TEST PROCEDURE GUIDELINE

FOR

OUT-OF-PLANT

TESTING OF PORV BLOCK VALVES

AT THE

FORT CALHOUN STATION

OMAHA PUBLIC POWER DISTRICT

Prepared by

ABB-COMBUSTION ENGINEERING NUCLEAR POWER

9204060365 920401
PDR ADOCK 05000285
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Prepared by: Pietro A. Adamo Date: 8/12/91

P. A. Adamo

VERIFICATION STATUS: COMPLETE

The Safety-Related design information contained in this document has been verified to be correct by means of:

✓ Design Review using Checklist(s) 1, 9 of QAM-101.

___ Alternate Analysis - Copy attached.

___ Verification Testing - Test Report No. ______.

Juan P. Wesn / [signature] / 8-14-91

Independent Reviewer: Name/Signature/Date

Items Not Applicable:
Checklist 1: All
Checklist 9: 5-20, 24

Approved by: RODoney for DCS Date: 8-13-91

D. Sibiga, Supervisor

RECORD OF REVISIONS

Revision Number	Effective Sections	Date	Prepared By	Approvals
00	All (Original Issue) Total pages=74	April 1991	T.P. Jaeger	D. Sibiga
01	Revised: - Table of Contents - Table 1 - Figure 1 - Paragraphs: 1.2.9; 3.2.1; 3.3; 3.3.1; 3.3.2; 3.4.3; 4.2.1; 4.2.2.1; 4.2.2.2; 4.2.2.5; 4.3.5; 4.4.1 (Entirely) 4.4.2.2; 4.4.2.3; 4.4.2.7; 4.4.2.9; 4.4.2.19; 4.4.2.22; 4.4.3.28; 4.4.3.29; 4.4.4.29; 4.4.5; 4.4.5.1; Added: - Paragraphs: 4.4.2.23 through 4.4.2.36 - Appendix C - Appendix D Deleted: - Paragraphs: 3.5; 4.4.5.2 4.4.5.2.1 through 4.4.5.2.13	July 1991	P. A. Adamo	D. Sibiga
02	Revised: - Table 1 - Paragraphs: 3.3; 3.3.1; 3.4.4.1; 4.2.1 4.4.1.[8;11;13;14;19;21;24;27;28] 4.4.2.[2;3;6;7;9;24;25;31;32] 4.4.3.[2;8;28] 4.4.4.[2;9;29]	August 13,1991	P.A. Adamo	D. Sibiga

TABLE OF CONTENTS

1.0 PURPOSE

1.1 This Test Guideline provides support to the Omaha Public Power District's (OPPD) Motor Operated Valve (MOV) Program at the Fort Calhoun Station. The program is being implemented by OPPD in response to the Recommended Actions of NRC issued Generic Letter 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance" and its supplements.

1.2 The purpose of this document is to provide guidelines to OPPD for establishing the procedural, documentational, parametrical and correlational requirements for testing the Power Operated Relief Valves (PORV) Block Valves HCV-150 and HCV-151. The following listing details the provisions made for in this guideline:

1.2.1 Provide documentation of the functional requirements for the PORV Block Valves.

1.2.2 Provide documentation of the maximum design basis conditions for which the PORV Block Valves are required to operate in Step 1.2.1, above.

1.2.3 Provide recommended tests and test conditions for which the PORV Block Valves are to be tested in situ.

1.2.4 Provide required tests and test conditions for which the PORV Block Valves are to be tested out-of-plant.

1.2.5 Provide test justification and guidelines for correlation between maximum design basis conditions, out-of-plant testing and in situ testing.

1.2.6 Provide a test guideline for out-of-plant testing which has sufficient detail on test method, test conditions and data acquisition requirements which will allow the out-of-plant test facility procedure writer to develop detailed test procedure(s).

1.2.7 Provide a guideline for correlating test results and expected results with justification and explanation for significant variances.

1.2.8 Provide guidelines for establishing detailed test acceptance criteria.

1.2.9 These guidelines also apply to testing required to meet any OPPD commitments to the NRC concerning NUREG 0737.

2.0 SCOPE

This Test Guideline specifically addresses the PORV Block Valves, HCV-150 and HCV-151, at OPPD's Fort Calhoun Station. It's scope is to establish testing guidelines for OPPD to develop specific testing procedures which will verify the valves' operability at the maximum design basis conditions. The scope of this guideline is also to provide the basis for an in situ periodic surveillance/trending testing program to ensure continued operability.

