MISSISSIPPI POWER & LIGHT COMPANY
Helping Build Mississippi
P. O. BOX 1640, JACKSON, MISSISSIPPI 39205

April 8, 1982

NUCLEAR PRODUCTION DEPARTMENT

U.S. Nuclear Regulatory Commission
Division of Licensing
Washington, D.C. 20555

Attention: Mr. Robert L. Tedesco, Assistant Director

Dear Mr. Tedesco:

SUBJECT: Grand Gulf Nuclear Station
Units 1 and 2
Docket Nos. 50-416 and 50-417
File 0260/0277/L-860.0/L-814.1
NUREG-0588 Evaluation - Response
to NRC Trip Report of
January 18, 1982
AECM-82/141

References: 1) AECM-81/231, dated July 1, 1981
2) AECM-81/335, dated September 1, 1981
3) AECM-81/502, dated December 21, 1981

Mississippi Power & Light Company's (MP&L) letter of July 1, 1981 (AECM-81/231) provided MP&L's evaluations of Class 1E electrical equipment qualifications to the requirements of NUREG-0588.

Since MP&L's July 1, 1981 submittal, two (2) supplements have been submitted (AECM-81/335 and AECM-81/502) that have provided additional information on the interim operation justification for equipment identified by MP&L requiring interim operation justification.

The purpose of this letter is to provide MP&L's response to the NRC Equipment Qualification Branch Trip Report - Audit of Documentation Concerning Environmental Qualification of Electrical Equipment for Grand Gulf Unit 1.

With the attached information, qualification or interim operation justification will have been established on all equipment at Grand Gulf Unit 1, subject to the NUREG-0588 harsh environment review.

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The following information is provided:

1. Attachment No. 1

   Provides interim operation justification for equipment previously identified by MP&L as requiring interim operation justification.

2. Attachment No. 2

Provides an update to Attachment No. 2 of the NRC EQB Trip Report of January 12, 1982.

3. Attachment No. 3

Provides additional information on qualification of drywell purge compressor motors.

4. Attachment No. 4

Provides additional information on qualification status of limitorque MOV's in regard to loss of lubricant.

If you have any questions or require further information, please contact this office.

Yours truly,

L. F. Dale
Manager of Nuclear Services

RAB/SHH/JDR:lm
Attachments

cc: Mr. N. L. Stampley (w/o)
Mr. G. B. Taylor (w/o)
Mr. R. B. McGehee (w/o)
Mr. T. B. Conner (w/o)

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Atlanta, Georgia 30303

ATTACHMENT NO. 1

JUSTIFICATION FOR INTERIM OPERATION

Equipment reviewed and justification for interim operation is attached.

1.	J-561.0	Temperature Elements (Thermoelectric)
2.	M-242.0	AC Actuator (Motor Operated Valves - Limitorque) - Outside Containment
3.	M-251.0	AC Actuator (Motor Operated Valves - Limitorque) - Outside Containment
4.	M-257.0/258.0	AC Actuator (Motor Operated Valves - Limitorque) - Outside Containment
5.	M-242.0	AC Actuator (Motor Operated Valves - Limitorque) - Inside Containment
6.	M-251.0	AC Actuator (Motor Operated Valves - Limitorque) - Inside Containment
7.	M-257.0/258.0	AC Actuator (Motor Operated Valves - Limitorque) - Inside Containment
8.	NSSS	S&K Flow Meter (20-9651-8550)
9.	NSSS	S&K Flow Transmitter (91X-16)

I. EQUIPMENT DESCRIPTION

Specification No.:	9645-J-561.0
Component:	Temperature Element Assemblies (Inside and Outside Containment)
Plant ID No.:	See Attachment 1
Manufacturer:	Thermoelectric, Inc.
Model No.:	27620

II. QUALIFICATION STATUS AT TIME OF ORIGINAL SUBMITTAL (July 1981)

The Thermoelectric temperature elements for inside and outside of containment use did not meet Category I requirements of NUREG-0588 because no qualification test data was available.

Interim Operation Justification provided.

III. QUALIFICATION STATUS AT SUPPLEMENT 1 SUBMITTAL (September 1981)

No change. Temperature element to be qualified by testing.

IV. QUALIFICATION STATUS UPDATE

In MP&L's initial NUREG-0588 submittal (AECM-81/231, July 1, 1981), MP&L provided interim operation justification for radiation as the only harsh environment the Thermoelectric temperature element was required to operate in. In regard to the operability of the Thermoelectric temperature elements in the temperature, pressure, and humidity harsh environment, MP&L inadvertently failed to discuss this in the initial NUREG-0588 submittal.

The following information is provided to demonstrate the operability of the Thermoelectric temperature element when the temperature elements are exposed to the DBA temperature, pressure, and humidity:

1. The Thermoelectric temperature element is not a complex electronic device, but rather a simple assembly of several components made of known materials.

2. Temperature Element Components

Metalic Parts

Part	Material
Ceramo Assy	
Thermocouple	Copper/Constantan
Shroud	ASTM A269 GR 316
Head	Aluminum
Cover	Aluminum
Nipple	ASTM A-312 GR 304
Fittings	ASTM A276 GR 304
Screws	Steel, Cadmium Plated Brass
Junction Filler	31655

Inorganic Parts

Part	Material
Ceramo Assy Insulation	Magnesium Oxide
Terminal Blocks	Hemit Mixture of Asbestos, Cement (Portland), Clay, Water

Organic Parts

Part	Material
Body Gasket ("O" Ring)	Viton V747-75
End Seal*	Uniset A 312 (epoxy/aromatic curing agent)
End Seal*	Epoxylite 6203
Insulating Tubing	Extruded Silicone Rubber

*Both end seal materials are being analyzed to facilitate the retagging of these temperature elements for use either inside or outside the containment.

3. The temperature elements are installed with a special connector for sealing the connection between the head assembly and the conduit. This connector and the viton "O" ring will be the primary sealing boundaries of the temperature element head. This allows consideration of the viton "O" ring as the only limiting material.

4. The purpose of the potting end seal material will be to provide a secondary sealing boundary. The uniset A-312 will perform in temperatures ranging to 400°F and the epoxylite 6203 at even higher temperatures.

5. The insulated silicone rubber tubing is rated for continuous operation at 400°F and its sole purpose is to keep the thermocouple leads from touching.

6. The "Hemit" terminal blocks are formulated from inorganic material and therefore not subject to aging, much the same as a metal. The qualified life period of the viton "O" ring has been determined by Arrhenius calculation performed by Bechtel to be 91.8 years at a normal operating temperature environment of 145°F, which includes a +15°F margin, using a very conservative activation energy of 0.5 eV.

7. The viton "O" ring was exposed to the following steam tests with minor to moderate effects:

Steam	Temperature	Days
20 Psig	260°F	50
50 Psig	300°F	21
80 Psig	325°F	9
120 Psig	350°F	6

8. The remaining materials, again, are not limiting for humidity effects because they are located within the primary sealing boundary of the temperature element.

Based on the above discussion and engineering judgement, the Thermoelectric temperature elements will function during and after being exposed to the DBA temperature, pressure, and humidity. Therefore, operability is assured until the Thermoelectric temperature elements are qualified by test to Category I of NUREG-0588.

V. QUALIFICATION STATUS WITH REGARD TO INTERIM OPERATION JUSTIFICATION

The discussion presented in the qualification status update section above (Section IV) establishes the interim operation justification for Thermoelectric temperature element identified in Attachment 1.

VI. FOLLOW-UP PROGRAM

The Thermoelectric temperature elements are being qualified by test at Acton test lab to Category I of NUREG-0588 with the qualification testing to be completed by June 1982 or soon thereafter as possible.

ATTACHMENT 1

Plant ID Numbers for Thermoelectric Temperature Elements

Inside Containment:	1M71-TE-N005 A, B, C, D
	1M71-TE-N006 A, B, C, D
	1M71-TE-N007 A, B, C, D
	1M71-TE-N008 A, B, C, D
	1M71-TE-N009 A, B, C, D
	1M71-TE-N010 A, B, C, D
	1M71-TE-N011 A, B, C, D
	1M71-TE-N012 A, B, C, D
	1M71-TE-N013 A, B, C, D
	1M71-TE-N022 A, B, C, D
	1M71-TE-N023 A, B, C, D
	1M71-TE-N024 A, B, C, D
	1M71-TE-N025 A, B, C, D
	1M71-TE-N026 A, B, C, D
Outside Containment:	1T46-TE-N002 A, B
	1T46-TE-N003 A, B, C, D
	1T46-TE-N004 A, B, C, D

I. EQUIPMENT DESCRIPTION

Specification No:	9645-M-242.0
Component:	AC Actuator (Motor Operated Valve)/(Outside Containment)
Plant ID No:	See Attachment 1 (Quantity 77)
Manufacturer:	Limitorque
Model No:	See Attachment 1
Sub-Components:	Class B Insulation AC Motor-Reliance, Model #447014-JZ 4 Train Limit and Torque Switch - Limitorque Hook-up Wiring - Flamtrol (Raychem) Terminal Blocks - Marathon 300, GE EB-5, Buchanon 0222/0524

II. QUALIFICATION STATUS AT TIME OF ORIGINAL SUBMITTAL (July 1981)

The Limitorque Motor Operated Valves (MOV) for outside of containment use did not meet Category II requirements of NUREG-0588 for the following reasons:

1. The qualified life of the subcomponents had not been adequately determined.
2. Hook-up wiring in the actuator did not meet the total expected dose.
3. Temperature test profile did not envelop the plant specific profile during the first 4.2 minutes of DBA.

III. QUALIFICATION STATUS AT SUPPLEMENT 1 SUBMITTAL (September 1981)

A. Class B Insulation AC Motor - Reliance, Model #447014-JZ
Interim Operation Justification provided.

B. 4 Train Limit and Torque Switch - Limitorque
Interim Operation Justification to be provided prior to fuel load.

C. Hook-up Wiring - Flamtrol (Raychem)
Interim Operation Justification to be provided prior to fuel load.

D. Terminal Blocks - Marathon 300, GE EB-5, Buchanon 0222/0524
Interim Operation Justification to be provided prior to fuel load.

IV. QUALIFICATION STATUS UPDATE

A. General

Further review of the 77 actuators has revealed that actuator B21-F020 does not perform a safety-related function. It has a non-Class IE power supply. It was initially included in the review because the valve had been purchased to the same specification as the other safety-related valves.

In the initial NUREG-0588 evaluation, an attempt was made to qualify all the Limitorque operators in the auxiliary building to a bounding radiation value of 57.9×10^6 RADS of gamma. This resulted in certain components (which were only qualified to 20×10^6 RADS) being declared unqualified for radiation.

Subsequently, a unique dose was calculated for each operator using the dose rate-versus-distance curves described in Section 6.3.1 of "Response to NUREG-0588." As described therein, the methodology utilized straight piping runs of infinite length and took minimal credit for shielding from other equipment. The results of this approach are provided in Table B-8 for each valve associated with this specification. However, using this methodology, the 27 valves shown on Attachment 2 still exceeded the 20×10^6 RAD limit. A detailed calculation was then performed for each valve taking credit for finite pipe lengths, actual pipe run configuration, and shielding due to all intervening equipment. The results of these final calculations are shown on Attachment 2; total integrated dose to each valve associated with this specification is now less than 20×10^6 RADS.

