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Dwight E. Nunn
Vice President

January 28, 2000

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Subject: **Docket Nos. 50-361 and 50-362**
Request for Proposed Alternative Testing for Check Valves Which are Internally Mounted in Motor Operated Valves, In Accordance with 10 CFR 50.55a(a)(3)
San Onofre Nuclear Generating Station, Units 2 and 3
(TAC Nos. M93515 and M93516)

Reference: Letter from Walter C. Marsh (SCE) to The Document Control Desk (NRC) dated February 13, 1996; Subject: Docket Nos. 50-361 and 50-262, Response to Generic Letter 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves"

Gentlemen:

This letter provides an enclosed request by Southern California Edison (SCE) to use alternative testing methodology for approval by the Director of the Office of Nuclear Reactor Regulation in accordance with the provisions of 10 CFR 50.55a(a)(3)(i) and (ii).

The subject gate valves, manufactured by WKM, were identified in SCE's submittal of February 13, 1996 (Reference) as valves with potential functional impact due to pressure locking. The internal spring-loaded Marotta poppet valves are credited to mitigate pressure locking. They are component sub-assemblies of the gate valve. Diagnostic testing of the motor operated valves coupled with the normal operation during the course of plant shutdown evolutions associated with placing the shutdown cooling (SDC) system in service provide adequate indication of the Marotta poppet valve performance.

Other than the indirect testing of the Marotta poppet valve, as mentioned above, there are only two viable methods of discrete quantitative performance monitoring for the Marotta poppet valves. The first method entails a major valve disassembly and removal of the poppet from the valve disk assembly. The second method involves removal of one of two body vent plugs followed by the application of a pressure source to the valve body cavity. The second method involves some uncertainty relative to discerning seat leakage from poppet operation. Both poppet test scenarios require removing the shutdown cooling

P. O. Box 128
San Clemente, CA 92674-0128
949-368-1480
Fax 949-368-1490

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system from service, and breaching the reactor coolant system pressure boundary. Therefore, both alternatives require a full core offload to facilitate specific testing of the poppet valves.

10CFR50.55a(a)(3) states that:

> "Proposed alternatives to the requirements of paragraphs (c), (d), (e), (f), (g), and (h) of this section or portions thereof may be used when authorized by the Director of the Office of Nuclear Reactor Regulation. The applicant shall demonstrate that:
>
> (i) The proposed alternatives would provide an acceptable level of quality and safety, or
>
> (ii) Compliance with the specified requirements of this section would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The enclosed request supports SCE's position that the current indirect test method provides an acceptable level of quality and safety and the two quantitative methods of testing would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

If you have any questions or would like additional information regarding this issue, please contact me or Mr. J. L. Rainsberry at (949)368-7420.

Sincerely,

Enclosure

cc: E. W. Merschoff, Regional Administrator, NRC Region IV
J. A. Sloan, NRC Senior Resident Inspector, San Onofre Units 2 and 3
L. Raghavan, NRC Project Manager, San Onofre Units 2 and 3

San Onofre Nuclear Generating Station
Second Ten Year Interval
Valve Relief Request Number 1

System: Reactor Coolant System

Components: Internal spring-loaded poppet valves (check valves) in the upstream (high pressure) segment of the Shutdown Cooling System (SDC) gate valves listed in Table 1 below.[1]

Table 1 WKM Gate Valves

VALVE ID	SIZE (INCHES)	DESCRIPTION
2(3)HV9337	16	SDC suction containment isolation valve
2(3)HV9339	16	SDC suction containment isolation valve
2(3)HV9377	8	SDC suction containment isolation valve
2(3)HV9378	8	SDC suction containment isolation valve

Category: Motor Operated Valve - A, Active

Internal spring-loaded poppet – C, Active.

