REV. 1
APRIL 19, 1982

GRAND GULF
MAIN STEAM ISOLATION VALVES

MPL# B21-F022
MPL# B21-F028

ADDITIONAL INFORMATION SUPPORTING JUSTIFICATION FOR INTERIM OPERATION

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ABSTRACT

The following tests and analyses have been performed on the Grand Gulf Main Steam Isolation Valves Upper Structure, or similar Upper Structures:

- Grand Gulf 28" Main Steam Isolation Valve Upper Structure has been compared with a dynamically tested 26" main steam isclation valve Upper Structure and it has been concluded that Grand Gulf Upper Structure is similar to the tested Upper Structure.

- Required Response Spectra have been developed for Grand Gulf at the base of valve cover. These response spectra have been compared with the test response spectra for the tested similar valve upper structure. The TRS envelope the RRS with margin.

- Static Bend tests have been performed on the Grand Gulf Main Steam Isolation Valve which assure valve operability under expected loads.

- A special valve closure analysis demonstrates adequacy of structure during opening/closing of the valve.

It is therefore, concluded that the Grand Gulf Main Steam Isolation Valve Upper Structure is dynamically adequate to meet the expected loadings. Thus, use of this equipment during startup and operation of the Grand Gulf Station is justified until such time as the requalification is complete.

GENERAL INFORMATION

Main Steam Isolation Valves

General Description

The Main Steam Isolation Valve is of a quick closing design for high pressure steam service. It is a Wye pattern type valve complete with actuator and accessory equipment. The valve is actuated with an air cylinder operator (air-to-open, air-and/or spring-to-close). The valves are usually installed in a horizontal main steam line with two valves in series per main steam line, inboard valve located within the drywell and the outboard valve located outside the containment. The valve is designed for steam service. The 28" size has a capacity of 4,120,000# per hour with 06.6 psig maximum calculated pressure drop across the fully open valve. The base material is carbon steel, with a type 17-4PH stainless steel stem and a stellite guide bushing located in the cover. The body seating surface and guide ribs, the disc seating surfaces and the guide surface near the main seat and the cover back-seating surface are all faced with stellite. The body-to-bonnet joint is a bolted type construction with a totally enclosed spiral wound stainless steel, asbestos filled gasket. The bonnet joint is prepared for seal welding, but seal welding would be performed by others at the installation site if required. The stem seal stuffing box is equipped with two sets of packing. A lantern ring is located between the two sets of packing with a leakoff connection to the lantern ring in the form of a socket welded pipe nipple. The body is equipped with provision for a 2" schedule 160 drain nipple located in the inlet end of the valve body. The valve is equipped with position switches to indicate open, closed and 94 percent open positions.

Operational Requirements

NOTE: All part nos. referred to are from dwg. 13561-01-H, Sheet 1 unless otherwise noted.

The valve is to be capable of opening with a 200 psi differential pressure tending to hold the valve closed, utilizing a minimum of 90 psig min. air pressure in the cyclinder actuator. To accomplish this requirement and keep the cylinder size within reasonable limits a cylinder balancing arrangement in the form of a cup whose upper end extends into the valve body bonnet bore is employed. The poppet is equipped with an internal pilot valve seat, and the end of the valve stem acts as the pilot valve poppet. When the valve stem lifts, the pressure in the balancing cylinder area decays, and thereby reduces the differential pressure acting over the main poppet area, thus reducing the operator force required to open the valve.

The valve is required to have an adjustable closing speed of three to ten seconds. This requirement is accomplished by a tandem air and hydraulic cylinder (part no. 37) and 1" flow control valve (part no. 6 sheet 4 of dwg. 13561-01-H) installed in the external manifold mounted on the hydraulic section of the tandem cylinder (part no. 37).

When closing the main steam isolation valve, the oil in the underside of the piston in the hydraulic cylinder must be displaced through the external manifold to the top side of the piston. The rate at which this oil displacement takes place is controlled by the adjustment of the 1" flow control valve (part no. 6 sheet 4 of dwg. 13561-01-H) which in turn controls the rate of valve closure.

Operational Requirements (Continued)

The closing speed control is provided with a minimum flow position to prevent full closure of the flow through the hydraulic cylinder's external piping.

The range of closing speed adjustment (3 to 10 seconds) is accomplished with not less than two full revolutions of the adjustment spindle of the 1" flow control valve (part no. 6 sheet 4 of dwg. 13561-01-H).

Provisions are required to accommodate an increase in fluid pressure due to the increase of ambient temperature from that existing during filling and sealing of the hydraulic system to that existing during emergency conditions. This requirement is satisfied by using a small accumulator (part no. 8 sheet 4 dwg. 13561-01-H) on the hydraulic cylinder external manifold. The accumulator is precharged with nitrogen at 100 psig, and has a design pressure limit of 5000 psig.

The valve is to be capable of opening at the rate of one inch plus or minus one-half inch per second. The opening speed adjustment is accomplished by use of a 1/2" flow control valve (part no. 7 sheet 4 dwg. no. 13561-01-H).

The valve operator is provided with an exercising control feature for stroking the valve from the 100% open position to the 94% open position. This requirement is accomplished by installing a normally open 1 1/4" three-way valve (part no. 2 sheet 4 dwg. no. 13561-01-H) in the line between the connection to the underside of the air cylinder operator and the main four-way air control valve. When the exercising control is energized, the under side of the pneumatic cylinder is vented and the springs (part no. 15 & 16) will force the valve toward the closed position.