Some of the actuators are exposed to an accident temperature of 310°F versus a test temperature of 250°F max. However, the rise of temperature from a normal value of between 80°F and 125°F to 310°F and the fall to 212°F takes place in a time duration of less than 5 minutes. Since the actuators are completely enclosed in metallic enclosures, the actual temperature to which the internal parts will be exposed will be much lower, as the enclosures will provide a buffer for temperature extremes.

DBA operability was demonstrated during testing for 16 days. The test temperature profile did not completely envelope the plant accident profile for a duration of 4.17 minutes. However, for the balance of the test the actuator is subjected to a much harsher environment than required. Based on this, a calculation was performed to show that the qualified life of the actuator during LOCA exceeds 100 days.

B. Class B Insulation, AC Motor - Reliance, Model #447014-JZ

Based on Limitorque Report B0058, the average expected life of a Class B motor at 125°F is approximately 2589 years. This is based on an equation for the Arrhenius Curve. A qualified life of 40 years at 125°F is equal to 1.5% of its failure life at this temperature. Degradation to the insulation system would be proportional to the percent of failure life, as it is a function of temperature and age. This implies that had the motor under test been thermally aged prior to subjecting it to the LOCA conditions, the degradation to its insulation system would have been negligible (1.5%). This would not have changed the results of this test in any significant way. Hence, one can safely conclude that the Class B, AC motor is qualified for 40 years at a normal ambient temperature of 125°F.

In addition, it is to be noted that the above life is derived on the basis of continuous running operation. The motors in the actuator operate for short durations only. Hence, enough conservatism is present in the above conclusion.

C. 4 Train Limit and Torque Switch - Limitorque

A review of the Limitorque Report B0085 indicates molded phenolic material has been used for these switches. This material has a temperature index of 150°C per Underwriters Laboratories. When this phenolic material was heated at that temperature for 6×10^4

hours, its physical properties were reduced to one half of their original value. A conservative value for its activation energy, per EPRI Research Project 980-1, is 0.96 eV. Assuming its degradation due to thermal aging at a normal temperature of 125°F follows the Arrhenius Curve, it would take 17.47×10^7 hours to reach the same level of degradation. A qualified life of 40 years is only 0.20% of this period.

D. Hook-up Wiring - Flamtrol (Raychem)

The hook-up wiring has been identified by Limitorque as Raychem Flamtrol. The Raychem Flamtrol Insulation System has been extensively tested and is qualified to IEEE 383-1974 per FIRL Report F-C4033-1 dated January 1975.

E. Terminal Blocks - Marathon 300, GE EB-5, Buchanon 0222/0524

This subcomponent is being evaluated under the Electrical Interface package which was provided to the NRC in MP&L letter to the NRC (AECM-81/502, 12/21/81). The terminal blocks are justified for interim operation and will be qualified by June 1982 or as soon thereafter as possible.

V. QUALIFICATION STATUS WITH REGARD TO INTERIM OPERATION JUSTIFICATION

The discussion presented in the qualification status update section above (Section IV) establishes the interim operation justification for the Limitorque Motor Operated Valves (MOV) identified in Attachment 1.

VI. FOLLOW-UP PROGRAM

The Limitorque Motor Operated Valves (MOV) identified in Attachment 1 will be qualified by June 1982 or as soon thereafter as possible.

ATTACHMENT 1

Page 1 of 2

77 VALVES
Limitorque
outside containment

Exhibit "F" Attachment 1

Valves 2½" & Larger with Limitorque Motor Actuator

William Powell

9645-M-242.0

System Name	Plant ID No.	Room No.	Actuator Model No.	Category	Service
Nuclear Boiler	B21 F020	1A305	SMB-00-7.5	b	System Isolation Remain Closed
	B21 F019	1A305	SMB-000-5	a	Containment Isolation
	B21 F065A	1A305	SMB-4-150	a	
	B21 F065B	1A305	SMB-4-150	a	
	B21 F098A	1A305	SMB-3-100	a	
	B21 F098B	1A305	SMB-3-100	a	
	B21 F098C	1A305	SMB-3-100	a	
	B21 F098D	1A305	SMB-3-100	a	
CRD Hydraulic System	C11 F322	1A201	SMB-000-5	a	Aux. Bldg. Isolation
RHR System	E12 F004A	1A103	SMB-2-40	a	Containment Isolation
	E12 F004B	1A105		a	
	E12 F004C	1A116		a	
	E12 F026A	1A103	SMB-000-5	a	System Control
	E12 F026B	1A105		a	
	E12 F049	1A102		a	
	E12 F064A	1A103	SMB-00-10	a	Containment Isolation
	E12 F064B	1A105		a	
	E12 F064C	1A118		a	
	E12 F053A	1A203	SB-3-100	a	System Control
	E12 F053B	1A205	SB-3-100	a	
	E12 F023	1A204	SMB-1-25	a	to RCIC System
	E12 F087A	1A304	SMB-2-40	a	System Control
	E12 F087B	1A306		a	
	E12 F052A	1A304		a	
	E12 F052B	1A306		a	
	E12 F003A	1A102	SMB-4-300	a	
	E12 F003B	1A106	SMB-4-300	a	
	E12 F048A	1A128		a	
	E12 F048B	1A129		a	
RHR System	E12 F024A	1A103	SMB-2-80	a	Containment Isolation
	E12 F024B	1A105	SMB-2-80	a	
	E12 F006A	1A203	SMB-2-80	a	Pump Suction from Reactor
	E12 F006B	1A205	SMB-2-60	a	Recirc.
	E12 F042C	1A320	SB-2-80	a	Containment Isolation
	E12 F008	1A204	SMB-3-100	a	
	E12 F027A	1A203	SMB-1-60	a	
	E12 F027B	1A205	SMB-1-60	a	
	E12 F011A	1A103	SMB-00-7 1/2	a	
	E12 F011B	1A105	SMB-00-7 1/2	a	
	E12 F040	1A128	SMB-000-5	a	System Control
	E12 F021	1A116	SMB-3-150	a	Containment Isolation
	E12 F047A	1A303	SMB-2-80	a	System Control
	E12 F047B	1A307	SMB-2-80	a	"
	E12 F094	1A123	SMB-2-60	b	Remain Closed
	E12 F096	1A123	SMB-2-60	b	

ATTACHMENT 1

Page 2 OF 2

Exhibit "F" Attachment 1

Valves With 2½" & Larger Limitorque Motor Actuator — William Powell — 9645-M-242.0

System	Plant ID No.	Room No.	Actuator Model No.	Category	Service
LPCS System	E21 F001	1A115	SMB-1-40	a	Suppression Pool Isolation
	E21 F005	1A220	SB-3-150	a	Containment Isolation
	E21 F011	1A115	SMB-000-5	a	System Testing
	E21 F012	1A115	SMB-3-150	a	
RCIC	E51 F064	1A305	SB-1-40	a	Containment Isolation
	E51 F077	1A209	SMB-000-2	a	Suppression Pool Isolation
RWCU System	G33 F004	1A305	SMB-0-25	a	Containment Isolation
	G33 F034	1A305	SMB-00-10	a	
	G33 F039	1A305	SMB-0-25	a	
	G33 F054	1A305	SMB-00-10	a	
Fuel Pool Cooling	G41 F028	1A527	SMB-00-10	a	Containment Isolation
& Cleanup	G41 F021	1A527	Later	a	System Control
	G41 F029	1A527	SMB-000-5	a	Containment Isolation
Standby Service	P41 F237	1A215	SMB-000-5	b	System Isolation
Water	P41 F238	1A215		b	
	P41 F241	1A123		b	
	P41 F081A	1A123		b	
	P41 F081B	1A123		b	
	P41 F064A	1A123		b	
	P41 F064B	1A123		b	
	P41 F155A	1A201		b	Aux. Bldg. Isolation
	P41 F155B	1A201		b	
	P41 F154	1A201		b	
	P41 F125	1A201		b	System Isolation
Component Cooling	P42 F066	1A319	SMB-00-10	a	Containment Isolation
Water	P42 F067	1A319		a	
Plant Service	P44 F053	1A319	SMB-000-5	a	Containment Isolation
Water	P44 F069	1A319	SMB-000-5	a	
Floor & Equip.	P45 F273	1A203	SMB-000-5	a	Containment Isolation
Drain	P45 F274	1A203	SMB-000-5	a	
Fire Protection	P64 FA10A	1A215	SMB-000-5	b	Isolation Valve Bypass-Remain Closed
	P64 FA10B	1A211	SMB-000-5	b	

ATTACHMENT 2

TABLE I
Dose to Limitorque Actuators

Room No.	Plant ID No.	Actuator Model No.	Accident Dose (Megarad)	Normal Dose (Megarad)
1A305	B21-F019	SMB-000-5	6.5	1.8
1A305	B21-F098A	SMB-3-100	3.5	1.8
1A305	B21-F098B	SMB-3-100	3.5	1.8
1A305	B21-F098C	SMB-3-100	3.5	1.8
1A305	B21-F098D	SMB-3-100	3.5	1.8
1A103	E12-F004A	SMB-2-40	17	.005
1A105	E12-F004B	SMB-2-40	17	.005
1A103	E12-F026A	SMB-000-5	10.5	.005
1A105	E12-F026B	SMB-000-5	10.5	.005
1A102	E12-F049	SMB-000-5	17.5	.005
1A105	E12-F064B	SMB-00-10	10.5	.005
1A203	E12-F053A	SB-3-100	11	.005
1A205	E12-F053B	SB-3-100	13	.005
1A202	E12-F003A	SMB-4-300	16	.005
1A106	E12-F003B	SMB-4-300	15.5	.005
1A103	E12-F024A	SMB-2-80	19	.005
1A105	E12-F024B	SMB-2-80	19	.005
1A203	E12-F027A	SMB-1-60	9.5	.005
1A103	E12-F011A	SMB-00-7.5	10.5	.005
1A105	E12-F011B	SMB-00-7.5	10.5	.005
1A305	E51-F064	SB-1-40	6.5	1.8
1A305	G33-F004	SMB-0-25	6.5	1.8
1A305	G33-F034	SMB-00-10	6.5	1.8
1A305	G33-F039	SMB-0-25	6.5	1.8
1A305	G33-F054	SMB-0-10	6.5	1.8
1A203	P45-F273	SMB-000-5	10	.005
1A203	P45-F274	SMB-000-5	10	.005

I. EQUIPMENT DESCRIPTION

Specification No:	9645-M-251.0
Component:	AC Actuator (Motor Operated Valve)/(Outside Containment)
Plant ID No:	See Attachment 1 (Quantity 67)
Manufacturer:	Limitorque
Model No:	See Attachment 1
Sub-Components:	Class B Insulation AC Motor-Reliance, Model #447014-JZ 4 Train Limit and Torque Switch - Limitorque Hook-up Wiring - Flamtrol (Raychem) Terminal Blocks - Marathon 300, GE EB-5, Buchanon 0222/0524

II. QUALIFICATION STATUS AT TIME OF ORIGINAL SUBMITTAL (July 1981)

The Limitorque Motor Operated Valves (MOV) for outside of containment use did not meet Category II requirements of NUREG-0588 for the following reasons:

1. The qualified life of the subcomponents had not been adequately determined.
2. Hook-up wiring in the actuator did not meet the total expected dose.
3. Temperature test profile did not envelop the plant specific profile during the first 4.2 minutes of DBA.