Class: III-1

Function:

These motor operated gate valves are manufactured by WKM. They are gate and segment style valves with Limitorque motor operators. These motor operated valves (MOVs) form the isolation

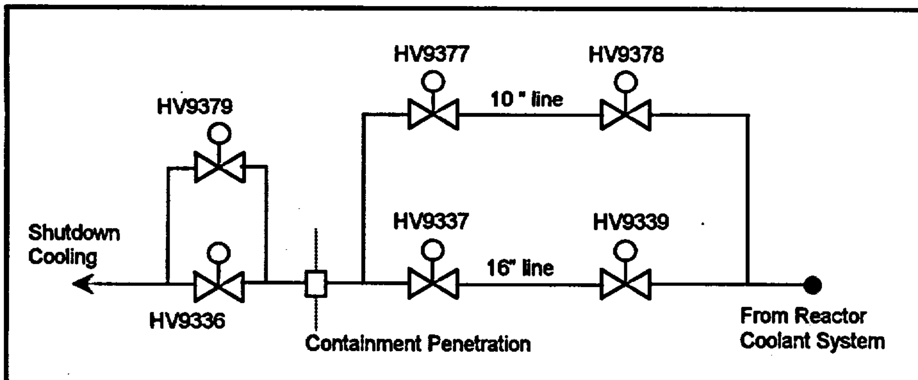

Figure 1 Simplified Valve Diagram

boundary (Figure 1) for the Reactor Coolant System (RCS) to SDC piping. They are closed with a key switch lock during normal operation. They are opened for shutdown cooling operation. The valves have both an RCS pressure isolation and containment isolation function. They are exempt

[1] This request is written in reference to the major equipment identification number because the spring-loaded poppet valves are internal sub-components of the main valve and do not have a specific identification number assigned.

from Appendix J requirements since a portion of the line inside containment remains pressurized when the RCS is pressurized. Updated Final Safety Analysis Report Table 6.2-35 for penetration 9 exempts 2(3)HV9337 and 2(3)HV9377 from Type C testing. Seat leakage testing is required per Technical Specification 3.4.14 for all four valves. Position indication is Quality Class II, Class 1E qualified, and required to indicate valve position. Certain outside containment line break scenarios require closing these valves. Small break loss of coolant events may require opening them should the shutdown cooling need to be used. The upstream (high pressure side) segment of each valve contains a vendor supplied spring-loaded poppet (check valve) designed to open at a differential pressure of 250±50 psid to relieve the internal pressure between the gate and segment to minimize the potential for pressure locking. The poppet valves have no rated capacity and do not have an adjustable set point. As such they are classified as spring-loaded check valves. The motor operated valves are the first and second valves off of the reactor coolant system. There are no upstream isolation valves to facilitate pressure boundary work on the subject valves without de-fueling the reactor.

Test Requirement:

Motor Operated Valves: ASME/ANSI OM-1987 through OMa-1988 Addenda, Part 10, paragraph 4.2, Inservice Tests for Category A and B Valves:

- Determine Seat leakage at least once every two years per paragraph 4.2.2.
- Exercise tested at cold shutdown intervals per paragraph 4.2.1.2(c).

Internal Poppet valves: ASME/ANSI OM-1987 through OMa-1988 Addenda, Part 10, paragraph 4.3, Inservice Tests for Category C Valves:

- Exercise tested at refueling intervals per paragraph 4.3.2.2(e).

Basis for Relief

The internal spring-loaded poppet valves are component sub-assemblies of the gate and segment of the valve. Periodic diagnostic testing of the motor operated valves coupled with the normal valve operation during the course of plant shutdown evolutions associated with placing the SDC system in service provide adequate indication of poppet valve performance. While diagnostic testing and operation of the motor operated valve does not provide direct trending information for the poppet valve performance, it does provide objective evidence that pressure locking is not occurring. Successive periodic MOV diagnostic tests clearly indicate no evidence of damage to the gate, segment, or seating surfaces as a result of pressure locking, even though the valve bonnets are exposed to RCS pressure.

