. W. R. Butler, Director
BWR Project Directorate No. 4
Division of BWR Licensing
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Clinton Power Station Unit 1
SER Outstanding Issue #7ii
Seismic and Dynamic Qualification of Equipment

Dear Dr. Butler:

This letter is in response to several open items identified in Supplemental Safety Evaluation Report (SSER) Number 5. Attached for your Staff's review are responses to Section 3.11.5, Items 1 through 3.

Please contact us if you have any questions on this matter.

Sincerely yours,

F. A. Spangenberg
Manager - Licensing
and Safety

SMK/ckc

Attachments

cc: B. L. Siegel, NRC Clinton Licensing Project Manager
NRC Resident Office
Regional Administrator, Region III, USNRC
Illinois Department of Nuclear Safety

Add. LIAW

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The following equates to SSER Supplement No. 5, items (1) through (3) of Section 3.11.5 for Clinton Power Station and constitutes Illinois Power Company's response:

* (1) "The applicant must notify the Staff that the deficiencies cited during the audit have been corrected and all equipment is qualified."

"With the exception of one file, adequate proof was provided to establish qualification as claimed. The one exception (file EQCL-009), contained a number of deficiencies:

- The aging of internal components was not adequately addressed.
- The requirement for submergence was inaccurately listed.
- The qualification of internal components was not fully established."

Response: All deficiencies cited during the audit have been corrected and all equipment is qualified.

File EQ-CL009 has been revised as follows:

Limitorque Report No. B0212 was incorporated to address aging of phenolics. With this addition the discourse on aging of internal components is complete. A copy of pertinent pages from Rev. 11 is attached for information.

The requirement for submergence of the operator was deleted. It was also deleted from FSAR 3.11 tables. A copy of the pertinent page from Rev. 5 is attached for information.

File EQ-CL025 (Rockbestos and Flametrol wires) has been incorporated by reference. This addition completes the discourse on the qualification of internal components. A copy of the pertinent page from Rev. 13 is attached for information.

* (2) "The acceptability of the safety related mechanical equipment qualification program must be established."

Response: The following is in response to the two open NRC questions pertaining to the mechanical environmental qualification program.

1. File MEQ-CL056 has been revised to address the adequacy of snubber lubricant. A copy of the pertinent pages from Rev. 6 is attached for information.

2. File MEQ-CL075 has been revised to address the adequacy of Buna-N material. A copy of pertinent pages from Rev. 5 is attached for information.

* (3) "The applicant must notify the Staff that the inconsistencies identified in FSAR Tables 3.11-1, -2, -3, and -4 have been corrected."

Response: The inconsistencies identified in FSAR Tables 3.11-1, -2, -3, and -4 have been corrected and are reflected in Amendment 36.

REV	COMMENTS	RESPONSIBILITY	SECTIONS	DATE
11	Revised Title Page (I) Revised Table of Contents (II) Added Issue Summary Page (III.3) Tab C: Revised Title Page, Pages C1 To C6, Added C6.1 Tab D: Revised Title Page, Pages D1, D7.2, D16, D25 Tab E: Revised Title Page Pages E1 To E3, E14, E18 Tab G: Revised Title Page; Added Report B0212, Coat C For New Valve Tab H: Revised Pages H1, H1.1, and Added H1.2, H1.3, H1.4	PREPARED BY: J H Woods	Tabs C, D, E & H	11/25/85
		REVIEWED BY: J H Woods	Tab G	11/25/85
		REVIEWED BY: S. Akhtar.	Tab C, D and E	11/25/85
		APPROVED BY: R Mahajan	Tabs C, D, E, G & H	11/25/85
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ISSUE SUMMARY

COMPONENT QUALIFICATION DIVISION

III.3

SARGENT & LUNDY ENGINEERS

PROJ. NO.: 4536-32

CQD- 002366

Attachment 2 to U-600429

justification is predicated on the use of the UL temperature index for molded phenolics of 150°C and an aging rate for the materials equivalent to the 10°C rule. The temperature index establishes that the material will degrade to 50% of its initial impact strength, tensile strength or dielectric strength in 6×10^4 hours when subjected to a 150°C temperature for this duration. The value of time and temperature establishes a point on a log life versus temperature plot. Assuming an aging characteristic following the 10 C° rule, the life of the material in a 60°C ambient can be found by extrapolating from the established point. This value of life turns out to be 3.0×10^7 hours. Forty years represents only 1.2% of the defined available life of the material. Therefore, it can be concluded that the switch and block material are imprevious to aging since an insignificant amount of degradation is anticipated. We concur with the Limitorque analysis, as summarized above.