III. QUALIFICATION STATUS AT SUPPLEMENT 1 SUBMITTAL (September 1981)

A. Class B Insulation AC Motor - Reliance, Model #447014-JZ
Interim Operation Justification provided.

B. 4 Train Limit and Torque Switch - Limitorque
Interim Operation Justification to be provided prior to fuel load.

C. Hook-up Wiring - Flamtrol (Raychem)
Interim Operation Justification to be provided prior to fuel load.

D. Terminal Blocks - Marathon 300, GE EB-5, Buchanon 0222/0524
Interim Operation Justification to be provided prior to fuel load.

IV. QUALIFICATION STATUS UPDATE

A. General

In the initial NUREG-0588 evaluation, an attempt was made to qualify all the Limitorque operators in the auxiliary building to a bounding radiation value of 57.9×10^6 RADS of gamma. This resulted in certain components (which were only qualified to 20×10^6 RADS) being declared unqualified for radiation. Subsequently, a unique dose was calculated for each operator using the dose rate-versus-distance curves described in Section 6.3.1 of "Response to NUREG-0588." As described therein, the methodology utilized straight piping runs of infinite length and took minimal credit for shielding from other equipment. The results of this approach are provided in Table B-8 for each valve associated with this specification.

However, using this methodology, the 23 valves shown on Attachment 2 still exceeded the 20×10^6 RAD limit. A detailed calculation was then performed for each valve taking credit for finite pipe lengths, actual pipe run configuration, and shielding due to all intervening equipment. The results of these final calculations are shown on Attachment 2; total integrated dose to each valve associated with this specification is now less than 20×10^6 RADS.

Some of the actuators are exposed to an accident temperature of 310°F versus a test temperature of 250°F max. However, the rise of temperature from a normal value of between 80°F and 125°F to 310°F and the fall to 212°F takes place in a time duration of less than 5 minutes. Since the actuators are completely enclosed in metallic enclosures, the actual temperature to which the internal parts will be exposed will be much lower, as the enclosures will provide a buffer for temperature extremes.

DBA operability was demonstrated during testing for 16 days. The test temperature profile did not completely envelope the plant accident profile for a duration of 4.17 minutes. However, for the balance of the test the actuator is subjected to a much harsher environment than required. Based on this, a calculation was performed to show that the qualified life of the actuator during LOCA exceeds 100 days.

B. Class B Insulation, AC Motor - Reliance, Model #447014-JZ

Based on Limitorque Report B0058, the average expected life of a Class B motor at 125°F is approximately 2589 years. This is based on an equation for the Arrhenius Curve. A qualified life of 40 years at 125°F is equal to 1.5% of its failure life at this temperature. Degradation to the insulation system would be proportional to the percent of failure life, as it is a function of temperature and age. This implies that had the motor under test been thermally aged prior to subjecting it to the LOCA conditions, the degradation to its insulation system would have been negligible (1.5%). This would not have changed the results of this test in any significant way. Hence, one can safely conclude that the Class B, AC motor is qualified for 40 years at a normal ambient temperature of 125°F.

In addition, it is to be noted that the above life is derived on the basis of continuous running operation. The motors in the actuator operate for short durations only. Hence, enough conservatism is present in the above conclusion.

C. 4 Train Limit and Torque Switch - Limitorque

A review of the Limitorque Report B0085 indicates molded phenolic material has been used for these switches. This material has a temperature index of 150°C per Underwriters Laboratories. When this phenolic material was heated at that temperature for 6×10^4 hours, its physical properties were reduced to one half of their original value. A conservative value for its activation energy, per EPRI Research Project 980-1, is 0.96 eV. Assuming its degradation due to thermal aging at a normal temperature of 125°F follows the Arrhenius Curve, it would take 17.47×10^7 hours to reach the same level of degradation. A qualified life of 40 years is only 0.20% of this period.

D. Hook-up Wiring - Flamtrol (Raychem)

The hook-up wiring has been identified by Limitorque as Raychem Flamtrol. The Raychem Flamtrol Insulation System has been extensively tested and is qualified to IEEE 383-1974 per FIRL Report F-C4033-1 dated January 1975.

E. Terminal Blocks - Marathon 300, GE EB-5, Buchanon 0222/0524

This subcomponent is being evaluated under the Electrical Interface package which was provided to the NRC in MP&L letter to the NRC (AECM-81/502, 12/21/81). The terminal blocks are justified for interim operation and will be qualified by June 1982 or as soon thereafter as possible.

V. QUALIFICATION STATUS WITH REGARD TO INTERIM OPERATION JUSTIFICATION

The discussion presented in the qualification status update section above (Section IV) establishes the interim operation justification for the Limitorque Motor Operated Valves (MOV) identified in Attachment 1.

VI. FOLLOW-UP PROGRAM

The Limitorque Motor Operated Valves (MOV) identified in Attachment 1 will be qualified by June 1982 or as soon thereafter as possible.

ATTACHMENT 1
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QUANTITY 67

ATTACHMENT 1

Component: Valves 2½" & Smaller with Limitorque AC Motor Actuator outside

Manufacturer: Yarway

Specification: 9645-M251.0

System Name	Plant ID No.	Room No.	Actuator Model No.	Category	Service
Inst. and Control System	M71 F595	1A417	SMB-000-5	a	Containment Isolation
RHR System	E12 F346	1A116	SMB-000-5	a	Containment Isolation
MSIV - Leakage Control System	E32 F006	1A305	SMB-00-15	a	Control Long Term Leakage through MSIVs
	F008	1A305			
	F009	1A305			
	F007	1A305			
RHR System	E12 F074A	1A304	SMB-00-15	a	Containment Isolation
	F074B	1A306			
	F073A	1A304			
	F073B	1A306			
Standby Service Water System	P41 F159A	1A319	SMB-00-10	a	Containment Isolation
	F159B	1A319			
	F160A	1A319			
	F160B	1A319			
Nuclear Boiler System	B21 F067A	1A305	SMB-00-10	a	Containment Isolation
	F067B	1A305			
	F067C	1A305			
	F067D	1A305			
RHR System	E12 F087A	1A103	SMB-00-10	a	RHR Jockey Pump Operation
	F087B	1A105		a	
RCIC System	E51 F078	1A103	SMB-00-10	a	Vacuum Breaker Isolation Valve
MSIV - Leakage Control System	E32 F001A	1A305	SMB-00-10	a	Control Long Term Leakage through MSIVs
	F001E	1A305			
	F001J	1A305			
	F001N	1A305			
	F002A	1A305			
	F002E	1A305			
	F002J	1A305			
	F002N	1A305			
	F003A	1A201			
	F003E	1A201			
	F003J	1A201			
	F003N	1A201			
Make-up Water Treatment System	P21 F017	1A428	SMB-00-10	a	Containment Isolation

ATTACHMENT 1

Component: Valves 2½ & Smaller With Limitorque AC Motor Actuator

Manufacturer: Marvav

Specification: 9645-M251.0

System Name	Plant ID No.	Room No.	Actuator Model No.	Category	Service
Standby Service Water	P41 F113	1A117	SMB-00-15	a	SSW Line Isolation
	F122A	1A302	SMB-000-2		
	F122B	1A301			
	F119A	1A121			
	F119B	1A101			
	F121A	1A302			
	F121B	1A301			
RHR System	E12 F290A	1A103	SMB-00-10	a	Minimum Flow Bypass for
	F290B	1A105		a	Jockey Pump
Feedwater Leakage Control System	E38 F001A	1A305	SMB-00-10	a	Control Long Term Leakage
	F001B	1A305		a	through Isolation Valve
Instrument Air System	P53 F003	1A428	SMB-000-5	a	Containment Isolation
CRD Hyraulic System	C11 F083	1A319	SMB-00-15	a	Containment Isolation
Reactor Recir	B33 F127	1A428	SMB-000-2	a	Containment Isolation
	B33 F125	1A319	SMB-000-2	a	
Leak Detection System	E31 F100A	1A322	SMB-000-2	a	Control Tank Level
	F100B	1A322	SMB-000-2	a	
Combustible Gas Control	E61 F595A	1A420	SMB-000-2	a	Sample Return from Hydrogen
	E61 F595C	1A417			Analyzer
	E61 F596A	1A420			
	E61 F596C	1A417			
	E61 F597A	1A420			
	E61 F597C	1A417			
	E61 F598A	1A420			
	E61 F598C	1A417			
Suppression Pool Make-up	E30 F592A	1A215	SMB-000-2	a	Sensing Line for Drywell
	E30 F592B	1A220			Pressure
	E30 F591A	1A220			
	E30 F591B	1A211			
	E30 F594A	1A115	SMB-000-2	a	Sensing Line for Suppression
	E30 F593A	1A122			Pool Pressure and Level
	E30 F593B	1A116			
	E30 F594B	1A123			

TABLE I

Dose to Limitorque Actuators

Room No.	Plant ID No.	Actuator Model No.	Accident Dose (Megarad)	Normal Dose (Megarad)
1A305	E32-F006	SMB-00-15	6.5	1.8
1A305	E32-F008	SMB-00-15	6.5	1.8
1A305	E32-F009	SMB-00-15	6.5	1.8
1A305	E32-F007	SMB-00-15	6.5	1.8
1A305	B21-F067A	SMB-00-10	4.0	1.8
1A305	B21-F067B	SMB-00-10	4.0	1.8
1A305	B21-F067C	SMB-00-10	4.0	1.8
1A305	B21-F067D	SMB-00-10	4.0	1.8
1A103	E12-F082A	SMB-00-10	6.5	.005
1A105	E12-F082B	SMB-00-10	6.5	.005
1A103	E51-F078	SMB-00-10	7.5	1.8
1A305	E32-F001A	SMB-00-10	6.5	1.8
1A305	E32-F001E	SMB-00-10	6.5	1.8
1A305	E32-F001J	SMB-00-10	6.5	1.8
1A305	E32-F001N	SMB-00-10	6.5	1.8
1A305	E32-F002A	SMB-00-10	6.5	1.8
1A305	E32-F002E	SMB-00-10	6.5	1.8
1A305	E32-F002J	SMB-00-10	6.5	1.8
1A305	E32-F002N	SMB-00-10	6.5	1.8
1A103	E12-F290A	SMB-00-10	6.5	.005
1A105	E12-F290B	SMB-00-10	6.5	.005
1A305	E38-F001A	SMB-00-10	6.5	1.8
1A305	F38-F001B	SMB-00-10	6.5	1.8

I. EQUIPMENT DESCRIPTION

Specification No:	9645-M-257.0/M-258.0
Component:	AC Actuator (Motor Operated Valve)/(Outside Containment)
Plant ID No:	See Attachment 1 (Quantity 25)
Manufacturer:	Limitorque
Model No:	See Attachment 1
Sub-Components:	Class B Insulation AC Motor-Reliance, Model #447014-JZ 4 Train Limit and Torque Switch - Limitorque Hook-up Wiring - Flamtrol (Raychem) Terminal Blocks - Marathon 300, GE EB-5, Buchanon 0222/0524

II. QUALIFICATION STATUS AT TIME OF ORIGINAL SUBMITTAL (July 1981)

The Limitorque Motor Operated Valves (MOV) for outside of containment use did not meet Category II requirements of NUREG-0588 for the following reasons:

1. The qualified life of the subcomponents had not been adequately determined.
2. Hook-up wiring in the actuator did not meet the total expected dose.
3. Temperature test profile did not envelop the plant specific profile during the first 4.2 minutes of DBA.