There are two viable methods of quantitative testing for the Marotta poppet valves. The first method entails a major valve disassembly and removal of the poppet from the valve disk assembly. Once removed the poppet could be tested and inspected. The second method involves removal of one of two body vent plugs followed by the application of a pressure source to the valve body cavity. The attendant pressure profile generally characterizes poppet valve performance, although the results may be confused by seat leakage. Both poppet test scenarios disable the shutdown cooling system and require breaching the reactor coolant system pressure boundary. Both scenarios require a de-fueled condition with the reactor coolant loops drained.

Of the four valves, the most recent valve disassembly was 3HV9339 (Maintenance Order 95071161, 8/9/95 – 8/23/95). The disassembly was a result of abnormal MOV diagnostic traces and incurred 15 days of de-fueled time, more than 750 man-hours labor, and a dose of approximately 1 man-REM. These values include only work on the valve and do not include interference removal and other supporting activities to perform the repairs. The core offload/reload process nominally requires 71 hours for offload, and 82 hours for reload based on the baseline outage-planning schedule. The combination of these items imposes a significant hardship.

The poppet valve is a mechanically simple and extremely reliable component as discussed below. Review of the poppet valve performance history shows there were no failures or degradation noted in the sixteen safety related and non-safety related valves that have been inspected. Five of the eight (four per unit) valves addressed in this request are included in the inspection population. The most probable failure mode for the poppet valve is open, which satisfies the function of the valve. The poppet valve, which is installed in the upstream gate segment, has no required function to close, as the down stream gate is the rated seating member of the valve.

Alternate Testing

Motor Operated Valves:

Test per San Onofre Nuclear Generating Station Risk Informed Inservice Testing Program and OMN-1, when approved, as follows:

- Determine Seat leakage at the interval determined by the Integrated Decisionmaking Process.
- Exercise at least once during each fuel cycle.
- Perform diagnostic testing at an interval not to exceed 6 years until such a time that accumulated data indicates further extension is warranted.

or

ASME/ANSI OM-1987 through OMa-1988 Addenda, Part 10, paragraph 4.2, Inservice Tests for Category A and B Valves:

- Determine Seat leakage at least once every two years per paragraph 4.2.2.
- Exercise test at cold shutdown intervals per paragraph 4.2.1.2(c).

Internal Poppet valves:

Satisfactory operation of the MOV and continued diagnostic traces satisfy periodic verification that pressure locking scenarios are not affecting the valves' material condition. In addition, any maintenance activity requiring disassembly of the valve will include permanent removal of the poppet assembly to mitigate reliance on the poppet to minimize pressure locking concerns.

Discussion

The subject gate valves, manufactured by WKM, were identified in Southern California Edison's (SCE) submittal of February 13, 1996 (Reference 1) as valves with potential functional impact due to pressure locking. This relief request pertains to the WKM valves currently considered as susceptible to pressure locking identified in Table 1.

The potential for pressure locking in these valves occurs because of leakage between the segment and the seat in the upstream valves, HV9339 and HV9378 (See Figure 2), which pressurizes the bonnet to the reactor coolant system (RCS) pressure of about 2,235 psia. The RCS pressure is reduced to below 400 psig prior to starting the SDC system. If internal bonnet pressure is not relieved, the high-pressure water trapped in the bonnet cavity causes the segment and the gate to press tightly against the seats. HV9377 and HV9337 may be, over time, subjected to the RCS pressure on the segment side similar to the upstream valves. For the SDC valves outside containment, 2(3)HV9336 and 2(3)HV9379, further evaluation indicates that they are not susceptible to pressure locking. Therefore, they are no longer considered within the scope of GL 95-07 and are not considered in this relief request.

In view of the pressure locking scenario described above, a valve may fail to open if a relief path from the bonnet cavity does not exist. The function of the internal poppet valves is to provide the relief path, thus reducing the potential for high bonnet pressure. This function is explained in detail below.

The subject valves are equipped with a spring-loaded poppet installed in the segment, which together with the gate make up the valve disc (see Figure 2). Marotta Scientific Controls, Inc. of Boonton, N.J, manufactured these poppet relief devices. The function of the poppet valve is to limit the pressure buildup in the bonnet, and between the gate and the segment to a specified value. This is achieved by providing a path between the bonnet and the upstream side of the valve. Limiting the pressure differential between the bonnet and the upstream side minimizes the potential for pressure locking. The poppet valves do not protect the code class boundary. They are neither capacity rated nor set point adjustable. Therefore, they are considered check valves.

