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DESCRIPTION:
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ENCLOSURES:
REPORT: "Oconee Units 2 & 3 Active Valve Operability".

ACKNOWLEDGED DO NOT REMOVE

PLANT NAMES: Oconee Units 2 & 3

(3 cys rec'd)

FOR ACTION/INFORMATION 5-8-73 fod

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P. O. Box 2178

May 1, 1973

RECEIVED
MAY 3 1973

Mr. R. C. DeYoung, Assistant Director
for Pressurized Water Reactors
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Re: Oconee Units 2 and 3
Docket Nos. 50-270, -287

Dear Mr. DeYoung:

In response to your letter dated January 2, 1973, please find attached for your review a copy of "Oconee Units 2 and 3 Active Valve Operability." This report will be incorporated in the Oconee FSAR.

Very truly yours,

A. C. Thies

A. C. Thies

ACT:vr

Attachment

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2914

OCONEE UNITS 2 & 3
ACTIVE VALVE OPERABILITY

In each of Oconee Units 2 and 3, there are seven valves that meet the definition of being active and also part of the reactor coolant pressure boundary in accordance with 10CFR50. These valves are required to actuate upon an engineered safeguards signal and to either isolate the reactor building or to open an engineered safeguard system flow path. These valves and their design conditions are listed in Table I. Actual system operating conditions are significantly less severe than design conditions, as shown in Table I. A summary of these valves follows:

Mark Number	Service	Size	Qty	System	Actuator
HP-V2A&B	Letdown Cooler Isolation	$2\frac{1}{2}$"	2	High Pressure Injection	Limitorque EMO
HP-V3	Letdown Isolation	$2\frac{1}{2}$"	1	High Pressure Injection	Sheffer Pneumatic
HP-V24A & B	High Pressure Injection Isolation	4"	2	High Pressure Injection	Limitorque EMO
LP-V4A&B	Low Pressure Injection Isolation	10"	2	Low Pressure Injection	Limitorque EMO

All of these valves receive extensive preoperational testing prior to initial fuel loading. The electric motor operators are all of the Limitorque SMB series and have a history of qualification testing to verify their reliability and operability. Extensive testing has been carried out by Limitorque and by an independent institute. The testing has been done over a number of years, and the most recent testing in the summer of 1972 bears out the operability confirmed initially.

It is also noted that the insulation on HP-V24A&B and LP-V4A&B EMO motors is Class B rather than the Class H insulation which is used on EMO's inside the reactor building and on the EMO's on which the tests were run.

One valve with a pneumatic cylinder operator is noted above. The operator supplier will be requested to prepare a report which will prove the operability of this operator under the required loadings. This report will be submitted when available.

I. ELECTRIC MOTOR OPERATOR QUALIFICATION TESTING

A. Shock and Vibration Testing

In August, 1970, a Limitorque SMB series operator was mounted on a test stand having a threaded valve stem driven by the operator simulating opening and closing a valve. The operator was electrically connected to stop at the full close position by means of a torque switch and stop at the full open position by means of a geared limit switch. The operator had a 4-train geared limit switch installed and all contacts not being used for motor control were wired to electric indicating lights at a remote panel.

The unit successfully completed a 5.3g shock level at 32 Hz with no discrepancies noted. An exploratory scan of 5 Hz to 35 Hz was made and no critical resonant frequencies were noted on the operator. The unit was shocked and vibrated in each of three different axes a total of two minutes on, one minute off, three times per axis. The unit was operated electrically to both the full open and full close position and all torque switches and limit switches functioned properly. None of the auxiliary limit switches wired to indicating lights ever flickered or indicated they were opening or flickering. All electrical and mechanical devices on the operator performed successfully.

B. Heat Testing

In January, 1969, a completely assembled and operational SMB series operator was placed in an oven where the temperature was maintained at approximately 325°F for a duration of 12 hours. The unit was electrically operated every thirty minutes for a period of approximately two minutes per cycle and the geared limit switches were used to stop the actuator at the full open and full closed position of travel. Indicating light circuits were also wired to the geared limit switches.

The test was successful in every respect. There were no malfunctions of the operator and upon inspection of the component parts used, there was no noticeable deterioration or wear.