III. QUALIFICATION STATUS AT SUPPLEMENT 1 SUBMITTAL (September 1981)

A. Class B Insulation AC Motor - Reliance, Model #447014-JZ
Interim Operation Justification provided.

B. 4 Train Limit and Torque Switch - Limitorque
Interim Operation Justification to be provided prior to fuel load.

C. Hook-up Wiring - Flamtrol (Raychem)
Interim Operation Justification to be provided prior to fuel load.

D. Terminal Blocks - Marathon 300, GE EB-5, Buchanon 0222/0524
Interim Operation Justification to be provided prior to fuel load.

IV. QUALIFICATION STATUS UPDATE

A. General

In the initial NUREG-0588 evaluation, an attempt was made to qualify all the Limitorque operators in the auxiliary building to a bounding radiation value of 57.9×10^6 RADS of gamma. This resulted in certain components (which were only qualified to 20×10^6 RADS) being declared unqualified for radiation. Subsequently, a unique dose was calculated for each operator using the dose rate-versus-distance curves described in Section 6.3.1 of "Response to NUREG-0588." As described therein, the methodology utilized straight piping runs of infinite length and took minimal credit for shielding from other equipment. The results of this approach are provided in Table B-8 for each valve associated with this specification. Total integrated dose to each valve associated with this specification is less than 20×10^6 RADS.

The maximum service temperature for these actuators is 80°F.

Out of the 25 actuators, only three of the actuators are exposed to high temperature during a DBA event and this temperature is, at the most, 140°F.

DBA operability was demonstrated during testing for 16 days. However, the environment to which the test was conducted was much more severe than actually occurs in the event of a LOCA/HELB. Based on the difference in the test temperature and the actual temperature, using the Arrhenius Equation it was determined that the qualified life of these actuators under LOCA/HELB conditions exceeds 100 days.

B. Class B Insulation, AC Motor - Reliance, Model #447014-JZ

Based on Limitorque Report B0058, an equation for the Arrhenius Curve for the thermal life of a Class B motor. The average expected life of a Class B motor at 80°F is approximately 41,162 years. A qualified life of 40 years at 80°F is equal to 0.097% of its failure life at this temperature. Degradation to the insulation system would be proportional to the percent of failure life, as it is a function of temperature and age. This implies that had the motor under test been thermally aged prior to subjecting it to the LOCA conditions, the degradation to its insulation system would have been negligible (0.097%). This would not have changed the results of this test in any significant way. Hence, one can safely conclude that the Class B, AC motor is qualified for 40 years at a normal service temperature of 80°F.

In addition, it is to be noted that the above life is derived on the basis of continuous running operation. The motors in the actuator operate for short durations only. Hence, enough conservatism is present in the above conclusion.

C. 4 Train Limit and Torque Switch - Limitorque

A review of the Limitorque Report B0058 indicates that molded phenolic material has been used for these switches. This material has a temperature index of 150°C per Underwriters Laboratories. When this phenolic material was heated at that temperature for 6×10^4 hours, its physical properties were reduced to one half of their original value. A conservative value for its activation energy, per EPRI Research Project 980-1, is 0.96 eV. Assuming that its degradation due to thermal aging at a normal temperature of 80°F follows the Arrhenius Curve, it would take 3.05×10^9 hours to reach the same level of degradation. A qualified life of 40 years is only 0.01% of this period.

D. Hook-Up Wiring - Flamtrol (Raychem)

The hook-up wiring has been identified by Limitorque as Raychem Flamtrol. The Raychem Flamtrol Insulation System has been extensively tested and is qualified to IEEE 383-1974 for FIRL Report F-C4033-1 dated January 1975.

E. Terminal Blocks - Marathon 300, GE EB-5, Buchanon 0222/0524

This sub-component is being evaluated under the Electrical Interface Package which was provided to the NRC in MP&L letter to the NRC (AECM-81/502, 12/21/81). The terminal blocks are justified for interim operation and will be qualified by June 1982 or as soon thereafter as possible.

V. QUALIFICATION STATUS WITH REGARD TO INTERIM OPERATION JUSTIFICATION

The discussion presented in the qualification status update section above (Section IV) establishes the interim operation justification for the Limitorque Motor Operated Valves (MOV) identified in Attachment 1.

VI. FOLLOW-UP PROGRAM

The Limitorque Motor Operated Valves (MOV) identified in Attachment 1 will be qualified by June 1982 or as soon thereafter as possible.

ATTACHMENT 1

Page 1 of 1

Butterfly Valves With Limitorque AC Motor Actuator
4 Train Limit Switch and Torque Switch outside

Exhibit "F" Attachment 1

Henry Pratt

Quantity 25

9645-M-257.0/M-258.0

System Name	Plant ID No.	Room No.	Actuator Model No.	Category	Service
Standby Service Water	P41 F014A	1A122	SMB-000-5/H2BC	a	Open for Operation
	P41 F014B	1A121		a	
	P41 F068A	1A122		a	
	P41 F068B	1A121		a	
Component Cooling Water	P42 F028A	1A527	SMB-000-2/H1BC	a	System Isolation
	P42 F028B	1A527		a	
	P42 F032A	1A527		a	
	P42 F032B	1A527		a	
	P42 F105	1A322		a	
	P42 F200A	1A322		a	
	P42 F200B	1A527		a	
	P42 F201A	1A322		a	
	P42 F201B	1A527		a	
	P42 F203	1A527		a	Train Isolation
	P42 F204	1A527		a	System Isolation
	P42 F205	1A322		a	
Plant Service	P44 F042	1A117	SMB-000-2/H1BC	a	System Isolation
	P44 F054	1A117		a	
	P44 F067	1A117		a	
Standby Gas Treatment	T48 F005	1A301	SMB-000-2/H1BC	a	System Isolation
	T48 F006	1A302		a	
	T48 F023	1A322	SMB-000-2/H2BC	a	
	T48 F024	1A322		a	
	T48 F025	1A322		a	
	T48 F026	1A322		a	

I. EQUIPMENT DESCRIPTION

Specification No:	9645-M-242.0
Component:	AC Actuator (Motor Operated Valve)/(Inside Containment)
Plant ID No:	See Attachment 1 (Quantity 31)
Manufacturer:	Limitorque
Model No:	See Attachment 1
Sub-Components:	Class RH Insulation AC Motor-Reliance, Model #601962-P 4 Train Limit and Torque Switch - Limitorque Hook-up Wiring - Flamtrol (Raychem) Terminal Blocks - Marathon 300, GE EB-5, Buchanon 0222/0524

II. QUALIFICATION STATUS AT TIME OF ORIGINAL SUBMITTAL (July 1981)

The Limitorque Motor Operated Valves (MOV) for inside of containment use did not meet Category II requirements of NUREG-0588 for the following reasons:

1. Lack of aging information.
2. Operability under flooding conditions was not addressed.
3. Operability under spray conditions was not addressed.
4. No variations in frequency or voltage were addressed.

III. QUALIFICATION STATUS AT SUPPLEMENT 1 SUBMITTAL (September 1981)

A. Class RH Insulation AC Motor - Reliance, Model #601962-P
Interim Operation Justification provided.

B. 4 Train Limit and Torque Switch - Limitorque
Interim Operation Justification to be provided prior to fuel load.

C. Hook-up Wiring - Flamtrol (Raychem)
Interim Operation Justification to be provided prior to fuel load.

D. Terminal Blocks - Marathon 300, GE EB-5, Buchanon 0222/0524
Interim Operation Justification to be provided prior to fuel load.

IV. QUALIFICATION STATUS UPDATE

A. General

Additional review of the four actuators with elevation level below flood level has revealed that valves 1G33-F100, 1G33-F102 and 1G33-F106 are not required to perform a safety related function. Valve 1E12-F009 is only required to function post DBA. This valve is located in the drywell at an elevation of 124'8" and its radial distance from the center of the drywell is about 25'. The flooding in the drywell, above the level of 117'4" occurs in the form of an annular ring contained by the drywell wall, which is about 36'6" away from the center. Since the water ring is expected to extend from the drywell wall to a width of 5' only, the valve is not affected by flooding.

The maximum radiation dose to which the actuator internals will be exposed has been determined by Bechtel. The total radiation dose (beta and gamma) to the actuator internals (based on enclosure size and location) will not exceed 200 Megarads.

Though the operability of the actuator was not demonstrated under spray during the test this is not considered a problem, as the actuators are enclosed in NEMA 4 water tight enclosures. Additionally, the spray is not caustic in nature.

The operability of the actuator was demonstrated during the test for 30 days. However, the test environment was more severe than the environment the actuators will be exposed to in the event of a LOCA. Using the Arrhenius method, it can be shown that the qualified life of the actuator during a DBA exceeds 100 days.

B. Class RH Insulation AC Motor - Reliance, Model #601962-P

Limitorque Report B0058 indicates that the activation energy for the insulating materials used in the motor is about 1.00 eV. Based on this, the motor insulating materials are qualified for more than 40 years.

C. 4 Train Limit and Torque Switch - Limitorque

Limitorque Report B0058 indicates that molded phenolic material has been used for these switches. This material has a temperature index of 150°C per Underwriters Laboratory. When this phenolic material was heated at that temperature for 6×10^4 hours, its physical properties were reduced to one half of their original value. A conservative value for its activation energy, per EPRI Research Project 890-1, is 0.96 eV. Assuming that its degradation due to thermal aging at a normal temperature of 135°F follows the Arrhenius curve, it would take 9.8×10^7 hours to reach the same level of degradation. A qualified life of 40 years is only 0.36% of this period.

D. Hook-Up Wiring - Flamtrol (Raychem)

The hook-up wiring has been identified by Limitorque as Raychem Flamtrol. The Raychem Flamtrol Insulation system has been extensively tested and is qualified to IEEE 383-1974 per FIRL Report F-C4033-1 dated January 1975.

E. Terminal Blocks - Marathon 300, GE EB-5, Buchanon 0222/0524

This sub-component is being evaluated under the Electrical Interface package which was provided to the NRC in MP&L letter to the NRC (AECM-81/502, 12/21/81). The terminal blocks are justified for interim operation and will be qualified by June 1982 or as soon thereafter as possible.