NOTE: The isolation valve is equipped with a position switch to indicate when the 94% open position has been reached. If the three-way exercising control is left in the energized position, the main steam isolation valve will go to the fully closed position.

The exercising speed is such that the valve shall be capable of stroking from 100% open to the fully closed position in 45 to 60 seconds. The exercising speed adjustment is accomplished by use of a 1/2" air metering valve (part no. 9 sheet 4 of dwg. no. 13561-01-H) installed in the exhaust port of the three-way exercising valve. The above time for full closing is not intended to imply that the valve is to be exercised to the fully closed position when the plant is in operation.

Operational Description of the Pneumatic System Components (Dwg. 13561-01-H Sheet 4)

The air supply to the pneumatic operating cylinder is controlled by a 1 1/4" four-way pilot operated valve (part no. 1) which depending on its position, applies air pressure to either the top or bottom end of the air cylinder operator while alternately exhausting the opposite end of the cylinder. This 1 1/4" four-way pilot operated valve (part no. 1) in turn is controlled by a three-way normally energized 1/4" dual solenoid operated valve (part no. 4).

Operational Description of the Pneumatic System Components (Continued)

To open the main steam isolation valve, either or both of the solenoids on the three-way main pilot control valve (part no. 4) are energized which feeds air pressure to the piston of the 1 1/4" four-way pilot operated valve (part no. 1) causing it to shift its position. The four-way pilot operated valve (part no. 1) then feeds air pressure to the underside of the air operating cylinder and at the same time exhausts air from the top end of the cylinder and the main steam isolation valve opens. Should either of the solenoids of the three-way main pilot control valve (part no. 4) be de-energized while the other is energized, the air pressure would be maintained in the piston of the 1 1/4" four-way pilot operated valve (part no. 1) and it would maintain its position, thus the main steam isolation valve would remain in the open position.

In the event of loss of system air supply, the air pressure in the piston of the 1 1/4" four-way pilot operated valve (part no. 1) would exhaust out through the three-way solenoid operated valve (part no. 4) to the air supply line. The 1 1/4" four-way pilot operated valve (part no. 1) would shift its position and exhaust the air pressure from the underside of the operating cylinder. The force generated by the closing spring will close the main steam isolation valve, (any air pressure contained in the air storage tank will assist the spring in closing the valve).

To close the main steam isolation valve, both solenoids on the three-way main pilot control valve (part no. 4) are de-energized which exhausts the air pressure from the piston to the 1 1/4" four-way pilot operated valve (part no. 1) causing it to shift its position. The 1 1/4" four-way pilot operated valve (part no. 1) then feeds air pressure to the top side of the air operating cylinder and at the same time exhausts the air from the bottom side of the operating cylinder and the main steam isolation valve closes. It should be noted that in the event no air pressure is available for closing, the closing springs will supply the force to close the main steam isolation valve.

A 1 1/4" normally open three-way pilot operated valve (part no. 2) is installed in the air line between the underside of the air operating cylinder and the main 1 1/4" four-way pilot operated valve (part no. 1). Its purpose is to accomplish the exercising feature.

This 1 1/4" three-way pilot operated exercising valve (part no. 2) in turn is controlled by a three-way normally de-energized solenoid operated valve (part no. 5).

To exercise the main steam isolation valve, the three-way solenoid operated valve (part no. 5) is energized which feeds air pressure to the piston of the 1 1/4" three-way pilot operated valve (part no. 2) causing it to shift its position. The air supply being fed from the main 1 1/4" four-way pilot operated valve (part no. 1) to the underside of the air cylinder is blocked and the air in the cylinder is exhausted to atmosphere through the 1 1/4" three-way pilot operated exercising valve (part no. 2). When the air pressure in the under-side of the air operating cylinder decays to a point where its force can no longer overcome the force generated by the closing springs, the

Operational Description of the Pneumatic Systems Components (Continued)

isolation valve will start to close. A 1/2" metering valve (part no. 9) installed in the exhaust port of the 1 1/4" three-way pilot operating exercising valve (part no. 2) is used to adjust the rate of exercising speed. The exercising speed from 100 percent open to fully closed position, (14 inches of valve stroke), is 45 to 60 seconds. When the three-way solenoid operated valve (part no. 5) is de-energized, it exhausts the air pressure from the piston of the three-way pilot operated exercising valve (part no. 2) causing it to shift its position. The exhaust port is now blocked and the air from the main 1 1/4" four-way pilot operated valve (part no. 1) is fed to the underside of the air cylinder operator and the main steam isolation valve returns to its full open position.

A 1 1/4" two-way pilot operated valve (part no. 3) is installed in a tee in the air line between the underside of the air operating cylinder and the 1 1/4" normally open three-way pilot operated exercising valve (part no. 2). This 1 1/4" two-way pilot operated valve (part no. 3) serves as an additional closing valve in the air control system. The 1 1/4" two-way pilot operated valve (part no. 3) is controlled by the same dual solenoid operated three-way valve (part no. 4) that controls the main 1 1/4" four-way pilot operated valve (part no. 1). When the three-way dual solenoid operated valve (part no. 4) is energized to open the main steam isolation valve, air pressure is also fed to the piston of the 1 1/4" two-way pilot operated valve (part no. 3) which shifts its position. The valve closes, blocking the exhaust port and prevents the air pressure in the line to the underside of the air operating cylinder from exhausting to atmosphere.