Figure 2 shows a cross sectional view of the 8 inch WKM valve, ID No. 2(3)HV9378. This valve drawing is representative of the other Model D-2 OPG POW-R-Seal WKM valves listed in Table 1 above. The figure shows the valve internal components, including the valve's split disc. This disc consists of the segment and the gate. The figure also shows the location of the spring-loaded poppet in the segment (Item 31).

The poppet valve is set to begin to open at a pressure of 250±50 psid (differential pressure) between the bonnet and the upstream side (the upstream side pressure plus 300 psi represents an upper bound on the bonnet differential pressure). The following is a brief description of the valve and its main components:

- The valve is 3/4" long and about 0.362" in diameter. It is threaded to the segment at the location shown in Figure 2. To eliminate assembly errors, the valve cannot be installed backwards.

- The valve internals include a stainless steel poppet, a retaining ring attached to the poppet, an inconel spring, and a stellite seat assembled as shown in Figure 3. The compression spring is 0.3" in diameter and is less than 0.5" long. It is securely enclosed between a recess in the seat and the retaining ring.

- The materials of the valve internals are highly corrosion resistant. Furthermore, the materials of the poppet and the seat (stainless steel on stellite) were selected such that binding will not occur under operating conditions. Binding could lead to the poppet being stuck in a closed position.

- The compression spring has a small height to diameter ratio. This feature ensures stability of the spring under a compressive load without the possibility of buckling.

- The valve has no guides and no stability components. It has only one moving part: the poppet assembly and the attached retaining ring.

The foregoing discussion emphasizes the valve's simplicity in design and construction. It also shows that the materials of construction were selected to provide resistance against corrosion, and to eliminate the potential for binding between the poppet and the seat. The function of the valve is described briefly as follows:

- The spring is compressed during assembly between the seat and the retaining ring. The compression of the spring force is transmitted to the poppet via the retaining ring to seat it against the stellite seat to provide the desired sealing. The arrow indicating the flow direction in Figure 3 is on the bonnet side and the seat is on the upstream side.

- If the bonnet pressure is sufficient to overcome the force in the spring, lift-off will take place. Spring stiffness and the amount of pre-compression applied to the spring during assembly are calculated such that lift off occurs at the valve set point. The path created between the bonnet and the upstream side by this lift off allows some of the water trapped in the bonnet to escape to the upstream side, thus relieving the bonnet overpressure.

The poppet valve is manufactured to a very simple design, with only one moving part, the poppet, which is attached to the retaining ring (see Figure 3). The poppet can only move in the axial direction guided by the retaining ring at one end and the hole in the seat at the other end. The short length of the compression spring eliminates the potential for buckling. Also, the seat end of the spring is enclosed in a recess in the seat to prevent lateral motion. All these features ensure that the poppet is allowed to move only in the axial direction should high pressure exist in the bonnet, with practically no possibility of deviation from this simple motion. Accordingly, there is no possibility of the poppet being stuck in a cocked position. Even if the poppet became misaligned, tight seating would not be possible, which provides a relief path. The simplicity in the poppet valve design ensures a high level of reliability.

Maintenance Test History

The WKM internal poppet valves at SONGS 2 and 3 are not periodically tested. However, poppet valve testing was added to SCE Maintenance Procedure SO123-I-6.75 as a prudent measure in January of 1998. The testing is done only if the valve must be disassembled in support of another maintenance activity. The procedure revision included lift testing since the calculation of record regarding pressure locking credited opening of the poppets to relieve bonnet pressure should it exist. Prior to 1998, the procedure only required the poppet valves be inspected and then replaced if the WKM valve was disassembled.