V. QUALIFICATION STATUS WITH REGARD TO INTERIM OPERATION JUSTIFICATION

The discussion presented in the qualification status update section above (Section IV) establishes the interim operation justification for the Limitorque Motor Operated Valves (MOV) identified in Attachment 1.

VI. FOLLOW-UP PROGRAM

The Limitorque Motor Operated Valves (MOV) identified in Attachment 1 will be qualified by June 1982 or as soon thereafter as possible.

Attachment 1

Exhibit "F Attachment 1

Quantity 31

Component Valves with Motor Actuators Manufacturer Valve: William Powell Actuator: Limitorque Specification 9645-M-242.0

Sheet 1 of 1

System Name	Plant I.D NO.	Wetting*	Room No.	Actuator Model No.	Category	Service
Nuclear Boiler	B21 F016	N/A	1A112	SMB-000-5	a	Containment Isolation
Standby Liquid Control	C41 F001A	N/A	1A512	Later	a	SLC Injection
Standby Liquid Control	C41 F001B	N/A	1A512	Later	a	SLC Injection
RHR	E12 F009	1	1A112	SB-3-100	a	Containment Isolation
RHR	E12 F028A	3	1A110	SMB-1-60	a	Containment Spray
RHR	E12 F028B	3	1A110	SMB-1-60	a	Containment Spray
RHR	E12 F037A	3	1A110	SMB-2-80	a	RHR "A" Control System
RHR	E12 F037B	3	1A110	SMB-2-80	a	RHR "A" Control System
RHR	E12 F042A	3	1A313	SB-2-150	a	Containment Isolation
RHR	E12 F042B	2 & 3	1A311	SB-3-150	a	Containment Isolation
RCIC	E51 F063	N/A	1A112	SB-1-40	a	Containment Isolation
RWCU	G33 F001	N/A	1A112	SMB-0-25	a	Containment Isolation
RWCU	G33 F028	N/A	1A310	SMB-00-10	a	Containment Isolation
RWCU	G33 F040	N/A	1A310	SMB-00-10	a	containment Isolation
RWCU	G33 F053	N/A	1A310	SMB-00-10	a	Containment Isolation
RWCU	G33 F100	1	1A112	SMB-00-10	a	Reactor Recirc. Suction
RWCU	G33 F102	1	1A112	SMB-1-40	a	Reactor Recirc. Suction
RWCU	G33 F106	1	1A112	SMB-00-10	a	Reactor Recirc. Suction
RWCU	G33 F250	N/A	1A112	SMB-0-25	a	Drywell Isolation
RWCU	G33 F251	N/A	1A414	SMB-0-25	a	Drywell Isolation
RWCU	G33 F252	N/A	1A112	SMB-0-25	a	Containment Isolation
RWCU	G33 F253	N/A	1A414	SMB-0-25	a	Drywell Isolation
Fuel Pool Cool & Clean Up	G41 F044	3	1A509	SMB-000-5	a	Containment Isolation
Component Cooling Water	P42 F068	3	1A313	SMB-00-10	a	Containment Isolation
Component Cooling Water	P42 F114	3	1A313	SMB-00-10	a	Drywell Isolation
Component Cooling Water	P42 F116	2 & 3	1A313	SMB-000-5	a	Drywell Isolation
Component Cooling Water	P42 F117	3	1A313	SMB-000-5	a	Drywell Isolation
Plant Service Water	P44 F070	3	1A313	SMB-000-5	a	Containment Isolation
Plant Service Water	P44 F074	3	1A313	SMB-000-5	a	Drywell Isolation
Plant Service Water	P44 F076	N/A	1A112	SMB-000-5	a	Drywell Isolation
Plant Service Water	P44 F077	3	1A313	SMB-000-5	a	Drywell Isolation

Wetting= 1-Flood 2-Froth 3-Spray

I. EQUIPMENT DESCRIPTION

Specification No:	9645-M-251.0
Component:	AC Actuator (Motor Operated Valve)/(Inside Containment)
Plant ID No:	See Attachment 1 (Quantity 24)
Manufacturer:	Limitorque
Model No:	See Attachment 1
Sub-Components:	Class RH Insulation AC Motor-Reliance, Model #601962-P 4 Train Limit and Torque Switch - Limitorque Hook-up Wiring - Flamtrol (Raychem) Terminal Blocks - Marathon 300, GE EB-5, Buchanon 0222/0524

II. QUALIFICATION STATUS AT TIME OF ORIGINAL SUBMITTAL (July 1981)

The Limitorque Motor Operated Valves (MOV) for inside of containment use did not meet Category II requirements of NUREG-0588 for the following reasons:

1. Lack of aging information.
2. Operability under flooding conditions was not addressed.
3. Operability under spray conditions was not addressed.
4. No variations in frequency or voltage were not addressed.

III. QUALIFICATION STATUS AT SUPPLEMENT 1 SUBMITTAL (September 1981)

A. Class RH Insulation AC Motor - Reliance, Model #601962-P
Interim Operation Justification provided.

B. 4 Train Limit and Torque Switch - Limitorque
Interim Operation Justification provided except for radiation.

C. Hook-up Wiring - Flamtrol (Raychem)
Interim Operation Justification to be provided prior to fuel load.

D. Terminal Blocks - Marathon 300, GE EB-5, Buchanon 0222/0524
Interim Operation Justification to be provided prior to fuel load.

IV. QUALIFICATION STATUS UPDATE

A. General

Additional review of actuators 1P45-F096 and 1P45-F097 affected by flood reveals that these two valves are normally closed and they do not receive any auto signal during LOCA. Hence, their operability is not required. (See Attachment 2 - FMEA)

The maximum radiation dose to which the actuator internals will be exposed has been determined by Bechtel. The total radiation dose (beta and gamma) to the actuator internals (based on enclosure size and location) will not exceed 200 Megarads.

Though the operability of the actuators was not demonstrated under spray during the test this is not considered a problem, as the actuators are enclosed in NEMA 4 water tight enclosures. Additionally, the spray is not caustic in nature.

The operability of the actuator was demonstrated during the test for 30 days. However, the test environment was more severe than the environment the actuators will be exposed to in the event of a LOCA. Using the Arrhenius method, it can be shown that the qualified life of the actuator during a DBA exceeds 100 days.

B. Class RH Insulation, AC Motor - Reliance, Model #601962-P

Limitorque Report B0058 indicates that the activation energy for the insulating materials used in the motor is about 1.00 eV. Based on this the motor insulating materials are qualified for more than 40 years.

C. 4 Train Limit and Torque Switch - Limitorque

Limitorque Report B0058 indicates that molded phenolic material has been used for these switches. This material has a temperature index of 150°C per Underwriters Laboratory. When this phenolic material was heated at that temperature for 6×10^4 hours, its physical properties were reduced to one half of their original value. A conservative value for its activation energy, per EPRI Research Project 890-1, is 0.96 eV. Assuming that its degradation due to thermal aging at a normal temperature of 135°F follows the Arrhenius curve, it would take 9.8×10^7 hours to reach the same level of degradation. A qualified life of 40 years is only 0.36% of this period.

D. Hook-Up Wiring - Flamtrol (Raychem)

The hook-up wiring has been identified by Limitorque as Raychem Flamtrol. The Raychem Flamtrol Insulation system has been extensively tested and is qualified to IEEE 383-1974 per FIRL Report F-C4033-1 dated January 1975.

E. Terminal Blocks - Marathon 300, GE EB-5, Buchanon 0222/0524

This sub-component is being evaluated under the Electrical Interface package which was provided to the NRC in MP&L letter to the NRC (AECM-81/502, 12/21/81). The terminal blocks are justified for interim operation and will be qualified by June 1982 or as soon thereafter as possible.

V. QUALIFICATION STATUS WITH REGARD TO INTERIM OPERATION JUSTIFICATION

The discussion presented in the qualification status update section above (Section IV) establishes the interim operation justification for the Limitorque Motor Operated Valves (MOV) identified in Attachment 1.

VI. FOLLOW-UP PROGRAM

The Limitorque Motor Operated Valves (MOV) identified in Attachment 1 will be qualified by June 1982 or as soon thereafter as possible.

ATTACHMENT 1

EXHIBIT "F" ATTACHMENT 1

Valves With Limitorque Motor Actuators INSide

Yarway

9645-M-251.0

Quantity 24

System Name	Plant I.D. NO.	Wetting*	Room No.	Actuator Model No.	Category	Service
Instrument Air Sys.	P53 F007	3	1A311	SMB-00-25	a	Drywell Isolation
Service Air Sys.	P52 F195	2&3	1A110	SMB-00-15	a	Drywell Isolation
RCIC System	E51 F076	N/A	1A112	SMB-000-2	a	Steam Warmup Line Iso.
Standby Service Water	P41 F168A	3	1A313	SMB-00-10	a	Containment Isolation
Standby Service Water	P41 F168B	3	1A311	SMB-00-10	a	Containment Isolation
Floor & Equip. Drain	P45 F096	1	1A112	SMB-00-10	a	Drywell Isolation
Floor & Equip. Drain	P45 F097	1&3	1A110	SMB-00-10	a	Drywell Isolation
Recirc. System	B33 F019	N/A	1A112	SMB-000-2	a	Drywell Isolation
Recirc. System	B33 F020	N/A	1A112	SMB-000-2	a	Drywell Isolation
Recirc. System	B33 F129	N/A	1A514	SMB-000-2	a	Drywell Isolation
Recirc. System	B33 F128	N/A	1A411	SMB-000-2	a	Containment Isolation
Recirc. System	B33 F126	2&3	1A313	SMB-000-2	a	Containment Isolation
Makeup Water Treatment	P21 F018	3	1A110	SMB-00-10	a	Containment Isolation
Nuclear Boiler	B21 F001	N/A	1A112	SMB-00-15	b	Reactor Head Vent to Suppression Pool-Closed.
Nuclear Boiler	B21 F002	N/A	1A112	SMB-00-15	b	Reactor Head Vent to Suppression Pool-Closed.
Nuclear Boiler	B21 F005	N/A	1A112	SMB-00-15	b	Reactor Head Vent to Suppression Pool-Closed.
Combustible Gas Control	E61 F595B	3	1A313	SMB-000-2	a	Sample Return From Hydrogen Analyzer.
Combustible Gas Control	E61 F595D	3	1A311	SMB-000-2	a	Sample Return From Hydrogen Analyzer.
Combustible Gas Control	E61 F596B	3	1A313	SMB-000-2	a	Sample Return From Hydrogen Analyzer.
Combustible Gas Control	E61 F596D	3	1A311	SMB-000-2	a	Sample Return From Hydrogen Analyzer.
Combustible Gas Control	E61 F597B	3	1A313	SMB-000-2	a	Sample Return From Hydrogen Analyzer.
Combustible Gas Control	E61 F597D	3	1A311	SMB-000-2	a	Sample Return From Hydrogen Analyzer.
Combustible Gas Control	E61 F598B	3	1A313	SMB-000-2	a	Sample Return From Hydrogen Analyzer.
Combustible Gas Control	E61 F598D	3	1A311	SMB-000-2	a	Sample Return From Hydrogen Analyzer.