Aging of phenolics per 10°C rule as assumed by Limitorque is conservative when we consider the following. The 10°C rule equates to Activation energy of .84ev for time/temperatures noted above.

Appendix B of the EPRI Final Report NP-1558, titled, "A Review of Equipment Aging Theory and Technology" indicates that phenolics have an activation energy range from 0.96 (ev) to 1.50 (ev). Using the lowest activation energy of .96ev, life at 60°C is 7.4×10^7 hours, almost twice the life rated by Limitorque. Thus, phenolics age at a rate much slower than that assumed by Limitorque. Based on this, the analysis by Limitorque is considered to be conservative and adequately justify the exclusion from thermal aging of contact blocks and switches.

Limitorque has supplied an additional Report entitled "Nuclear Power Station Qualification Type Test Report Limitorque Valve Operators With Type LR Motor For Westinghouse PWR": Number B0212 (Tab G). This Report

Demonstrates That the aging of The Phenolics does not effect The safety Related Function of the motor.

In addition to phenolics, the torque and limit switches contain O-rings and possible gasketing materials. Limitorque contends that their analysis of gaskets and seals, as described for the actuator, is applicable to these switches.

Mechanical Aging

The valve actuator assembly was cycled 500 times (one cycle consisted of an open and close stroke).

. The cycling was performed under load using a load cell to simulate sealing thrust. Performance was judged by monitoring the thrust output through the torque switch. The thrust readings remained within reasonable limits, 20,740 lbs. initially, and 21,053 lbs. final. The test demonstrated operability of the motor and wear aging of the motor and torque switches.

NUCLEAR POWER STATION
QUALIFICATION TYPE TEST REPORT
LIMITORQUE VALVE ACTUATORS WITH TYPE LR MOTOR
FOR WESTINGHOUSE PWR

REPORT B0212

Tested per IEEE Standards 382-1980, 323-1974 and 344-1975

Test performed 18 June 1984 to 30 November 1984

Written by J. B. Drab Date 4-10-'85

J. B. Drab
Special Projects Engineer

Approved by W. J. Denkowski Date 4/10/85

W. J. Denkowski
Vice President-Engineering

Accepted by _____ Date _____

P. G. McQuillan
Q. A. Administrator

2.0 (Cont.)

2.1 (Cont.):

The actuator tested contained the following accessories:

1) 4-rotor geared limit switch (B/M #10120-1-3)
   Brown nuclear insulating material
   Bronze intermittent gear case
   Mobil 28 lubrication
2) Nuclear torque switch (B/M #11500-010-02)
   Brown nuclear insulating material
3) Viton seals
4) Pressure relief valve in main gear box
5) Reliance Electric Company Type LR motor
6) Marathon 300 terminal strip (7-point, every other terminal removed).

NOTE: The test motor was connected to the power supply through safety-related splices. To provide the future option of use of a qualified safety-related splice or a terminal strip to connect the incoming power leads to the motor, the test terminal strip was mounted in the test actuator. During the pressure-temperature transients, at each operation of the test actuator, a motor located outside the test chamber was run in each direction for 30 seconds using power directed through the test terminal strip.

3.0 ACCEPTANCE CRITERIA:

The basic function of a valve actuator during a DBE is to provide the required torque and be capable of accepting the thrust to actuate a valve to either the open or closed position, as required. Also, it is required that limit switches and torque switch function properly to provide proper control logic. All qualifications conducted by Limitorque in this test program have been directed toward the candidate SMB-00 actuator delivering its rated torque of 250'# and capable of accepting rated thrust of 14,000# while both the limit switch and torque switch are providing their proper control functions.

The electrical resistance to ground of all limit and torque switch connections and motor leads are taken for information and are not part of the acceptance.