When the dual solenoids of the main three-way pilot operated valve (part no. 4) are de-energized to close the main steam isolation valve, the air pressure is exhausted from the piston of the 1 1/4" two-way pilot operated valve (part no. 3) causing it to shift its position. The air in the underside of the air cylinder operator is then exhausted to atmosphere through the open 1 1/4" two-way pilot operated valve (part no. 3) as well as through the main 1 1/4" four-way pilot operated valve (part no. 1).

Hydraulic Speed Control System

The purpose of the hydraulic speed control system is to control the opening and closing speed of the pneumatic cylinder operator on the main steam isolation valve. The sub-plate mounted hydraulic speed control system is connected to the speed control cylinder at the top and bottom ports. By the use of adjustable flow control valves in the sub-plate assembly, the amount of flow from one side of the hydraulic cylinder piston to the other can be regulated. This regulated flow controls the operator cylinder opening and closing speed.

Operational Description of the Hydraulic System Components

Part Nos. From Dwg. 13561-01-H Sheet 4

A 1" closing flow control valve (part no. 6) (adjustable and pressure compensated), is sized so that the time to fully stroke the pneumatic operator is less than 3 seconds when only spring force is applied in the closing direction.

Operational Description of the Hydraulic System Components (Continued)

It is also capable of adjusting the closing time to 10 or more seconds when both air pressure and spring loads are applied in closing direction. The range of closing speed adjustment, (3 to 10 seconds) is accomplished with not less than two full revolutions of the adjustment spindle. The closing flow control valve (part no. 6) is equipped with a minimum flow position to prevent its full closure. The minimum flow position is sized so that the time of full pneumatic operator stroke is greater than 10 seconds in order to achieve the adjustable closure range of 3 to 10 seconds. The adjustable spindle of the closing flow control valve (part no. 6) is provided with a positive locking device.

A 1/2" opening flow control valve (part no. 7), (adjustable and pressure compensated), is sized so that the time to fully stroke the pneumatic actuator (retract piston rod from fully extended position), is at a rate of 1 inch, plus or minus 1/2 inch per second. The opening flow control valve (part no. 7) is equipped with a minimum flow position to prevent its full closure. The minimum flow position is sized so that the time of full operator stroke is less than 1/2" per second in order to achieve the adjustable opening range of 1/2" to 1 1/2" per second. The adjustable spindle of the opening flow control valve (part no. 7) is provided with a positive locking device.

The accumulator is included in the hydraulic system in order to accommodate an increase in fluid pressure due to the increase of ambient temperature from that existing during filling and sealing of the hydraulic system to that existing during emergency ambient conditions.

DYNAMIC INFORMATION

The required response spectra (RRS) used in this evaluation for the Grand Gulf MSIV Upper Structure are based on the following observations:

a) The main steam isolation valve (MSIV) is mounted on the piping which is supported by the main steam guide and the head fitting. The main steam guide, in turn, is mounted on the platform near the drywell wall, and the head fitting is mounted in the shield building wall.

b) The support system and valve body are stiff so that the loads (response spectra) input to the MSIV upper structure can be considered the same as obtained from the building model.

Based on the above observations, it can be shown that in the vicinity of the main steam isolation valves (MSIV), the controlling dynamic loads as determined by the piping dynamic analysis are the combination of safe shutdown earthquake (SSE) plus the safety relief valve blowdown structural load (SRV). Grand Gulf unique enveloped (SSE + SRV) response spectra, hereafter called the required response spectra (RRS), have been developed to compare with the test response spectra (TRS) used on the tests of similar valve upper structures. Based on the comparison of RRS and TRS, the following conclusions can be made:

1. Grand Gulf Project Unique Response Spectra show 2g ZPA loading on the MSIV, whereas the test response spectra used for testing the 24 inch and 26 inch MSIV upper structures used ZPA of 5.5g.

2. Test response spectra used for testing the MSIV upper structures were broad band in comparison with narrow band real input motion to Grand Gulf MSIV. So, it can be seen that TRS provide conservatively higher load than the required load (RRS).

3. The natural frequency of the Grand Gulf Upper Structure is about 28 Hz. The natural frequencies of the tested MSIV Upper Structures were between 10 Hz and 14 Hz. Since the tests were performed from 2 Hz to 40 Hz, excitation of the upper structure at the natural frequency is assured.

4. Comparison of different components of Grand Gulf MSIV Upper Structure and the tested MSIV Upper Structure have been made (Appendix I). The comparison shows that the Grand Gulf MSIV Upper Structure is physically similar to the tested upper structure and generally made out of better material.

Based on the above information, it can be concluded that the TRS used for testing the 24 inch and 26 inch MSIV upper structures envelop the Grand Gulf Unique Required Response Spectra (RRS) (See Fig. 1) and that comparison of these spectra is justified based on similarity of the valve upper structures.

TESTS AND ANALYSES SUPPORTING OPERABILITY
OF GRAND GULF MAIN STEAM ISOLATION VALVES

Operability of the Grand Gulf Main Steam Isolation Valve is based on the following information:

1. A Static Bend Test was performed on the Grand Gulf Valve which demonstrated that the valve would close within the required time period of 4.0 $\pm$ 1 seconds. The valve was exercised using air and springs, while the valve was being subjected to a static equivalent seismic load. In this test, the stem moved freely without any scratches or binding when a load of 18,550 lbs (approximately 5.6 g) was applied at the spring top plate. On the Grand Gulf valve, the maximum expected dynamic load is approximately 6.6 g's applied at the center of gravity of the upper structure. Calculating moments, the static bend test imposed a moment of approximately 945,663 in-lbs at the valve body/bonnet centerline. The comparable maximum expected dynamic moment is approximately 752,043 in-lbs. The static bend test therefore bounds the expected dynamic moment.