* Wetting: 1 - Flood
2 - Froth
3 - Spray

ATTACHMENT 2

FAILURE MODE AND EFFECTS ANALYSIS
FOR EXEMPTION
DRYWELL ISOLATION VALVES

FUNCTION:

The following motor actuated valves are used for drywell isolation and are closed during normal plant operation.

Valve	System
1P45-F096	Floor and Equipment Drains System
1P45-F097	Floor and Equipment Drains System

FAILURE MODES:

The following electrical failure modes could occur due to the harsh environment:

1. Short the device output
2. Open the device output
3. Short the device output to ground

FAILURE EFFECTS:

These valves, which are closed during normal operation, do not receive any type of "Auto" close signal and remain closed in the event of an accident. The effects of the above failure modes would not cause actuation of these valves to the open position. Furthermore, these valves are installed in series, downstream of a closed manual valve.

CONCLUSION:

Based on the above discussion, it can be concluded that the failure of these valves in any mode described above would not adversely affect plant safety.

I. EQUIPMENT DESCRIPTION

Specification No:	9645-M-257.0/M-258.0
Component:	AC Actuator (Motor Operated Valve)/(Inside Containment)
Plant ID No:	See Attachment 1 (Quantity 8)
Manufacturer:	Limitorque
Model No:	See Attachment 1
Sub-Components:	Class RH Insulation AC Motor-Reliance, Model #601962-P 4 Train Limit and Torque Switch - Limitorque Hook-up Wiring - Flamtrol (Raychem) Terminal Blocks - Marathon 300, GE EB-5, Buchanon 0222/0524

II. QUALIFICATION STATUS AT TIME OF ORIGINAL SUBMITTAL (July 1981)

The Limitorque Motor Operated Valves (MOV) for inside of containment use did not meet Category II requirements of NUREG-0588 for the following reasons:

1. Lack of aging information.
2. Operability under flooding conditions was not addressed.
3. Operability under spray conditions was not addressed.
4. No variations in frequency or voltage were addressed.

III. QUALIFICATION STATUS AT SUPPLEMENT 1 SUBMITTAL (September 1981)

A. Class RH Insulation AC Motor - Reliance, Model #601962-P
Interim Operation Justification provided.

B. 4 Train Limit and Torque Switch - Limitorque
Interim Operation Justification to be provided prior to fuel load.

C. Hook-up Wiring - Flamtrol (Raychem)
Interim Operation Justification to be provided prior to fuel load.

D. Terminal Blocks - Marathon 300, GE EB-5, Buchanon 0222/0524
Interim Operation Justification to be provided prior to fuel load.

IV. QUALIFICATION STATUS UPDATE

A. General

The maximum radiation dose to which the actuator internals will be exposed has been determined by Bechtel. The total radiation dose (beta and gamma) to the actuator internals (based on enclosure size and location) will not exceed 200 Megarads.

Though the operability of the actuator was not demonstrated under spray during the test this is not considered a problem, as the actuators are enclosed in NEMA 4 water tight enclosures. Additionally, the spray is not caustic in nature.

The operability of the actuator was demonstrated during the test for 30 days. However, the test environment was more severe than the environment the actuators will be exposed to in the event of a LOCA. Using the Arrhenius method, it can be shown that the qualified life of the actuator during a DBA exceeds 100 days.

B. Class RH Insulation, AC Motor - Reliance, Model #601962-P

Limitorque Report B0058 indicates that the activation energy for the insulating materials used in the motor is about 1.00 eV. Based on this, the motor insulating materials are qualified for more than 40 years.

C. 4 Train Limit and Torque Switch - Limitorque

Limitorque Report B0058 indicates that molded phenolic material has been used for these switches. This material has a temperature index of 150°C per Underwriters Laboratory. When this phenolic material was heated at that temperature for 6×10^4 hours, its physical properties were reduced to one half of their original value. A conservative value for its activation energy, per EPRI Research Project 890-1, is 0.96 eV. Assuming that its degradation due to thermal aging at a normal temperature of 135°F follows the Arrhenius curve, it would take 9.8×10^7 hours to reach the same level of degradation. A qualified life of 40 years is only 0.36% of this period.

D. Hook-Up Wiring - Flamtrol (Raychem)

The hook-up wiring has been identified by Limitorque as Raychem Flamtrol. The Raychem Flamtrol Insulation system has been extensively tested and is qualified to IEEE 383-1974 for FIRL Report F-C4033-1 dated January 1975.

E. Terminal Blocks - Marathon 300, GE EB-5, Buchanon 0222/0524

This sub-component is being evaluated under the Electrical Interface package which was provided to the NRC in MP&L letter to the NRC (AECM-81/502, 12/21/81). The terminal blocks are justified for interim operation and will be qualified by June 1982 or as soon thereafter as possible.

V. QUALIFICATION STATUS WITH REGARD TO INTERIM OPERATION JUSTIFICATION

The discussion presented in the qualification status update section above (Section IV) establishes the interim operation justification for the Limitorque Motor Operated Valves (MOV) identified in Attachment 1.

VI. FOLLOW-UP PROGRAM

The Limitorque Motor Operated Valves (MOV) identified in Attachment 1 will be qualified by June 1982 or as soon thereafter as possible.

ATTACHMENT 1

Page 1 of 1

EXHIBIT "F" ATTACHMENT 1 Sheet 1 of 1

Quantity 8

Valves with Limitorque Motor Actuators — Henry Pratt — 9645-M-257.0/M-258.0

SYSTEM NAME	PLANT ID NO.	WETTING*	ROOM NO.	ACTUATOR MODEL NO.	Cat.	SERVICE
Suppression Pool Makeup	E30F001A	3	1A110	SMB 000 5/H3BC	a	Suppression Isolation
	E30F001B	3	1A110		a	
	E30F002A	3	1A110		a	
	E30F002B	3	1A110		a	
Combustible Gas Control	E61F003A	3	1A509	SMB-000-2/H1BC	a	Drywell Isolation
	E61F003B	N/A	1A512		a	
	E61F005A	N/A	1A512		a	
	E61F005B	N/A	1A512		a	

*Wetting - 1-Flood
2-Froth
3-Spray

I. EQUIPMENT DESCRIPTION

Purchase Part Drawing No.:	169C8338
Component:	Flow Meter
MPL No.:	E32-N006
Manufacturer:	Schutte & Koerting (S&K)
Model No.:	20-9651-8550

II. QUALIFICATION STATUS AT TIME OF ORIGINAL SUBMITTAL (July 1981)

The S&K flow meter did not meet Category II requirements of NUREG-0588 due to insufficient radiation testing.

III. QUALIFICATION STATUS AT SUPPLEMENT 1 SUBMITTAL (September 1981)

Justification for interim operation provided. Full qualification will be established when Teflon washer is replaced with a brass washer.

IV. QUALIFICATION STATUS UPDATE

GE issued FDI (Field Disposition Instruction), JB1-WAUJ, Rev. 0 on November 1, 1981 to replace the Teflon washer with a brass washer. FDI JB1-WAUJ is to be completed prior to the beginning of Phase II operation. Once the Teflon washer is replaced, the S&K flow meter will be qualified to Category II of NUREG-0588.

V. QUALFICATION STATUS WITH REGARD TO INTERIM OPERATION JUSTIFICATION

The S&K flow meter will be qualified to Category II of NUREG-0588 prior to the beginning of Phase II operation.

VI. FOLLOW-UP PROGRAM

None

I. EQUIPMENT DESCRIPTION

Purchase Part Drawing No.:	169C8339
Component:	Flow Transmitter
MPL No.:	E32-N053
Manufacturer:	Schutre & Koerting (S&K)
Model No.:	91X-16

II. QUALIFICATION STATUS AT TIME OF ORIGINAL SUBMITTAL (July 1981)

The S&K flow transmitter did not meet Category II requirements of NUREG-0588 due to the lack of qualification testing.

III. QUALIFICATION STATUS AT SUPPLEMENT 1 SUBMITTAL (September 1981)

No change reported.

IV. QUALIFICATION STATUS UPDATE

The only harsh environment experienced by the S&K flow transmitter is radiation. The required Total Integrated Dose (TID) for the S&K flow transmitter is 2.18×10^5 Rads.

Since the July 1, 1981 initial NUREG-0588 submittal by MP&L, a test report has been obtained from S&K for radiation testing performed by Wyle Laboratories at S&K's direction. The Wyle Laboratories radiation testing was conducted for a TID of 1.0×10^6 Rads. This TID is a factor of 4.5 greater than the required TID of 2.18×10^5 Rads.

As a result of the radiation testing performed by Wyle Laboratories, the S&K flow transmitter experience a 6.0% shift in accuracy. The specified accuracy was 2% full scale. This shift in accuracy poses no problem since this device is required to operate at a rising flow rate. To compensate for the accuracy shifting in the S&K flow transmitter, the setpoint for the trip device will be adjusted downward to accommodate the larger error and to keep the accuracy at 2% full scale.

V. QUALIFICATION STATUS WITH REGARD TO INTERIM OPERATION JUSTIFICATION

The S&K flow transmitter will be qualified to Category II of NUREG-0588 on completion of setpoint change prior to the beginning of Phase II operation.

VI. FOLLOW-UP PROGRAM

None

Attachment No. 2: Qualification Status of Individual Equipment Items (Non-NSSS)

Equipment Description	Manufacturer	Model No.	No. of Items	Equipment Qualification Status Information
4. Transmitter	Rosemount	1153 GB9	1	Qualified. 1153 HB7 has successfully passed additional testing and results reviewed.
7. CGC Heat Tracing	Thermon Mfg. Co.	EQ-2399-80	24	Justification for interim operation provided in MP&L letter AECM-81/335, dated September 1, 1981; Supplement No. 1
8. Area Radiation Detectors	Cable: Boston Insulated Wire & Cable; Detector: Victoreen	RG-59B/U Coaxial (878-1 Ass'y) 877-1 Detector	4	Qualified. Test report received and reviewed.
9. Temp. Element	Thermoelectric	27620	56	Justification for interim operation provided in Attachment No. 1 of this letter, AECM-82/141.
11. Solenoid Valves	ASCO	HTX8320A108V	5	Qualified. Test report received and reviewed.
21. 600 Volt Cable and 1.0KV Power Cable	Okonite	Various	Various	Qualified. Additional test data obtained and reviewed.
24. Coaxial and Triaxial Cable	Raychem	STILAN	Various	Qualified. Additional test data obtained and reviewed.
32. Terminal Block	GE	E8-25, CR151B CR-2960SY139 3B thru 3D	--	Justification for interim operation provided in MP&L letter AECM-81/502, dated December 21, 1981; Supplement No. 2.