3.0 **TECHNICAL BASES**

3.1 Valve/Actuator Data

3.1.1 Tag Number: HCV-150 and HCV-151

3.1.2 Valve Type: 2500# ANSI Class Gate

3.1.3 Valve Size: 2 1/2 inch

3.1.4 Valve Orientation: Installed in horizontal line with stem upright

3.1.5 Valve Manufacturer: Crane

3.1.6 Valve Model: 797-U

3.1.7 Actuator Manufacturer: Limitorque

3.1.8 Actuator Model: SMB-00

3.2 Functional Requirements

The PORV Block Valves must be capable of providing the following functions:

3.2.1 The PORV Block Valves are normally open during most plant conditions when the reactor head is on the reactor vessel to allow the PORVs to provide for overpressure protection. However, in order to provide reactor coolant pressure boundary integrity, the block valves must be capable of being closed if required to isolate a PORV which has excessive leakage. The valve must then be capable of remaining closed to maintain the integrity of the reactor coolant pressure boundary.

3.2.2 In addition to isolating a PORV due to excessive leakage, a normally open PORV Block Valve must

also be capable of being closed to isolate a stuck open PORV during any postulated plant condition.

3.2.3 The PORV Block Valve(s) may be required to be closed during plant operation for limited periods as a result of excessive leakage (case described in Section 3.2.1) of one or both of the PORVs, or as a result of one or both of the PORVs being stuck open (case described in Section 3.2.2). If a PORV Block Valve is placed in the closed position for one of these reasons, the valve must be capable of being reopened and then closed as necessary, to provide for

1) overpressure protection.
2) depressurization for the mitigation of steam generator tube rupture and other design basis events.
3) once through cooling upon loss of all feedwater.

3.2.4 As a reactor coolant pressure boundary valve which is normally open, the Combustion Engineering Emergency Procedure Guidelines (prepared for the CEOG), CEN-152, requires the PORV Block Valves to be closed as part of the LOCA recovery procedure to isolate the PORV in order to maintain reactor coolant system inventory.

3.2.5 The PORV Block Valves must be capable of being repositioned to their correct open or closed position in the event of mispositioning by the

control room operator. This would be required under any conceivable operating condition.

3.3 Design Basis Operating Conditions

Appendix C to this guideline provides a listing of the operating scenarios presently ascribed to the PORV Block Valves. The list identifies the event, the valve stroke direction, maximum pressure, maximum ΔP, maximum flow rate, fluid states and the assumptions made for each required operating condition of the valve.

Of the 19 operating conditions identified in Appendix C, the PORV Block Valve need to be tested only to the 6 enveloping conditions identified in Table 1 of this guideline.

3.3.1 Test Cases Selection Criteria

The 6 test cases of Table 1 were selected from the list of the PORV Block Valve operational requirements in Appendix C following the criteria noted below.

The valve performs two basic operations: Opening and closing. However, the dynamic and static loads created by the internal fluid impact the valve's ability to perform those basic operations in a dramatic fashion. Temperature, pressure, pressure differential, fluid state and flow rates all combine to create substantially complex flow conditions within the valve to render highly questionable any

prediction of the local/internal valve loading state, and thus its ability to operate, without testing the valve at the bounding conditions.

It cannot be stated without verification that if a valve strokes successfully in one direction under a given set of conditions it will stroke successfully in the alternate stroking direction at the same or even less severe set of conditions. The reason is that, when first opening, the valve must overcome the maximum ΔP load although the dynamic loads are initially 0. When closing, the ΔP may be negligible but the dynamic loads are at maximum. The dynamic loads may cause turbulence and valve "chatter", deflect and misalign valve components and generally tend to create conditions for mechanical damage and ultimately seizure of the valve. Therefore, the test cases selection process started with the grouping of all operating conditions that require the valve to open and again those conditions that require the valve to close.