Of the total population of safety and non-safety related WKM valves all of which have internal poppet valves (37+) at SONGS, 16 safety related and non-safety related poppet valves have been inspected, tested, or replaced during valve disassembly[2]. Of these 16 valves, 13 poppet valves have been inspected or replaced and three poppets have been tested. Additionally, a spare poppet valve was also tested as explained below.

Lift off testing - no failures.

Inspection - acceptance criteria were not met in two instances, with one missing the poppet and one missing the debris screen. Neither of which would have prevented the valve from performing its pressure relieving function.

Replacements - 6 were replaced as required by the procedure at that time even though there was no sign of degradation, including the poppet in 3HV9339 as a part the 1995 disassembly.

Spare valve - a spare poppet valve was tested at SONGS by pressurizing the inlet and recording the relief pressure. The test was repeated 25 times with the relief pressure consistently between 250 and 260 psi.

If major valve disassembly is required, current procedures require testing the poppet valves as follows:

a. Inspect the poppet valve debris screen.
   Acceptance Criteria: Clean, no broken strands, or foreign material.

b. Remove and test the poppet valve as follows:

   - Perform the valve seat leak rate test by pressurizing the valve inlet to 150 psig.
     Acceptance Criteria: Seat leak rate < 2 cc/hr maximum

   - Perform the valve relief test by pressurizing the valve inlet.
     Acceptance Criteria: Valve relieves at 200 to 300 psig.

c. Re-install the poppet valve, or replace it.

The above test requirements do not represent periodic testing of the poppet valves. Currently, testing is performed only when the major valves are disassembled to perform other maintenance work. Periodic testing of the poppet valves is not necessary based on the simple design and its inherent reliability. The WKM valves, however, are routinely opened during plant shutdown sequences in support of placing the shutdown cooling system in service. Since the bonnets of the SDC valves inside containment may be pressurized due to minimal seat leakage, the existence of an adequate relief path is necessary to prevent pressure locking of the valves when the RCS pressure is reduced in preparation for opening the valves and starting SDC.

The simple design, combined with the maintenance experience, and satisfactory MOV diagnostic testing provides an assurance that there is a relief path between the bonnet and the upstream side that prevents excessive pressure build up in the bonnet.

Failure Mechanics

Potential poppet valve damage and/or failure during operation is expected to be in any of the following forms:

[2] All internal poppet valves were initially tested prior to installation in the WKM valves prior to startup per Reference 3

1. Poppet and/or seat corrosion - The poppet is made of stainless steel and the seat is made of stellite. Both materials are highly resistant to corrosion, which makes damage due to corrosion highly unlikely or insignificant.

2. Poppet-seat binding resulting in the poppet valves being stuck closed is not credible based on the materials of the poppet and the seat (stainless steel on stellite).

3. Loose particles may become lodged between the strands of the screen. This could potentially impair the relief path. However, the high differential pressure associated with pressure locking would dislodge any loose particles.

4. The spring is made of inconel, which is very resistant to corrosion. Furthermore, any damage to the spring leads to loss of stiffness and decreasing the lift-off differential pressure.

Based on the above considerations, the capability to provide a relief path and limit valve bonnet pressure will not be impacted by any potential damage to the poppet valve during operation.

The above is supported by an industry survey of Marotta valves. A search of the Nuclear Plant Reliability Data System (NPRDS) archives, Nuclear Industry Check Valve Group failure data, and Equipment Performance Information Exchange (EPIX), shows a total of seven recorded failures of check valves manufactured by Marotta. Although the design details of these valves were not available, the description of the failures clearly indicates that these valves failed to completely seat which resulted in excessive leakage across the valves. Such a failure, if experienced by the subject poppet valves, would not compromise the intended function of the valve. To the contrary, onset of leakage across the valve would tend to provide the desired pressure relief.

Operational History

These WKM valves are routinely opened during outages to start shutdown cooling. There has been no failure to open for these valves since the startup of both units in 1982 (Unit 2) and 1983 (Unit 3), which could be attributed to failure or degradation of the Marotta valve. Furthermore, valves 2(3)HV9378 and 9339, which are the first boundary valves between the RCS and the SDC system, are routinely subjected to entrapped RCS fluid in the valve bonnet. Subsequent depressurization of the RCS to initiate shutdown cooling and opening of these valves provides reasonable assurance that the poppet valves are providing a vent path since it has been confirmed that the valve actuators have inadequate thrust to open against normal RCS pressure. The successful opening of these valves provides additional indication of the functionality of the internal Marotta valve.