C. Live Steam Testing

In January, 1969, a complete SMB series operator was set up for electrical operation and live steam was piped into the conduit taps on the top of the limit switch compartment. One of the bottom conduit taps was left open to drain off any condensate. The operator was set on a timer basis for operation every thirty minutes for two minutes per cycle over a period of approximately nine hours. During this test, the live steam in the switch compartment had no effect on the function of the limit switches in their control of the operator at the full open and full closed position of travel. In addition, the limit switches were wired to indicating lights which operated satisfactorily.

The test was successful and there was no noticeable effect on the function of any of the parts in the limit switch compartment.

D. Life Cycle Testing

In January 1969, the operator was mounted on a stand inside a test chamber and a 150 cycle load test was made on the unit. This test cycle consisted of stroking a 2-3/8" diameter valve stem at a speed of 6 inches per minute for a total of approximately 12 inches in two minutes. The valve stem in the full closed position produced a thrust of 16,500 pounds on a rigid plate securely bolted to the test chamber. The unit was wired so that the open position geared limit switch stopped the unit in the full open position.

After the life cycle testing was completed, the unit was inspected and found to be in excellent condition. There was no noticeable wear on any of the parts.

E. Simulated Accident Environment Testing

In November, 1968, an electric motor operator was tested under conditions which simulated the temperature, humidity and chemical environments that could be expected in the containment following some postulated accident such as the rupture of a major reactor coolant pipe.

The operator was placed in an Autoclave type chamber and subjected to 90 psig saturated steam. At specified intervals, the operator was cycled to assure proper operation. Forty minutes after the introduction of steam, a 1.5% boric acid solution was sprayed on the operator assembly. The operator continued to operate satisfactorily. Later, the steam pressure was periodically reduced to simulate post accident conditions. The boric acid spray was allowed to continue for four hours. The steam pressure was eventually reduced to 15 psig. The test continued for seven days.

During this time, the operation of the operator became erratic. The corrosive effects of the steam and boric acid spray caused electrical contact malfunctions which were bypassed by the use of an appropriate jumper. The valve continued to cycle during the seven day period.

A design change was made to the limit switch in order to correct the erratic operation, and it was tested under similar accident conditions and found to operate satisfactorily. This design change has been incorporated into all subsequent applicable models of this operator.

2. RECENT TESTING

More recent tests on Limitorque SMB series operator were conducted during the summer of 1972 by the Franklin Institute Research Laboratories.* In these tests an operator was exposed to gamma radiation (200 megarads), a steam/chemical environment (for twelve days), a steam environment at temperatures as high as 340°F during the first day (test consisted of a 30 day exposure) and a seismic test similar to those conducted in August, 1970. During all of these tests, the operator was periodically cycled and was found to operate satisfactorily.

3. VALVE PURCHASE SPECIFICATION

In addition to a proven record as verified by the previous testing the valve vendor must also comply with the purchase specification requirements. The purchase specifications for these seven valves require that they be hydrostatically tested, leak tested and cycled between the extremes of fully opened or closed. The hydrostatic test is in accordance with the Standard for Steel Pipe Flanges and Flanged Fittings (USAS B16.5). The leak test requires that with the disc closed tight, hydrostatic pressure shall be applied alternately on each side of the closed disc with the side opposite the pressure open for inspection. Acceptance criteria require that valves not show a leakage greater than 10 cubic centimeters per hour per inch of seat diameter, or permanent deformation when the valves are subjected to two times design pressure, except that the stress developed at test pressure shall not exceed 90% of the specified minimum yield strength based on the minimum specified wall thickness.

Valve vendors have submitted generic calculations to B&W which show that when similar valve assemblies are subjected to a 3g horizontal force and to a 2g vertical force, the stresses incurred are within the code allowable stresses. These calculations also verified that the first natural frequency is above 20 Hz for these valves.

4. PREOPERATIONAL TESTING

The testing procedures for valves that require operation to meet engineered safeguards requirements are quite extensive during the preoperational testing program. These tests demonstrate proper installation, strength and functional performance of valves. Subsequent to satisfactory preoperational testing, surveillance

*[1] Qualification test of Limitorque valve operator, motor brake, and other units in a simulated reactor containment post-accident environment, Final Report F-C3327, July 1972.