Equipment Description	Manufacturer	Model No.	No. of Items	Equipment Qualification Status Information
33. Terminal Block	Conax	None	--	No longer being used. Bechtel/ MP&L/Raychem have developed and tested an environmental interface sealing kit for use at Grand Gulf.
34. Drywell Purge Compressor Motors	Turbonetic Reliance Motor	445 TS TEFC-XT	2	Qualified. Additional information provided in MP&L letter AECM-81/502, dated December 21, 1981; Supplement No 1. Also, additional information is provided as Attachment No. 3 of this letter, AECM-82/141.
38. Limitorque Valve Actuator	Reliance	447014-JZ	169	Additional justification for interim operation provided in Attachment No. 1 of this letter, AECM-82/141.
39. Limitorque Valve Actuator	Reliance	601962-P	39	Additional justification for interim operation provided in Attachment No. 1 of this letter, AECM-82/141.
41. Solenoid	ASCO	HTX 8320A20V	61	Qualified. Test report received and reviewed.
42. Limit Switch	MICRO	LSQ-101	61	Being replaced with a qualified NAMCO EA-740 limit switch.
43. Terminal Block	Hiller	Unknown	61	Justification for interim operation provided in MP&L letter AECM-81/502, dated December 21, 1981; Supplement No. 2; Terminal block identified as a GE EB-25.

Equipment Description	Manufacturer	Model No.	No. of Items	Equipment Qualification Status Information
44. 4 Train Switch	Limitorque	--	6	Justification for interim operation provided in Attachment No. 1 of this letter, AECM-82/141.
45. Limitorque Valve Actuator	Reliance HK Porter	Model DC Motor Unknown	9	Justification for interim operation provided in MP&L letter AECM-81/502, dated December 21, 1981; Supplement No. 2.
46. Limitorque Valve Actuator	Reliance	601962 447014JZ	24	Additional justification for interim operation provided in Attachment No. 1 of this letter, AECM-82/141.
47. Valve Position Switch	NAMCO	EA170	2	Being replaced with a qualified NAMCO EA-740 limit switch.
48. Bettis Air Actuator	ASCO	NP Series	37	Qualified. Test report received and reviewed.
49. Fan Motor	Reliance	Various	18	Qualified. Test report received and reviewed.
51. Fan Motor	Reliance	34-26.5-1770	2	Qualified. Test report received and reviewed.
52. SGTS Heater & Control	CVI	Unknown	2	Justification for interim operation provided in MP&L letter AECM-81/502, dated December 21, 1981; Supplement No. 2.

Attachment No. 2: Qualification Status of Individual Equipment Items (NSSS)

Equipment Description	Manufacturer	Model No.	No. of Items	Equipment Qualification Status Information
11. Flow Meter	S&K	20-9651-8550	1	Justification for interim operation provided in Attachment No. 1 to this letter, AECM-82/141.
12. Flow Transmitter	S&K	91X-16	1	Justification for interim operation provided in Attachment No. 1 to this letter, AECM-82/141.
13. Pressure Transmitter	Rosemount	1152	--	Justification for interim operation provided in MP&L letter AECM-81/502, dated December 21, 1981; Supplement No. 2.
14. Pressure Transmitter	Rosemount	1151	--	Justification for interim operation provided in MP&L letter AECM-81/502, dated December 21, 1981; Supplement No. 2.
15. Sensor & Converter	GE	None	1	This device was exempted from the NUREG-0588 review. Justification provided in MP&L letter AECM-81/335, dated September 1, 1981; Supplement No. 1.

ATTACHMENT NO. 3

EQUIPMENT DESCRIPTION

Specification No.:	9645-M-050.1
Component:	Drywell Purge Compressor Motors
Plant ID No.:	Q1E61-C001A & B
Manufacturer:	Turbonetics; Motor: Reliance Electric Company
Model No.:	Frame: 445 TS; Enclosure: TEFC-XT

GENERAL

During the NRC NUREG-0588 audit, the Equipment Qualification Branch (QEB) audit team raised certain questions concerning the validity of the qualification of the drywell purge compressor motors. Also, EQB audit team trip report discussed these same questions concerning the validity of the qualification of the drywell purge compressor motors.

MP&L addressed all of these concerns in Supplement No. 2 to MP&L's NUREG-0588 submittal in MP&L's letter (AECM-81/502) to the NRC dated December 21, 1981. However, one area of concern still exists in the qualification status of the drywell purge compressor motors. This concern is in regard to the effects of minimum voltage (90%) on the motor windings. The question posed by the NRC EQB audit team trip report is as follows:

Question

Determine the effects of minimum diesel output voltage (90% - per Reg. Guide 1.9) on maximum motor winding temperature and startup capability?

Response

The attached analysis demonstrates that the Grand Gulf Unit 1 drywell purge compressor motor windings will be capable of withstanding a 112% load at 90% rated voltage.

DRYWELL PURGE COMPRESSOR MOTOR EVALUATION REPORT

MPL No. Q1E61C001 A & B

INTRODUCTION

This evaluation was in response to a request by Mississippi Power and Light Company in March 1982 to NUTECH Engineers, Inc. to perform an analytical evaluation based on test data to resolve concerns over the subject motor.

BACKGROUND

As a result of a site audit conducted in October 1982, it was determined that the test conditions of the purge compressor motor with 143% of the rated load during a DBA, at an ambient temperature of 192°F was erroneously used as a margin in the environmental qualification for the motor.

Also, it was not established that the motor could operate utilizing the stand-by diesel generator power. This requires the motor to operate at 90% of the rated voltage.

Consequently, it is necessary to re-examine the net margin for motor service under accident and post accident conditions, specifically:

a) to determine the effect of temperature and pressure accident conditions on the required motor duty, and

b) to determine the effect of a minimum diesel output voltage (Reg. Guide 1.9) on the maximum motor winding temperature.

PROCEDURE

To satisfy these concerns, an analysis was performed to determine the steady state temperature of the winding at 112% of the rated load and 90% of the rated voltage with an ambient of 200°F. This is the true load based upon the compressor's peak operating conditions of 6.5 psig for 5.6 hours. The detailed approach and calculations are presented in the attached calculation sheets.

RESULTS AND CONCLUSIONS

Analysis shows that the steady-state winding temperature of the motor at 112% rated load and 90% rated voltage during the required design basis accident plus margin would be 325.4°F. This is well below the maximum allowable temperature for the motor winding of 356°F. In conclusion, the motor is acceptable for use under the conditions stated.

REFERENCES

1. Electric Motor Data Sheet, 9645-M-050.1 Appendix T, Rev. 4 for the Drywell Purge Compressor Motor dated 4/24/79

2. Turbonetics Final Report, "Design Basis Event and Post Event Qualification for Drywell Purge Compressor (SC-6) Prototype" TBI-77TR-5, Rev. B, dated 8/2/79

3. Turbonetics Final Report, "Design Basis Event Qualification for Drywell Purge Compressor (SC-6) Prototype", TBI-79TR-1, Rev. 0, dated 5/21/79

4. Turbonetics Final Qualification Report, "Drywell Purge Compressor, "TBI-81TR-2, Rev. A dated 12/29/81

5. Reliance Instruction Manual B-3620-7, "Installation, Operation and Care of Reliance Standard Integral Horsepower Induction Motors (180-449 Frames) dated September, 1974.

6. Bechtel Enclosure 4 to MPB-81/0581 "Drywell Purge Compressors, Specification 9645-M-050.1 Engineering Evaluation"

7. Memorandum for Zoltan R. Rosztoczy, Chief of Equipment Qualification Branch, NRC from J.E. Kennedy
Subject: Trip Report - Audit of Mississippi Power and Light Company's Documentation Concerning Environmental Qualification of Electrical Equipment for Grand Gulf Nuclear Station Unit 1, dated Jan. 18, 1982

nutech

San Jose, California

Project Grand Gulf - 1 File No. --

Owner MP&L

Client MP&L

1. ANALYSIS OBJECTIVE: To determine the winding temperature of the purge compressor motor at 112% rated load and 90% rated voltage based on test data during the DBA test.

2. DESCRIPTION OF ITEM: Drywell Purge Compressor Motor, MPL No. Q1E61-C001 A & B.

3. MANUFACTURER: Reliance Electric

4. TYPE: T.E.F.C. Induction Motor

5. FRAME DESIGNATION: 445TS

6. INSULATION CLASS: H-Type RN

7. SPECIMEN TESTED: As identified in Section 2.0 of Turbonetics Test Report No. TBI-77TR-5

8. ANALYSIS BASIS:
   a) Compressor motor peak load of 112% of the rated load based on General Electric's 'Drywell - Wetwall Pressure Envelope Following Grand Gulf DBA'.
   b) Electrical performance test data during DBA test as identified in Figures 15 and 16 of the Report No. TNI-77TR-5

9. ANALYSIS:

A) Determination of the motor current at 112% of the rated load by interpolating test data during the DBA test:

The current vs. % rated load data, as shown in the following table, are taken under following test conditions:

The rated voltage - 100% V_{rated}
Ambient average temperature = 134°F

Table 1

Amps	KW	% rated Load	Ref.	Remarks
3.04I	82	109.9	Fig. 15	
3.14I	85	113.9	" "	See Note 1
3.2 I	87	116.6	" "	
3.3 I	89	119.3	" "	
3.4 I	92.5	123.9	" "	
3.5 I	96	128.7	" "	
3.6 I	99	132.7	" "	
3.74I	100	134.0	" "	
3.76I	103	138.1	" "	
3.8 I	106.7	143.0	" "	See Note 2

Note 1: At 113.9% of the rated load the average winding temperature - $224^{\circ}F \pm^{2}_{4}{}^{\circ}F$ with an ambient of $134^{\circ}F$.

Note 2: At 143.0% of the rated load the average winding temperature - $305^{\circ}F$ with an ambient of $192^{\circ}F$.

The above data is plotted as Amps vs. % rated load in Figure 1

From Figure 1, by interpolating test data the motor current at 112% rated load is obtained as 3.1I...(1)

B) Determination of the motor current at 112% of the rated load and 90% of the rated voltage during the DBA test (90% V_L is required by DG Set, the power source):

At 100% rated load (P_L) & 100% rated voltage V_L, the rated current I_L is given by,

$$I_L = \frac{P_L}{\sqrt{3}\, V_L \cos\phi\, \eta}, \text{ where } \cos\phi = \text{power factor}, \eta\text{-efficiency}$$

Then at 112% P_L,

$$I_L = \frac{1.12\ P_L}{\sqrt{3}\, V_L \cos\phi\, \eta} = 3.1I \text{ from (A) above....(2)}$$

At 112% P_L & 90% V_L,

$$I_L = \frac{1.12\ P_L}{\sqrt{3}\ V_L \cos\phi\eta} \times \frac{1}{0.9} = \frac{1.24\ P_L}{\sqrt{3}\ V_L \cos\phi\eta} = \frac{3.1}{0.9} I$$

$$= 3.44I \quad ....(3)$$

This shows, the motor current will increase by 24% of the rating for 112% rated load and 90% rated voltage. This current is equivalent to 3.44I of the plot in Figure 1 (3.44I corresponds to 126% of the rated load).

c) Determination of the motor winding temperature (steady-state) at 112% rated load and 90% rated voltage during DBA test:

Assumptions:

i) Winding temperature rise is proportional to Ohmic heating (I^2R), the source of motor winding heating.

ii) Motor current will increase almost with the same proportionality till the load of 132% since it can be seen from Figure 1 that up to 132% of the rated load, the curve is almost a straight line.

iii) The fan cooling rate at a given ambient will almost be the same since the speed of the induction motor does not change significantly with overload.