2. A special "Closure Analysis" was performed on the Grand Gulf 28" Main Steam Isolation Valves. This analysis was done to assure that the air pressure in the pneumatic cylinder and the springs are more than adequate to open/close the valve under the Grand Gulf specified flow conditions.

3. Upper Structures of two main steam isolation valves similar to the Grand Gulf Main Steam Isolation Valve have been previously tested. The Test Response Spectra of the tested Upper Structures envelope the Required Response Spectra of the Grand Gulf Upper Structure (See Figure 1). Operability of the Upper Structure was demonstrated during and after the seismic test.

Grand Gulf Main Steam Isolation Valves were supplied by Atwood and Morrill Valve Co. using Sheffer/Hiller SA-A039 pneumatic and hydraulic components. These valves remain in open position all the time during normal plant operation and are checked periodically for their closure capability. The Upper Structure of a similar 26" valve was tested and operated successfully during and after the test under simulated seismic loadings. The Test Response Spectra for the similar 26" valve Upper Structure envelopes the Grand Gulf Required Response Spectra. Grand Gulf Main Steam Isolation Valve Upper Structure is very similar to the tested Upper Structure (Refer to Appendix-I for detailed comparison). The Required Response Spectra for Grand Gulf is enveloped by the Test Response Spectra with substantial Margin. (See Figure 1). Based on the similarity of the tested Upper Structure and the Grand Gulf Upper Structure it is anticipated that the Grand Gulf Upper Structure would respond in a similar manner when dynamically tested. It is expected that the relative stress level in the Yoke Rods would be lower due to the use of superior yoke rod material and size which provides additional assurance of Upper Structure's seismic capability. Furthermore, successful "Static Bend Test" and "Closure Analyses" have been performed.

It is, therefore, concluded that the Grand Gulf Upper Structure is dynamically adequate to meet the expected loadings. Thus startup and operation of Grand Gulf Station is justified until such time as requalification is completed.