The next criteria for selecting test cases was to identify the fluid states under which the valve is required to operate in opening and/or closing. The state of the fluid is an important selection criteria. The state of a fluid affects its dynamic behavior in a piping system and, accordingly, it also affects the dynamic loading conditions on a valve.

The last criteria for selecting test cases is to pick those cases within each subgroup that represent the various fluid states, that have the greatest maximum pressure, greatest maximum ΔP and greatest maximum flow rates. This process is performed for events when the valve is required to open and then repeated for events when the valve is required to close.

The only exception to the above criteria is provided by Case II-1 in Appendix C:

The flow rate in this case is so small that the fluid state is not a significant criterion. Per Appendix D, the amount of condensate present in the loop seal is 66.4 lbs. (at most). The only test case for which this condition may have any bearing is Test Case Number 6, where the valve would be opening at high pressure. However, the amount of water is so small that it would be blown out of the valve as soon as the valve is unseated, leaving the valve unfettered for the rest of the stroke. Therefore, duplication of the water plug during testing for the purpose of demonstrating valve operability is not deemed strictly necessary.

3.3.2 Maximum Conditions for Valve Operability

The test cases below envelope the PORV Block Valve functions in a progressively severe order. The corresponding conditions are provided in Table 1.

CASE 1 - Open Block Valve to enable the LTOP system. Misposition is postulated. (Appendix C, Case III-1, Liquid Flow.)

CASE 2 - Open Block Valve to allow the functional recovery of the RCS pressure control using PORV as a success path. Misposition is postulated. (Appendix C, Case VI-3, Liquid Flow.)

CASE 3 - Close Block Valve due to a stuck-open PORV. (Appendix C, Case I-3, Liquid Flow.)

CASE 4 - Close Block Valve due to a stuck-open PORV. (Appendix C, Case I-3, Two Phase Flow.)

CASE 5 - Close Block Valve stuck-open PORV. (Appendix C, Case I-1, Saturated Steam Flow.)

CASE 6 - Open Block Valve to enable the LTOP. Mispositioning is postulated. (Appendix C, Case III-3, Saturated Steam Flow.)

Table 1

Maximum Condition Cases

CASE	Function (Open/Close)	Maximum Upstream Pressure (psia)	Minimum Downstream Pressure (psia)	Maximum Differential Pressure (psid)	Maximum Flow (lbm/hr)	Temperature (°F)	Process Fluid State	Appendix C Case
1	OPEN	485	15	470 (1)	225,000	82	WATER	III-1
2	OPEN	1200	15	1185 (1)	180,000	540	WATER	VI-3
3	CLOSE	1400	15	1385 (2)	368,480 (3)	540 (4)	WATER	I-3
4	CLOSE	1400	15	1385 (2)	160,000	587	TWO PHASE	I-3
5	CLOSE	2376	15	2361 (2)	110,220	661	SAT. STEAM	I-1
6	OPEN	2500	15	2485 (1)	130,000	668	SAT. STEAM	III-3

NOTES:

1) The valve starts to stroke open from a fully closed position. The differential pressure across the valve when fully closed is at its maximum. As the valve continues to open, the pressure differential across the valve continues to decrease until it becomes essentially zero when the valve reaches its fully open position. Simultaneously, the flow rate across the valve starts at 0 lbm/hr when the valve is fully closed and increases as the valve strokes open, until it reaches its maximum value when the valve is fully open.

2) The valve starts to close from a fully open position. The differential pressure across the valve when fully open is essentially 0. As the valve continues to close, the pressure differential across the valve continues to increase until it reaches its maximum value when the valve reaches its fully closed position. Simultaneously, the flow rate across the valve starts at its maximum value when the valve is fully open and decreases as the valve strokes toward the closed position, until the flow completely stops when the valve is fully closed.

3) The flow rate for this case was computed using the formula $Q = CV\sqrt{\Delta P \frac{62.4}{P}}$ from Crane's Technical Paper No. 410, 1976 Edition because no published flow rate values were found. Maximum flow rate is achieved when the PORV Block Valve is fully opened. In this condition, the flow choking is achieved by the PORV because it has a smaller flow area at the seat (1.093 inch diameter). Therefore, the maximum flow rate, Q, is computed using the PORV's Cv, the maximum ΔP and the density of the liquid P, as is applicable.