During the Unit 2 Cycle 9 refueling outage, the piping segments between HV9377 and HV9378, and between HV9337 and HV9339 were pressurized on 2/18/97 through the drain valve to about 350 psia to perform a leak test on HV9337 and HV9377. The Unit was then pressurized to 2250 psia at 0337 on 2/19/97. The Unit returned to shutdown cooling and the valves reopened at 1450 on 2/19/97 indicating that no pressure locking occurred. All four SDC valves (HV9377, HV9378, HV9337 and HV9339) are required to open per the SDC system's Operating Instruction (Reference 4).

Test Methodology

As discussed above, the only two viable test options are:

- Remove the poppet valve, test outside the MOV, and replace it, or

- Test the poppet valve in situ.

Testing the poppet valve in situ requires an external source (such as a hydro pump) be used to pressurize the space between the valve gate and segment. The connections for the hydro pump and measurement/test equipment would be made through the valve body plug. The associated hardships and risk utilizing this method are:

- Removal of the body plugs on the valves closest to the RCS loop, HV9378 and HV9339, would require the reactor core to be off loaded and draining of the SDC System

- The pressure profile obtained by this method may be the compound results of poppet valve flow, valve seat leakage, and packing leakage. The additional sources of leakage are not quantifiable and may contribute to indeterminate results which would require emergent work to disassemble the MOV to test the poppet valve

- Removal and reinstallation of the valve body plugs could potentially damage the valve body, resulting in RCS pressure boundary leakage upon return to service. Such leakage will not be noted until the RCS is pressurized as part of returning the unit to service and will be unisolable.

- Disassembly of the valve results in a significant radiation dose.

The second option is to remove the internal poppet valve. Removal of the poppet valve requires complete disassembly of the gate valve. The associated hardships and risks are:

- Complete reactor core offload and draining of the SDC system.

- Disassembly of the gate valve poses a number of risks:

    - The valve bonnet is a pressure seal design with a metal seal ring. The design is inherently difficult to work on and is prone to causing body seal ring damage. Such damage and difficulties have been experienced a number of times during previous valve maintenance.

    - Damage to the valve body seal ring surface will result in RCS pressure boundary leakage upon return to service.

    - Furthermore, the valve body plugs are removed during a valve overhaul. Removal and reinstallation of the valve body plugs can damage the valve body resulting in RCS pressure boundary leakage upon return to service.

    - The location and service of these valves makes disassembly a difficult, labor intensive task which incurs significant dose to accomplish.

Summary

In summary, quantitative testing of the Marotta poppet valves presents a significant burden as it requires a full core offload and valve disassembly. The simplicity of design, inherent reliability, and diagnostic testing of the MOV actuator and valve assembly provide an acceptable level of assurance that pressure locking of the valve will not occur. In addition, SCE will remove the poppet if valve disassembly is required for other maintenance or performance issues.

References

1. Letter from Walter C. Marsh of SCE to U. S. Nuclear Regulatory Commission dated February 13, 1996; Subject: Docket Nos. 50-361 and 50-262.Response to Generic Letter 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves"

2. Maintenance Procedure SO123-I-6.75, Revision 2,"WKM Model D-2 Gate Valve Disassembly, Cleaning, Inspection and Reassembly."

3. SCE Document No. SO23-507-5-1-207, Rev. 4,"Pressure Test of POW-R-SEAL Gate Valves." This is WKM Engineering Standard, Classification Number 36-0105.

4. SCE Document No. SO23-3-2.6, Revision 11,"Shutdown Cooling System Operation." This was the applicable revision at the time of Unit 2 Cycle 9 refueling outage.