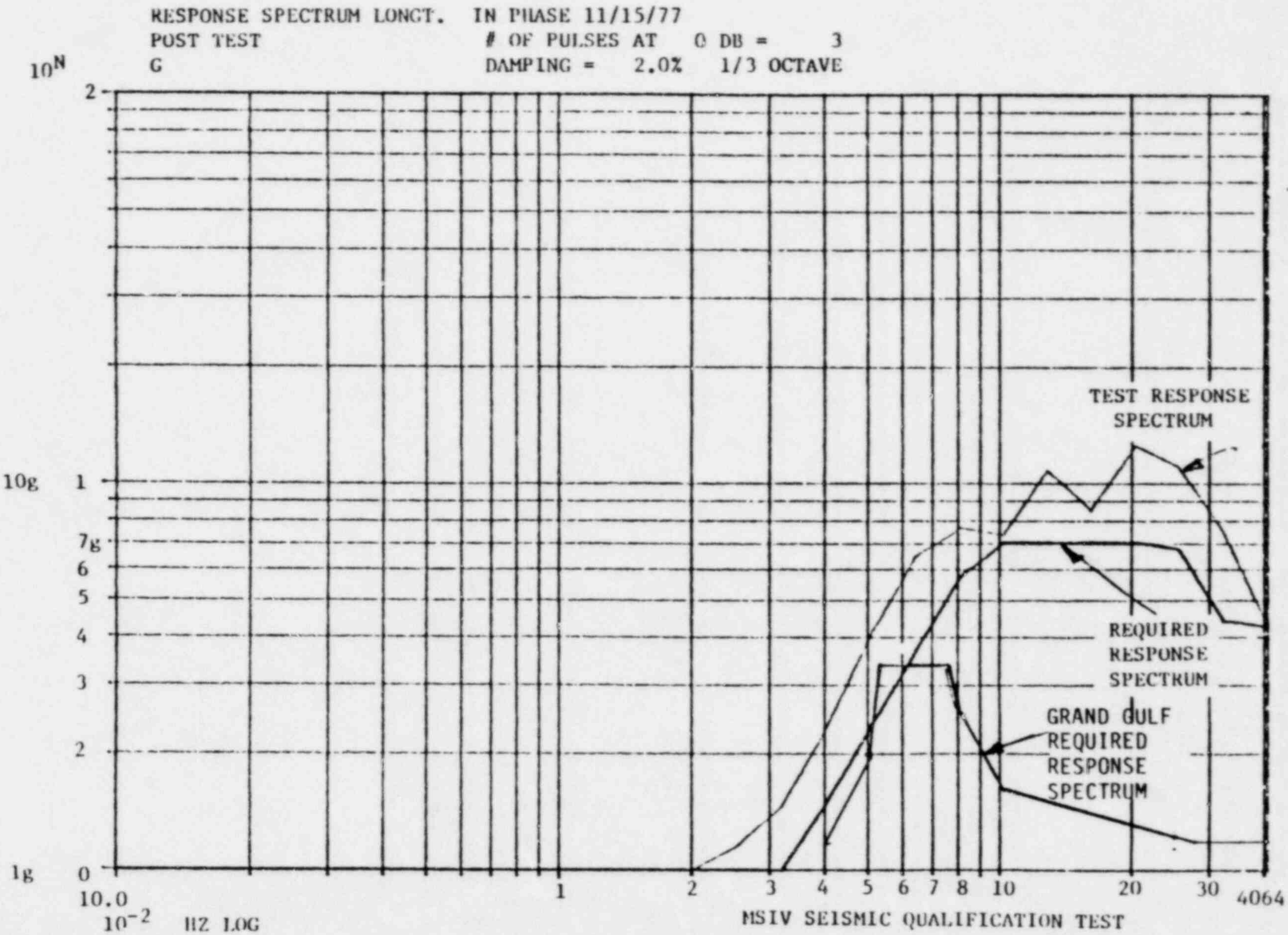


Figure 1 Response Spectrum

Appendix I

PHYSICAL COMPARISON OF GRAND GULF AND THE TESTED UPPER STRUCTURE

APPENDIX I - PHYSICAL COMPARISON OF GRAND GULF AND THE TESTED UPPER STRUCTURE (Actuator Only)

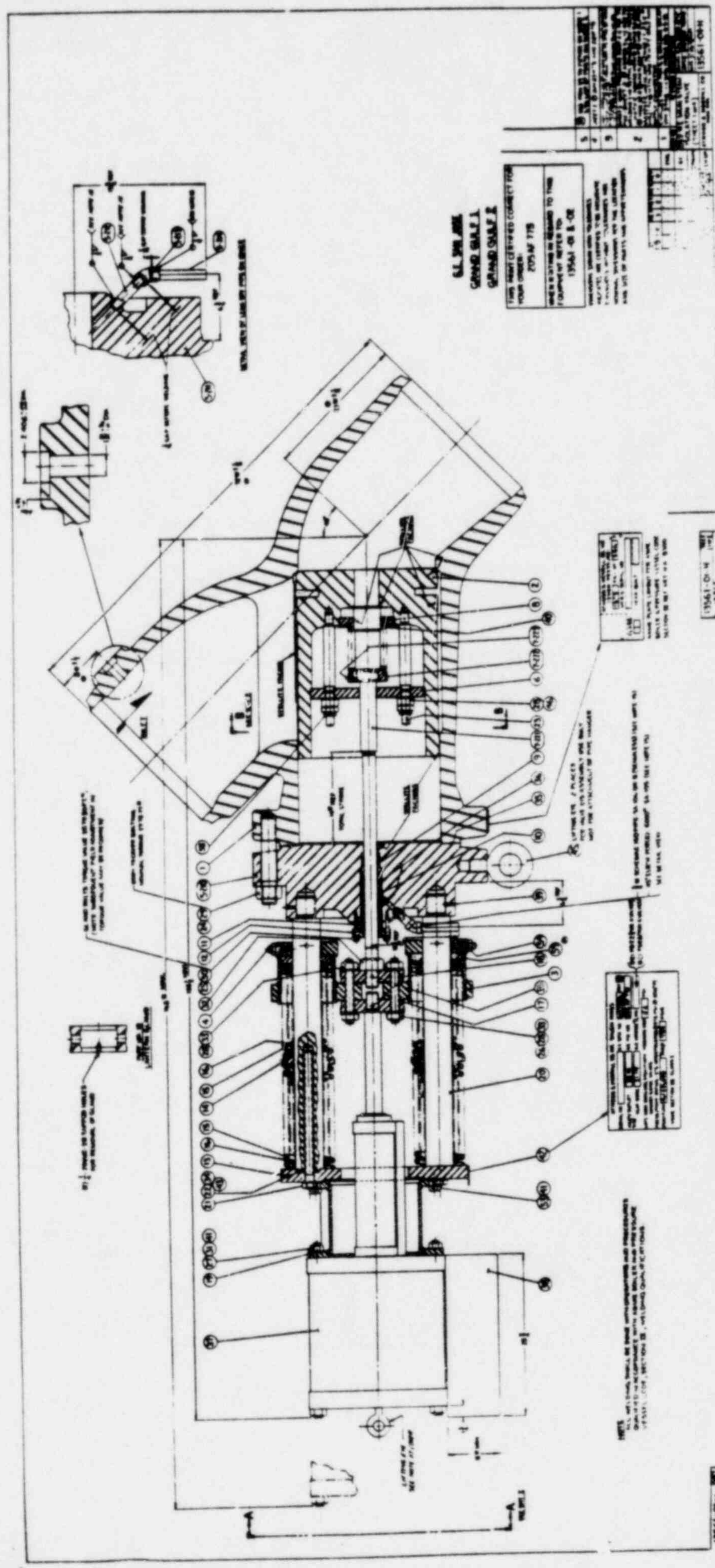
Item Description	Grand Gulf Upper Structure	24" - Tested Upper Structure Report No. NEDE-24122-2
Pneumatic/Hydraulic Component Vendor	Sheffer/Hiller	Sheffer/Hiller
Component Model No.	SA-A039	SA-A012
Dual Solenoid Supplier/Model No.	ASCO/HTX832320	ASCO/HTX832320
Single Solenoid Supplier/Model No.	ASCO/HTX8320A20	ASCO/HTX8320A20
2-Way Valve Supplier/Model No.	Norgren B0004A	Norgren/B-1026B-0C-A1 Similar to B0004A
3-Way Valve Supplier/Model No.	Norgren/C0007A	Norgren/C-1037B-00A1 Similar to C0007A
4-Way Valve Supplier/Model No.	Norgren/F013A	Norgren F2227B-00-A1 Similar to F013A
O-Rings	Viton	Viton
Pneumatic Cylinder Height	24 1/8"	27 1/2"
Pneumatic Cylinder Bore Dia.	20"	20"
Piston Diameter	3"	3"
Stroke Length	15"	18"
Operating Pressure	90 - 125 PSI	90 - 125 PSI
Hydraulic Cylinder Bore Dia.	5"	5"
Piston Diameter	3"	3"
Hydraulic Fluid	GE Silicone-SF-1147	Shell Irus - 902