Calculation:

Let the steady-state winding temperature at 112% rated and 90% rated voltage be T. The motor current is 3.44I from (3) above. We know from test data (See Table 1),

At 113.9% the rated load,
motor current = 3.14I,
winding temperature rise = 226-134 = 92°F, where
134°F was the ambient and 226°F was the highest (See Table 1)

Then $\frac{T-134}{92} = \frac{(3.44I)^2}{(3.14I)^2}$

or $T-134 = \frac{(3.44)^2 \times 92}{(3.14)^2} = \frac{11.83 \times 92}{9.86} = 110.4$

or $T = 110.4 + 134 = 244.4^{\circ}F$

Since the motor has to work after and during DBA at an ambient temperature of 200°F, difference from the test ambient and margin of 15°F are to be added to T to arrive at the projected winding temperature (T_p).
Hence the steady-state winding temperature at 112% rated load and 90% rated voltage during the requried DBA condition shall be as follows:

$T_p = 244.4 + (200-134) + 15$

$= 325.4^{\circ}F$

D) An Alternate Approach - Estimate of the winding temperature at the equivalent 126% of the rated load based on test data during the DBA test:

From Table 1,

At 113.9% of the rated load the winding temperature rise by test is 92°F at an ambient of 134°F and at 143% of the rated load the winding temperature rise by test is 113°F at an ambient of 192°F.

For this estimate, it will be conservative to use the temperature rise of the winding at 143% of the rated load when the required load is 126% of the rated load, which is equivalent to 112% of the rated load and 90% of the rated voltage.

Since the temperature rise of the winding is higher at higher load it can be concluded that the temperature rise of the winding will be higher at 143% of the rated load than at 126% of the rated load.

Hence the estimated temperature rise of the winding at 112% of the rated load and 90% of the rated voltage will not exceed

$113^{\circ}F + 200^{\circ}F$ (the required ambient) + $15^{\circ}F$ (margin) or $328^{\circ}F$.

It can be noted that this steady-state winding temperature is only slightly higher than the calculated one in Section 9C above.

10. CONCLUSION: The motor winding temperature rise during and after DBA at 112% rated load and 90% rated voltage is within the limit. The above conclusion is considered conservative because of the following reasons:

a) The motor winding being a Class H type insulation has a continuous rating of $356^{\circ}F$ ($180^{\circ}c$). Then the extra margin = $356-325.4 = 31.6^{\circ}F$, which is more than adequate for a conservative approach.

b) The measured winding temperature $224^{+2}_{-4}{}^{\circ}F$ (See Table 1) demonstrates the effect of hot spots for the winding under test at 113.9% of the rated load. The hot spot temperature rise was taken in consideration in the above calculation because the temperature used ($226^{\circ}F$) to calculate the temperature rise was the highest.

c) The motor will start working at 112% of the rated load 100 sec after the onset of DBA in accordance with Section 8a above. The motor will work at this load only for 5.6 hours. According to the test report identified in Section 7, motor tested at 143% of the rated load for 22 hours during and after DBA.

d) The motor winding may not see or may see for a short time the calculated $325.4^{\circ}F$ steady-state winding temperature, because the winding may take a couple of hours to reach the steady-state temperature from the start up time. As per Figure 10 of Turbonetics test report No. TBI-79TR-1, the time required to reach a steady state temperature by a similar motor (only difference is that the tested motor has 60 HP capacity where the Grand Gulf motor is rated as 100 HP) is 10 hours.

e) As per Section 3.4 of Turbonetics test report No. TB1-81TR-2, a continuous operating temperature of 370°F for insulation system of the motor is acceptable. This will give another 14°F (370-356) extra margin. Hence the total extra margin for the steady-state winding temperature = 31.6 [from (a) above] + 14 = 45.6°F

nutech

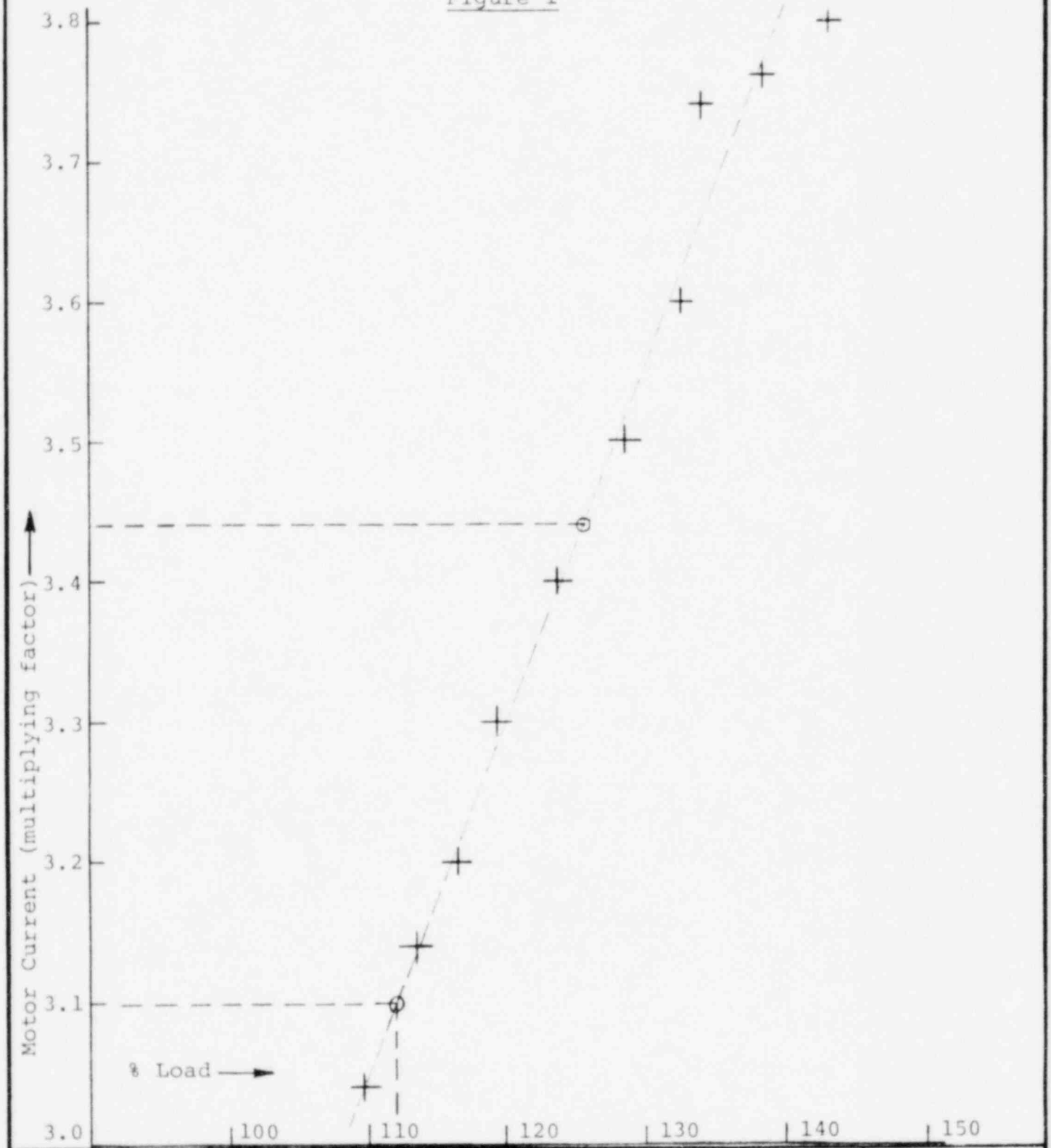
San Jose, California

Project Grand Gulf - 1 File No. --

Owner MP&L

Client MP&L

Figure 1



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ATTACHMENT NO. 4

LOSS OF LUBRICANT IN MOTOR OPERATED VALVE

SUBJECT: Motor Operated Valve, Limitorque, 9645-M-242.0, Outside Containment, Model SMB-1-40 (E21-F001)

CONCERN: Item 15, Attachment 3 of the NRC Trip Report (Audit of MP&L's Documentation Concerning Environmental Qualification of Electrical Equipment for Grand Gulf Unit 1) requested MP&L to provide the following information:

1. Provide information concerning alternate systems and components to perform the same function as the E21-F001 valve.

2. Provide the failure position for the E21-F001 valve and discuss its impact.

3. Address the question involving the possibility of loss of lubricant for the E21-F001 MOV when it is exposed to the harsh environment temperature of 310°F.

RESPONSE: In regard to Items 1 and 2 above, MP&L has received from Bechtel (March 26, 1982) revised evaluations for the Limitorque MOV's in Specification M-242.0/251.0/257.0/258.0. Bechtel's revised evaluations now establishes full qualification for the Limitorque MOV's in Specification M-242.0/251.0/257.0/258.0. Bechtel has based qualification on extensive material evaluations, additional Limitorque test data, and Limitorque analysis.

In regard to the question of loss of lubricant for Limitorque MOV's, the following is provided:

A. Inside Containment Service

Limitorque actuators require lubrication at three places:

1) Motor Bearings

The motors furnished with Limitorque actuators are lubricated for life.

2) Geared Limit Switch

The geared limit switches are lubricated with Mobil Grease 28 and periodically inspected for lubrication. This grease has been extensively tested by Limitorque for use in the LOCA environment and is also recommended in NRC IE Information Notice 79-03, dated February 9, 1979.

3) Main Gearbox

The main gearbox is lubricated with Mobilux EP1, and periodically inspected for lubrication.

During the LOCA test for containment service, the actuator was flooded inadvertently with water on the 5th day. The water was drained out by flushing air and nitrogen through the limit switch compartment. The actuator was further tested and operated in the harsh environment for the remaining 25 days of the test. The test results show that the actuator performed satisfactorily throughout the test. This is confirmed by the values of peak current for the closing stroke, and the stroke time. These values did not show any significant change.

In addition, a physical inspection of the disassembled unit after the test, showed that:

The gasket between the motor casing and the gearbox was in good condition.

The main drive gear was still covered with grease.

The bearing and the shaft moved freely, thereby confirming that the lubrication was not impaired.

As can be seen on Figure B-10, after 30 days the post-LOCA temperature is approximately 150°F and ramps to 100°F by 100 days. These temperatures would not be severe enough to cause degradation of the grease.

From the above discussion, it can be concluded that the greases being used in the Limitorque actuators do maintain lubrication during harsh environment. Periodic maintenance procedures ensure that the right amount and type of grease is present in the actuators at all times.

B. Outside Containment Service

The greases used in the actuators for outside containment service are the same as those used in the actuators suitable for containment service. These greases have been found to be suitable for a more severe environment than which is expected in the auxiliary building. Therefore, the greases are also suitable for use in these actuators.