4. This is an estimated maximum temperature based on the assumption of coexistence of liquid with saturated steam at the specified pressures.

3.4 Determination of Required Testing

Section 3.3 identified the maximum cases for which the PORV Block Valves must be capable of operating. To verify the valves' capability to function and remain operable under these conditions, it is desirable, and in some cases necessary, to perform testing to demonstrate that the valve can in fact perform its safety functions. There are two reasons for testing, one is to demonstrate capability and the other is to verify continued operability.

3.4.1 Demonstration of Capability

Testing performed to demonstrate capability, for the most part, can be considered a one time test. This is true as long as the valve is maintained in a condition similar to that tested and/or has not undergone major maintenance which could have affected valve operability. This testing should, when possible, be performed at or above the maximum conditions for which the valve is required to operate. Unfortunately, it is not always possible to perform this type of testing in situ. This is the case for the PORV Block Valves. Testing at these conditions would challenge the primary safety valves and reactor coolant pressure boundary as well as introduce significant transients which compromise the plant's safety. It is therefore recommended that this testing be performed in an out-of-

plant test loop. This testing will evaluate the valve's capability to perform repeated cycles at the maximum conditions by monitoring valve degradation, if any, during the operability stroke tests. Also, this testing will develop a basis for correlation to in situ testing at reduced conditions. See Sections 3.4.3 and 3.4.4 for specifics on out-of-plant and in situ testing.

3.4.2 Verification of Continued Operability

Testing which is performed to verify continued operability is basically performed to demonstrate the valve has not degraded or deviated from that originally tested at the design basis conditions. This testing does not necessarily have to be performed at the maximum conditions but at some reduced conditions which would still provide an indication of continued operability. The reduced conditions should be at some point(s) above zero static conditions which could provide suitable evidence that the valve's condition has not deviated from that tested at maximum design basis conditions. It is standard practice to establish a baseline at a predetermined reduced condition which can be recreated in situ and for which the results can provide suitable evidence of the valve's continued operability (i.e., the valve has not degraded from the maximum design basis test condition) via correlation of the reduced condition test results to the maximum design

basis condition test. Thus, the guideline provides for testing at recommended reduced conditions to provide that correlation. The reduced conditions are based on testing during hot standby or hot shutdown modes as recommended by the NRC in Generic Letter 90-06. See Section 3.4.4 for specifics on in situ operability testing.

3.4.3 Out-of-Plant Testing

Testing at the maximum design basis condition cases listed in Table 1 will provide the necessary verification that the valve can perform all safety functions. Testing at those conditions is recommended for out-of-plant testing. The test guideline of section 4.0 provides for such testing.

In addition to testing at the maximum design basis condition cases above, the out-of-plant testing must also make provisions for testing at the reduced conditions which can be reproduced during in situ testing. This provision is incorporated into the out-of-plant test guideline of Section 4.0. The testing at conditions below the maximum design basis is necessary in order to provide the correlation between the recommended in situ test conditions and the design basis test conditions.

3.4.4 In Situ Testing

This test procedure guideline does not provide guidelines for in situ testing. However, it does provide recommended in situ test conditions as a means to establish common test conditions between the out-of-plant and in situ testing. This will preclude any chance of not being able to provide the needed correlation between the two. It is noted that, as a result of review and evaluation of the out-of-plant test results, it may be desirable to change the recommended in situ test conditions in order to improve test correlation.

3.4.4.1 Recommended In Situ Test Conditions

The NRC recommends stroke testing the PORV's during Hot Standby (Mode 3) or Hot Shutdown (Mode 4) prior to entering or establishing conditions where the PORV's are used for Low Temperature Overpressure Protection (LTOP). Likewise, it follows that the PORV Block Valves should be tested prior to entering into the LTOP mode. This is particularly true because testing at this condition would represent a closer simulation of the pressure/differential pressure seen by the valve at the maximum conditions than would testing which is performed at the some lower conditions, such as those present during

Cold Shutdown or Refueling.
Based on Figure 1b of the LTOP study Final Report (dated July 1990) for 20 EFPY, made by CE (refer to letter of O-MPS-90-053 to Mr K. Holthaus dated July 20,1990) and the Telecon of 8/12/91 between P. Adamo (CE) and K. Holthaus (OPPD), LTOP is assumed to start at 1600 psia and 385°F. Therefore, the reduced test conditions will be established slightly above this point at 1600 psia and 400°F. This is the recommended pressure and temperature at which the PORV Block Valve should be tested in situ for establishing correlation point with the test of section 4.0 of this guideline.