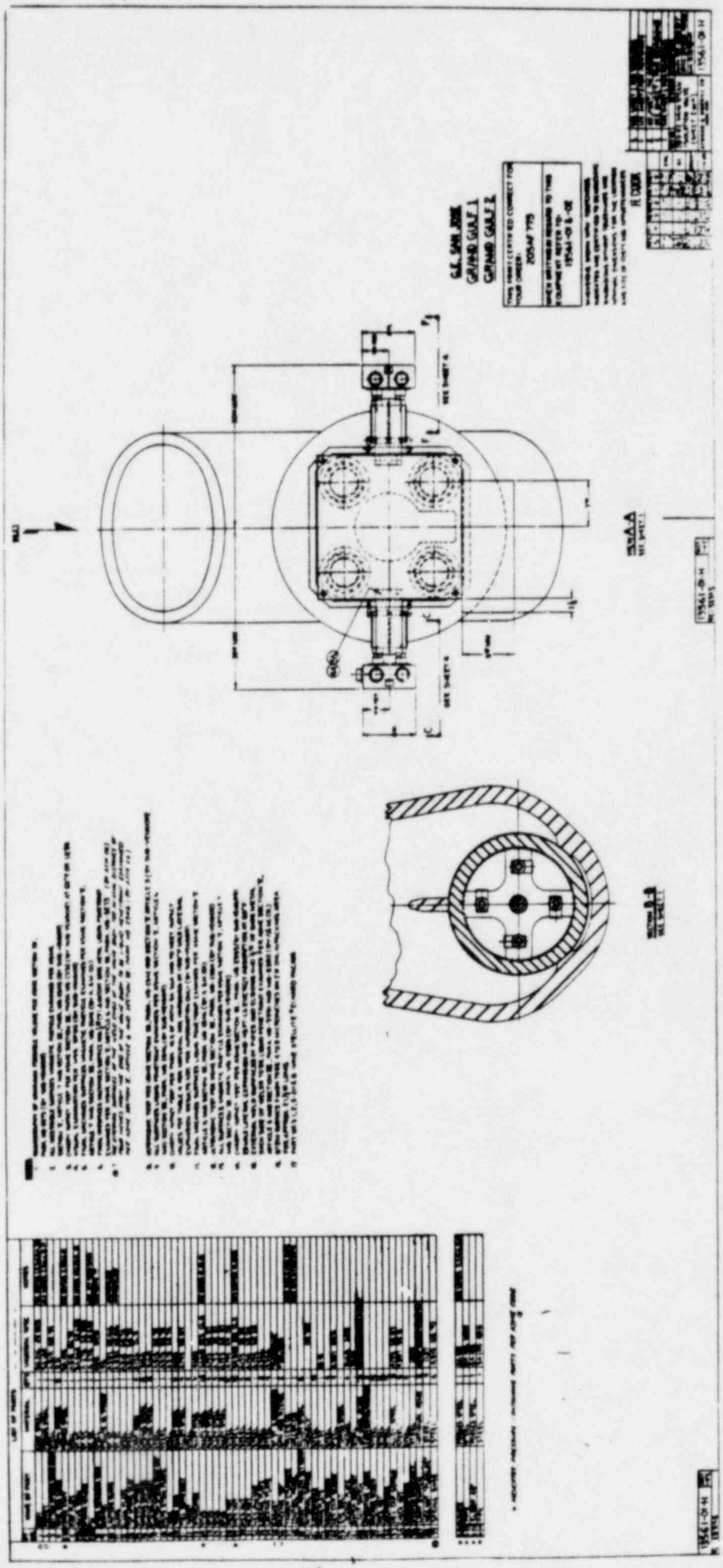
APPENDIX I - PHYSICAL COMPARISON OF GRAND GULF AND THE TESTED UPPER STRUCTURE (Yoke Components Only)