4.4 HELB/MSLB Simulation:

Expose the aged actuator to a HELB/MSLB event simulation using pressure-temperature transients illustrated in Fig. 1 in Appendix G. Megger limit switch and torque switch connections and motor leads to ground and operate actuator at times indicated in Fig. 1. Spray at a rate of 0.15 gpm/ft^2 of actuator horizontal cross-section during time shown on the pressure-temperature profile (Fig. 1) using a chemical spray consisting of 2500 ppm Boron buffered with Sodium Hydroxide to 10.5pH.

4.5 Post Test Inspection:

At conclusion of the pressure-temperature transients, disassemble the actuator making observations on the condition of the components.

5.0 ACCURACY OF TEST DATA:

The accuracy of the data presented in this report is within the accuracies of the instruments included in Appendix A.

6.0 TYPE TEST RESULTS:

6.1 Baseline Test:

The results of the baseline test are included in Appendix B. This report also includes the baseline test taken prior to the HELB/MSLB environmental test (included in Appendix F) which demonstrates there was no significant change in actuator performance after simulated aging for 40-year life.

6.2 Thermal Aging:

The lubricant in the main gear box and limit switch intermittent gear housing is subject to periodic maintenance during Nuclear Power Plant operation. Due to this fact, thermal accelerated aging of the lubricant was not considered necessary since during the actuator's life, the lubricant could be reconditioned or replaced. Maintenance of the lubricant following the thermal aging step only is permitted.

6.0 TYPE TEST RESULTS (Cont.):

6.2 Thermal Aging (Cont.):

Due to the high activation energies of the limit switch, torque switch and terminal block, thermal aging of these components with the actuator would age these materials far beyond acceptable margins.

Because of this, the limit switch, torque switch and terminal block were aged separately. The limit and torque switches were activated by an external drive through the oven wall to simulate the same mechanical cycles they would experience had they been in the test actuator during its thermal aging.

Accelerated thermal aging was initiated June 20, 1984, and concluded July 3, 1984.

The actuator, including motor and using limit and torque switches that are not part of the test actuator, was thermally aged at a nominal temperature of 284 degrees F for 300 hours simulating a 40-year life.

During thermal aging, the actuator was cycled 210 times including 10 cycles for "setup." Each cycle consisted of stroking the actuator from a limit switch trip open position to a torque switch trip thrust seated closed position back to the limit switch open position.

The limit and torque switch was thermally aged at a nominal temperature of 238 degrees F for 100 hours simulating over a 40-year life (activation energy of 1.78 eV). During thermal aging both switches were cycled 210 times including 10 cycles for "setup."

The terminal strip was thermally aged at a nominal temperature of 261 degrees F for 100 hours simulating over a 40-year life (activation energy of 1.63 eV).

6.3 Mechanical Aging:

Mechanical aging consisted of stroking the actuator from an open limit switch controlled position to a torque switch controlled close position at room ambient temperature. The stroke time was nominally 19 seconds. The cycling was initiated on July 9, 1984, and concluded July 18, 1984. The actuator was cycled for a total of 1816 cycles including five (5) "setup" cycles and resulted in 2026 total mechanical cycles during thermal and mechanical aging procedures.

6.0 TYPE TEST RESULTS (Cont.):

6.10 Post Accident Actuator Inspection:

6.10.1 Motor:

The motor was removed from the actuator and dismantled for inspection.

The stator insulation was darkened to almost black in color. However, high insulation resistance measurements and balanced phase to phase resistance prove the stator to be in good electrical condition. The bearings and lipseal were in good condition. The rotor and stator I.D. were in good condition, however, did show evidence of slight build-up of an unidentified substance in the motor air gap.

6.10.2 Switches:

The limit and torque switches were in good condition. The switch contacts were slightly discolored but clean. The lubricant in the limit switch intermittent gear box darkened in color, but maintained its lubricity. The contact springs on the torque switch and finger springs on the limit switch were in good condition.

6/10.3 Main Gear Box:

The main gear box lubricant darkened in color, but maintained its lubricity. There was evidence of a small amount of condensate in the lubricant. Bearings and gears were in good condition with no wear noted.