5. Letter from J. L. Rainsberry (SCE) to Document Control Desk (NRC) dated July 21, 1999;Subject: Response to Request for Additional Information Regarding Generic Letter 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves"

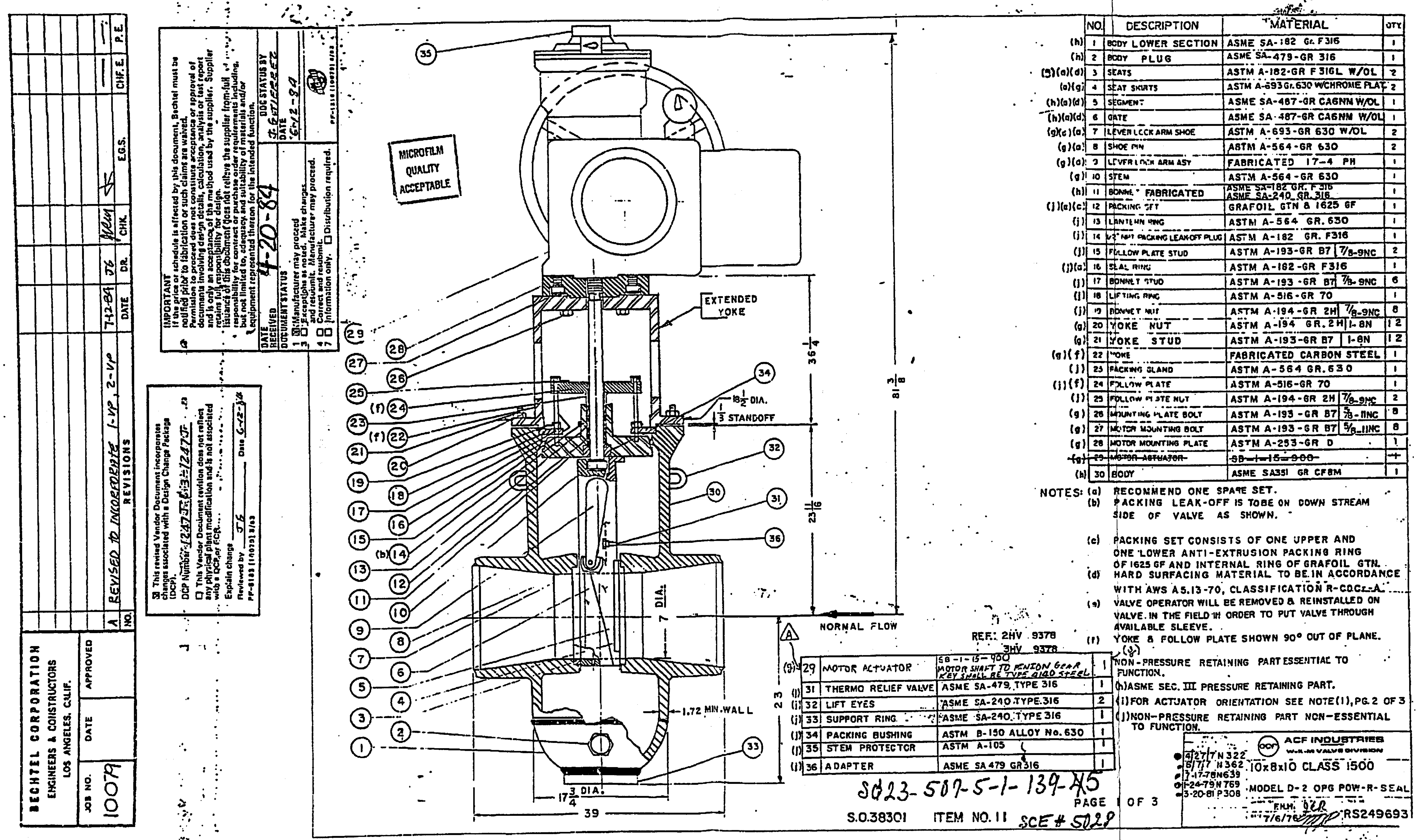

Figure 2 WKM 10x8x10 inch Valve 2(3)HV9378

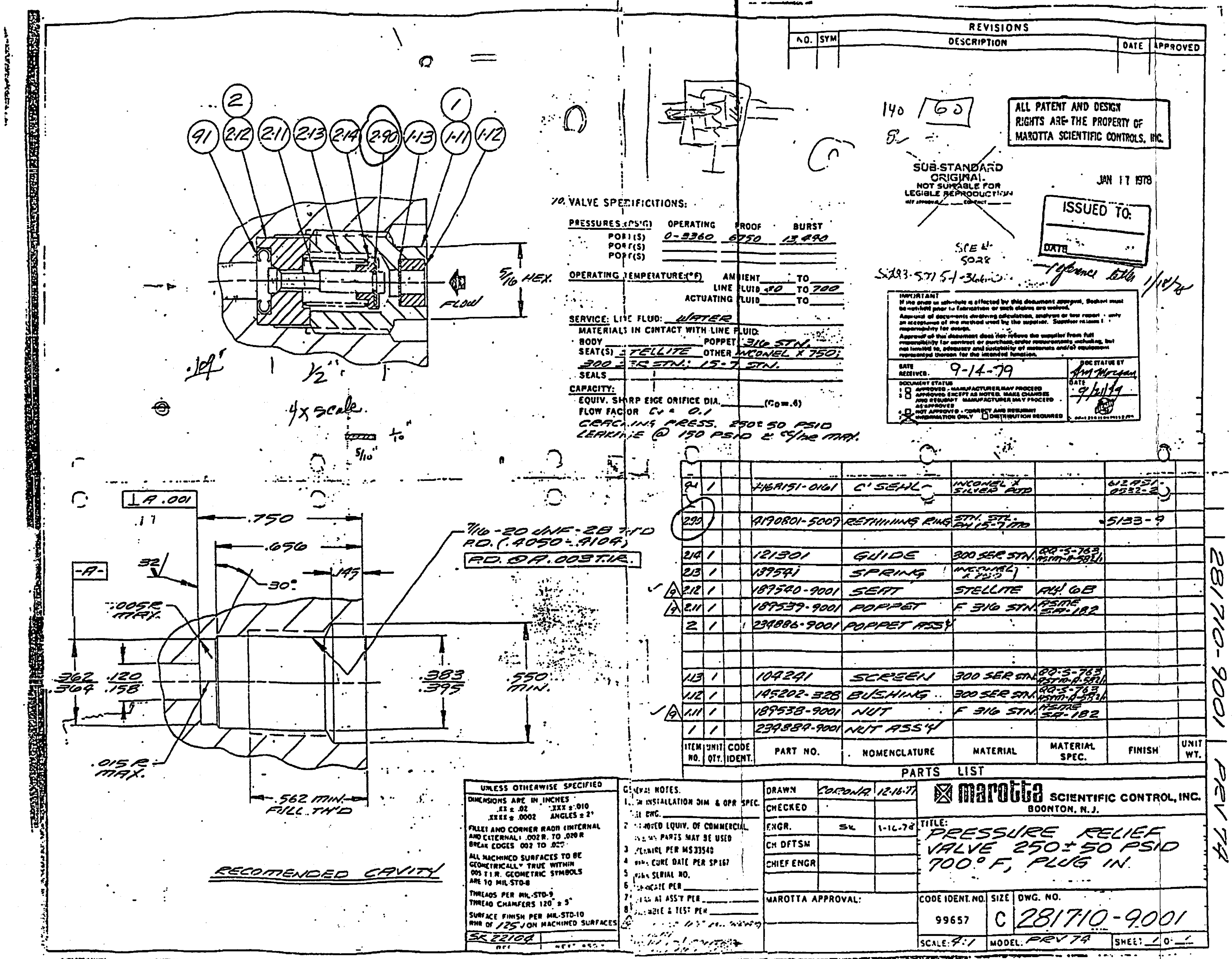

Figure 3
Marotta Pressure Relief Valve
250±50 psid