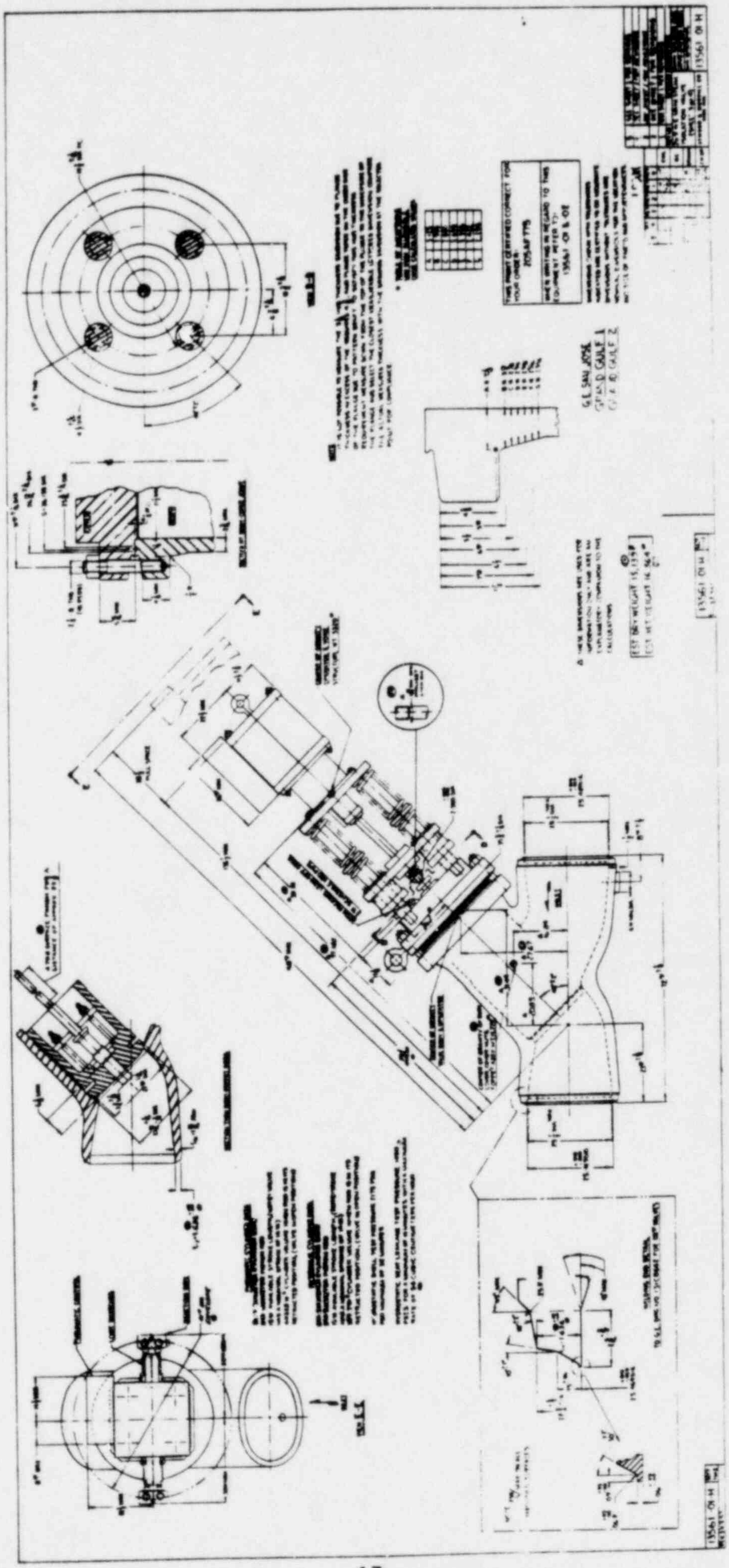
Item Description	Grand Gulf Upper Structure	26" - Tested Upper Structure Report No. NEDE-24122-1
Valve Vendor	A & M	A & M
Valve Size	28"	26"
Bonnet Cover Plate Dia.	35 5/8"	33 7/8"
Bonnet Cover Plate Thickness	5 5/8"	5 3/8"
Bonnet Cover Plate Material	SA-105	SA-105
Body Bonnet Bot diameter	2¼	2"
Number of Body Bonnet bolts	18	20
Yoke Rod Material	AISI - 4140	AISI - 1018
Yoke Rod Diameter	4.5"	3"
Yoke Rod Length	[illegible]7 3/4"	34 1/4"
Tested Yoke Rod Stress	-	20,000 PSI
Yoke Rod Yield Stress	103,000 PSI	48000 PSI
Outside Springs		
Spring Wire Diameter	25/32"	23/32"
Spring Coil Outside Diameter	7 3/4"	6 1/4"
Boxed load (Valve Closed)	1412 lbs	1150 lbs
Boxed load (Valve Open	2524 lbs	2346 lbs
Inside Springs		
Spring Wire Diameter	9/16"	17/32"
Spring Coil Outside Diameter	6"	4 5/8"
Boxed load (Valve Closed)	712 lbs	618 lbs
Boxed load (Valve Open)	1220 lbs	1260 lbs
General		
Overall Upper Structure Height	Approx. 90"	Approx. 85.50"
Overall Upper Structure C.G.	39.56"	33.81"
Overall Upper Structure Weight including cover.	5860 lbs	4597 lbs
Stem Travel Nominal	14"	13"
Limit Switches	NAMCO EA-740	NAMCO EA-740
Stem Diameter	2"	2"