7.0 CONCLUSIONS:

The Limitorque SMB-00-15 valve actuator was subjected to an HELB/MSLB event qualification test consisting of exposure to a steam chemical environment, including two temperature and pressure transients from 120 degrees F to over 420 degrees F in approximately 27 seconds. Prior to exposing the actuator to the DBE environment, the entire actuator was:

a) Thermally aged to simulate a 40-year life

b) Mechanically aged to over 2000 cycles

7.0 CONCLUSIONS (Cont.):

c) Pressurization tested
d) Irradiated to life radiation level
e) Plant vibration aging and seismic testing
f) Irradiated to DBE radiation level

The actuator was cycled with simulated valve seating loads during the DBE environmental testing at elevated temperatures and pressures.

Since the actuator performed normally throughout the test, it is concluded this test qualifies similar Limitorque actuators for use in PWR containment chamber service where the environmental conditions stipulated in this report or lesser conditions are encountered.

The SMB-00 actuator qualified in this report is an average, mid-size unit. All size actuators are constructed of the same materials with components designed to equivalent stress levels, same clearances and tolerances with the only difference being in physical size which varies corresponding to the differences in units rating. It is concluded all other sizes (from smallest to largest) of the type SMB, SB, SBD, and SMB/HBC are also equally qualified.

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Cycles:

The unit was tested for 500 cycles.

(Note: A valve actuator with identical treatment of thermal aging and radiation was cycled 1208 times and exposed to a LOCA accident. Thus, substantially higher levels of margin are implicitly considered. This is found in Appendix C, Section 3.1.2 of the Limitorque report).

The valve actuator tested for outside containment qualification, Report No. 80003, was cycled for 1993 cycles during thermal and mechanical aging and for 6 cycles during DBE test.

The DC actuator, tested per Report 80009, was actuated for 2004 cycles during mechanical aging and for 7 cycles for DBE test.

The above, provides us the assurance that adequate margin exists in the design of Limitorque actuators.

Steam / Spray / Submergence.

Performance of actuator was proven under steam conditions used in the test which was coincident with a pressure maximum of 105 psig. Steam exposure lasted upto 4 days. Clinton DBE steam is upto 6 hours maximum at maximum pressure of 30 psig. Test provides ample margin. (See CPS - FSAR Table 3.11-5 for CPS requirements).

Performance under spray conditions has been evaluated for actuators located inside containment. The maximum spray the CPS actuators would see is 1 gpm/ft²/hr of demineralized water. The maximum containment pressure is 15* psig and temperature 185°F.* (See Tab G for spray flow requirement for Clinton.). Although the BWR qualification testing did not incorporate any spray test, the operability of the actuator is evident when we review the spray testing done in the PWR qualification, Report 600456. The unit tested for PWR qualification received identical treatment as that for BWR qualification. The main difference between BWR & PWR qualification is in the DBE profiles in that BWR profile peak temperature was 340°F as opposed to the PWR peak test temperature of 300°F. But then, the maximum temperature the actuators subject to spray will see is only 185°F. The spray test for PWR qualification was 1.2 gpm (See p. 17, Report 600456) at approximately 70 psig (See p 9, Report 600456) provides the assurance that the actuators will be operable under CPS spray conditions.

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1* SEE ZONES H15, H26 & H44

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Calcs. For		Calc. No.
		Rev. / Date
Safety–Related / Non–Safety–Related		Page / of

Client	Prepared by	Date
Project	Reviewed by	Date
Proj. No. / Equip. No.	Approved by	Date

Calc. No: CQD-002366
Rev: 05 Date: 10-01-89
Proj. No: 4536-32
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Vibration

It is possible that the actuators will experience pipe induced vibration. Low level vibration was done during the seismic testing of the actuators. This will be addressed in SQRT documentation.

Interface:

For the proper operation of the valves it is important that the actuators be sized properly for the associated valves. The compatability of the actuator will be proven by the pre-operational start-up tests performed at site.

Conclusion

Based on our analysis it is concluded that the limitorque actuators listed in Tab D are qualified for a 40 year plant life. No maintenance and surveillance are required for environmental qualification.