[2] Qualification test of Limitorque valve operators in a simulated reactor containment post-accident steam environment, Final Report F-C3441, September 1972.

testing requirements have been established to assure continued satisfactory operation of these valves. Furthermore, if maintenance or repair of these valves is required, appropriate functional testing will be accomplished to assure proper operation subsequent to the maintenance or repair.

A. System Electrical Test

1. Electric Motor Operated Valves

The purpose of these tests is to verify electrical characteristics of valve operators in performing their function. Preliminary checkout of the operator valve assembly requires that the valve be free to move and that if the motor operated valve travels in the wrong direction from its mid-travel position, its breaker must be tripped immediately as there would be no torque limit protection. The valve can be operated manually with a handwheel to ascertain its freedom of movement.

The phase rotation of the operator is checked. During valve operation, verification that the valve travel and motor are stopped is done by closing the torque limit switch. Similarly, the opening of the valve is terminated by the opening of the limit switch.

2. Pneumatic Cylinder Operated Valves

The purpose of these tests is to verify proper operation of the piston operated valve and the solenoid controlling the air supply to the valve. Valves with handwheels are checked for freedom of movement prior to applying air to the pistons. Valve position limit switches are set during this check.

The valves are then operated using air supplied through the solenoids. Proper valve travel, solenoid, and limit switch operation is verified.

3. ES Test (Both EMO and Piston Valves)

In checking the valve for ES actuation, the valve is placed in the position opposite to its ES position and then an ES signal is simulated. The valve moves to its ES position. Then the control room switch is turned to the position opposite of ES operation and the valve is verified as remaining in its ES position. Similarly, turning the circuit breaker panel switch to the position opposite of ES operation has no effect on the valve.

Acceptance criteria for these electrical tests are:

1) Valves must open, close, and travel in the proper direction in response to control and engineered safeguards signals.

2) The valve open and closed indicating lights must indicate correctly.

3) Valve electric motor operator resistance-to-ground readings must be within specification.

4) The specified valve travel time is within specification requirements.

B. <u>System Engineered Safeguards Test</u>

The purpose of these tests is to demonstrate actual valve performance for its intended engineered safeguard use. Initially, all valves are placed in their non-ES position prior to simulating an ES signal. Upon initiation of an ES signal, the tests for the subject valve demonstrate containment isolation and also emergency injection flow capability to the reactor coolant system from the low pressure injection system and the high pressure injection system.

C. <u>System Functional Testing</u>

The purpose of this testing is to verify that the valves perform as intended for normal operation. Cycling the valves under conditions of specified differential pressure and/or flow that may be encountered during plant operation will verify that the valve operator does not exceed maximum cycle time.

D. <u>Integrated ES Actuation Test</u>

The purpose of this test, in which these valves are used, is to demonstrate the full operational sequence that would bring the emergency core cooling systems and the containment pressure reducing systems into action, including the transfer to alternate power sources.

General acceptance criteria for this test are:

1. The ES systems operate as described in the FSAR.

2. Upon actuation of an ES signal, high pressure and low pressure injection to the reactor coolant system are supplied in accordance with FSAR requirements.

3. Upon loss of normal station power, the ES systems continue to perform their designed functions without interruption.

Following completion of the preoperational test program and issuance of an operating license for the facility, these valves are functionally tested as required by the FSAR.

5. SYSTEM HYDROSTATIC TESTS

Fluid systems hydrostatic tests are performed on the various systems to assure leak tight installation of the valve in the piping system.

6. TECHNICAL SPECIFICATIONS

The technical specification testing requires that these valves be operated during an interval no longer than every three months to assure their continued availability. During the life of the facility, these valves will be appropriately operated subsequent to any required maintenance, repair or replacement.

7. ACTUAL SEISMIC CONDITIONS

In summary, we want to emphasize the results of the dynamic seismic analysis for the specific piping systems in which these valves are located (Table II). The maximum acceleration of 1.05g indicated is considerably less than the maximum g force in either the horizontal or vertical direction that the seven valves are required to withstand. The entire scope of testing verifies valve operability from conditions of extreme duress to normal operation, and the results of the earliest environmental, vibratory, and load testing have been verified in later independent testing.