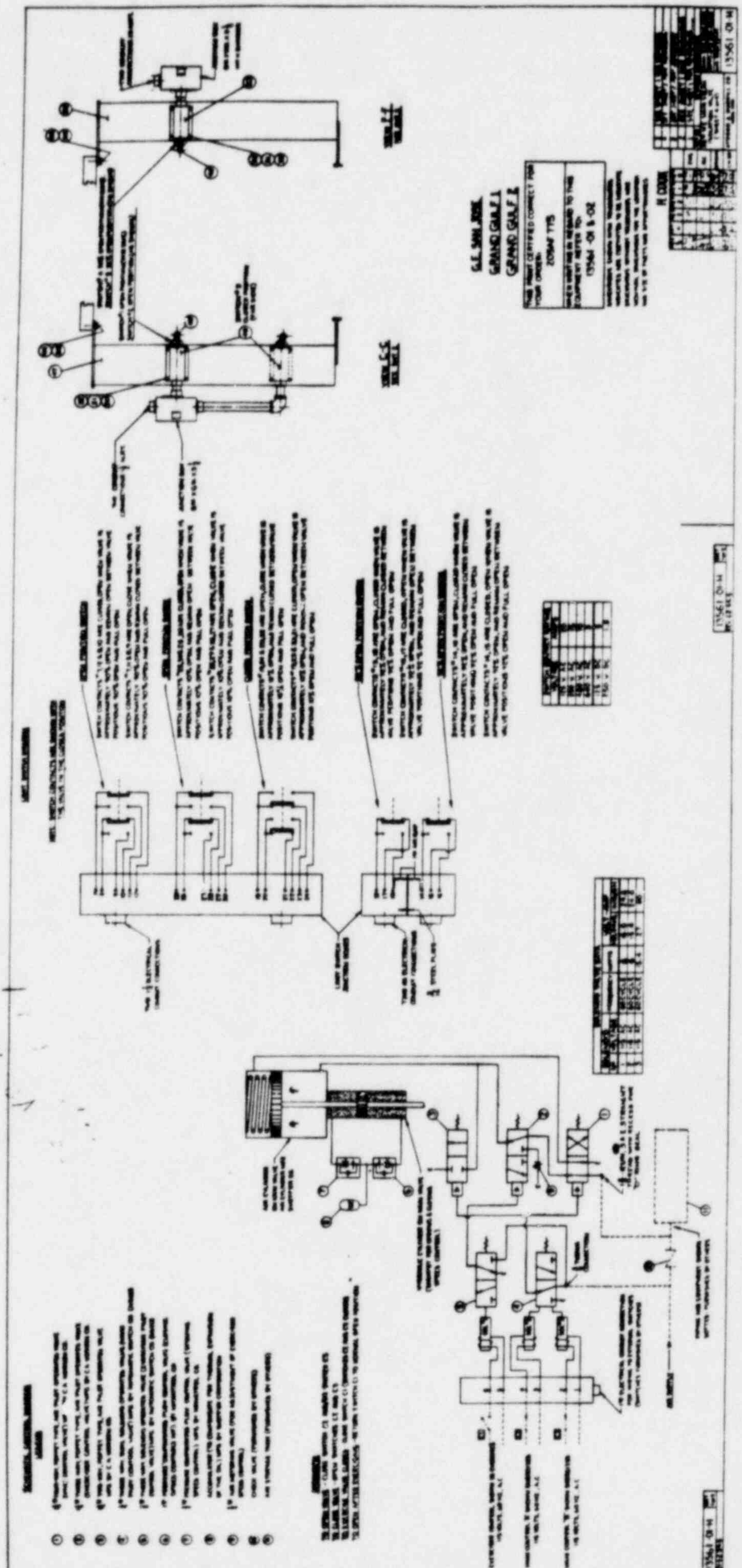
Appendix II

VALVE ASSEMBLY DRAWINGS









ATTACHMENT NO. 2

HPCS Valve Actuators
E22-F001/F004/F010/F011/F012/F015/F023

JUSTIFICATION FOR INTERIM OPERATION FOR HPCS VALVES E22-F001/ F004/F010/F011/F012/F015/F023 (SEISMIC QUALIFICATION)

REFERENCES: 1) Limitorque Seismic Qualification Report #B0037

2) Limitorque Seismic Test Report #B0085

Interim operation of the Limitorque actuators is justified based on the following:

1. Limitorque ran series of seismic tests (see Reference 1 above) on the family of their actuators from a small unit (SMB-000-5) to the largest unit (SMB-5). The general construction of these units is similar, and were enveloped by the series of seismic tests.

2. The control box, housing the torque and limit switches is the same size and construction for all the different sized actuators.

3. The actuators were operated before, during and after the seismic test with simulated valve load on the actuator for operability demonstration (see Figure 2 and Section 2.0.2 of Reference 1).

4. The tests as indicated in Reference 1 state that there are no resonances below 33 Hz. One actuator SMB-5 had a broad resonant peak at 28.8 Hz with a gain of 2.5 in the lateral axis and sine dwell test was conducted at this frequency (Appendix 12 of Reference 1). All other actuators were tested at 33 Hz to a level of 6 g's.

   Based on the above and the Reference 1, the actuator models are qualified for seismic excitation up to 33 Hz and 6 g's by the following Appendices:

Actuator Model		Report Appendix
SMB-00-15	(E22-F001)	6
SB-3-100	(E22-F004)	5
SMB-4-200	(E22-F010/F011)	12
SB-0-24	(E22-F012)	4
SB-1-40	(E22-F015)	2
SMB-4-150	(E22-F023)	12

CONCLUSION:

The demonstrated capability of the actuators exceed the piping calculated accelerations and therefore the interim use is justified. This conclusion is augmented by the fact that the backup ADS, LPCI and LPCS systems could provide emergency cooling water if required.

JUSTIFICATION FOR INTERIM USE FOR E22-F004 (ADDITIONAL TO THE ABOVE JUSTIFICATION)

Actuator SB-3-100 mounted on the valve E22-F004 has a motor brake installed. An actuator with motor brake has never been seismically tested before. However, it is increased by 40 lbs (size 8" in diameter by 3" in height). This is approximately 3% of the actuator weight (1200 lbs). Because the difference in weights is insignificant, it is concluded that the seismic qualification for other HPCS valve actuators be applied to E22-F004. This conclusion is augmented by the fact that the backup ADS, LPCI and LPCS systems could provide emergency cooling water if required.

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ATTACHMENT NO. 3

HPCS Diesel Generator Systems
E22-S001/S002/S003/S004