DGG/cf
4-27-73

TABLE I

ACTIVE - REACTOR COOLANT PRESSURE BOUNDARY VALVES

Mark Number	System	Service	Size	Purchased By	System Valve Class	System Design Rating	System Cond During Opr	Type	Motor Operator Type	Valve Mfg.	Valve Movement
2HP-V2A 3HP-V2A	High Pressure Injection	Letdown Cooler Outlet	2½"	B&W	B	2500 psig 650°F	2170 psig 135°F 40-100 gpm	Globe	Limitorque SMB-00-15	Rockwell	Full Open to Full Close
2HP-V2B 3HP-V2B	High Pressure Injection	Letdown Cooler Outlet	2½"	B&W	B	2500 psig 650°F	2170 psig 135°F 40-140 gpm	Globe	Limitorque SMB-00-15	Rockwell	Full Open to Full Close
2HP-V3 3HP-V3	High Pressure Injection	Letdown Line RB Isolation	2½"	B&W	C	2500 psig 200°F	2170 psig 135°F 40-140 gpm	Globe	Sheffer Piston	Rockwell	Full Open to Full Close
2HP-V24A 3HP-V24A	High Pressure Injection	HP Inj RB Isolation	4"	B&W	B	3050 psig 200°F	2200-2950 psig 120-245°F 450 gpm	Globe	Limitorque SMB-1-25	Rockwell	Full Close to Full Open
2HP-V24B 3HP-V24B	High Pressure Injection	HP Inj RB Isolation	4"	B&W	B	3050 psig 200°F	2200-2950 psig 450 gpm 120-245°F	Globe	Limitorque SMB-1-25	Rockwell	Full Close to Full Open
2LP-V4A 2LP-V4B	Low Pressure Injection	LP Inj RB Isolation	10"	B&W	B	2500 psig 300°F	255 psig 280°F 3000 gpm	Gate	Limitorque SMB-4-150	Walworth	Full Close to Full Open
3LP-V4A 3LP-V4B	Low Pressure Injection	LP Inj RB Isolation	10"	B&W	B	2500 psig 300°F	255 psig 280°F 3000 gpm	Gate	Limitorque SMB-4-100	Velan	Full Close to Full Open

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4-26-73

TABLE II
SEISMIC INFORMATION FOR R. B. ISOLATION VALVES
OCONEE NUCLEAR STATION
UNITS 2-3

Valve No.	Valve Body												Operator											
	Displacements (inches)						Accelerations (G)						Displacements (inches)						Accelerations (G)					
	X + Y EQ.			Y + Z EQ.			X + Y EQ.			Y + Z EQ.			X + Y EQ.			Y + Z EQ.			X + Y EQ.			Y + Z EQ.		
	Dx	Dy	Dz	Dx	Dy	Dz	Ax	Ay	Az	Ax	Ay	Az	Dx	Dy	Dz	Dx	Dy	Dz	Ax	Ay	Az	Ax	Ay	Az
2HP-V2A 3HP-V2A	Rigidly Mounted To Building																							
2HP-V2B 3HP-V2B	Rigidly Mounted To Building																							
2HP-V3 3HP-V3	Rigidly Mounted To Building																							
2HP-V24A 3HP-V24A	.010	.024	.010	.006	.018	.006	.040	.340	.066	.028	.116	.052	.024	.042	.022	.014	.034	.014	.146	.600	.178	.114	.220	.146
2HP-V24B 3HP-V24B	.120	.001	.042	.040	.002	.014	1.050	.012	.376	.354	.034	.122	.080	.006	.046	.026	.002	.014	.700	.114	.390	.236	.052	.134
2LP-V4A 3LP-V4A	.094	.001	.050	.046	.001	.024	.288	.007	.154	.170	.012	.088	.100	.001	.055	.050	.001	.028	.326	.008	.176	.224	.012	.124
2LP-V4B 3LP-V4B	.058	.002	.036	.006	.002	.038	.272	.009	.160	.400	.010	.238	.082	.024	.003	.088	.024	.002	.386	.198	.005	.560	.216	.006

Notes:
1. Dx = Seismic Displacement (x-Direction)
2. Ax = Seismic Acceleration (x-Direction)
3. X-Direction = North-South
4. Z-Direction = East-West
5. Values are Design Basis Earthquake