A second correlation point will be initially established at zero static conditions. These conditions are easily established during any refueling shutdown. However, this point may be more prone to change because testing at static conditions versus testing at even a small pressure such as 100 psia may prove not to provide representative test results suitable for correlation.

3.4.4.2 Inservice Testing

In addition to the in situ MOV testing above where actuator signatures may

provide for trending and advanced indication of oncoming degradation, inservice testing (IST) of these valves is also performed in accordance with the ASME Code Section XI as required by 10CFR50.55a. This testing also performs a Go/No-Go type operability test but does not provide much indication for detecting oncoming degradation. The advantage here is that this testing is performed frequently (quarterly) where as the MOV diagnostic testing is only performed every several years primarily due to the extent of setup time involved. Thus, operability testing on this smaller scale continues to provide some level of assurance that the valves will perform their intended functions in the time between the MOV in situ testing. The in-service testing shall be, per the ASME Code Section XI and the Generic Letter 89-04, performed to verify all safety functions of the valve. Therefore, the PORV Block Valve shall be tested in both the open and closed directions. Response #2 in OPPD Letter LIC-90-0982 to the NRC, Response to Generic Letter 90-06, "Power-Operated Relief Valve and Block Valve Reliability; Additional Low-Temperature Overpressure Protection for Light-Water Reactors" dated December 19, 1990 indicates the Block Valve is only tested

in the closed direction. Both the overpressure control (automatic or manual) and the Once Through Cooling scenarios require the PORV Block Valve to open if previously closed to isolate the PORV.

As ASME/ANSI Operation and Maintenance (OM) becomes applicable to OPPD (either by reference in ASME Code Section XI or by reference in 10CFR50.55a), OPPD will be required to establish test reference values for the PORV Block Valves obtained at a time taken when the valve is known to be operating acceptably and performed at conditions which can be easily reproduced in situ, so that all future in-service test results can be compared to them. The testing recommended in Section 4.0 verifies the valves' acceptability and establishes the appropriate reference values. The reference values should be the same as the correlation points previously discussed so that when the MOV in situ testing is performed, it will satisfy the inservice testing as well.

3.4.5 Test Approach

The maximum pressure and differential pressure values listed in Table 1 represent the limiting pressure and differential pressure conditions.

These values are associated with the no-flow condition. As a result of dynamic head losses and vena contracta effects, the actual conditions at the valve will vary under flow conditions; however, at the moment of closure the conditions will return to the limiting values. These values always bound the dynamic conditions. To address the difference between, no-flow and flow conditions, this guideline will setup the initial and final conditions and use the dynamic conditions which actually result at the Block Valve. This is a valid approach because the test setup simulates the as-built piping resistances as those found in the plant. Therefore, if the actual pressures and differential pressures at the Block Valve during the various flow test conditions are different than the listed maximum values, it's because they would actually be that way in situ. This is an acceptable condition and no correction of the input source pressure will be warranted to adjust the actual pressures at the valve. In fact, actual pressures immediately upstream and downstream of the Block Valve's disc may even be different than that seen by the pressure instrumentation which is located in the upstream and downstream piping. Placement of pressure measuring equipment inside the valve would significantly increase testing costs, require physical attachment to the valve and may alter the flow condition within the valve thus compromising the simulation. This effect is due to Vena Contracta effects. Although this effect

is probably occurring in our case but may not be directly noticed, it will be detected, if significant, via a change in the required thrust and/or visual observation of accelerated wear/damage.

Although the effects upon the valve thrust requirements caused by the static internal pressure and pressure differential across the disc are fairly predictable and simulated, the dynamic effects of the fluid flow within the valve is less predictable and harder to simulate. The reasons for the latter are the complex phenomena of energy exchange and turbulent flow that occurs within the contorted flow paths within the valve. Flow can also impact the rate of loading of the actuator and the valve's ability to withstand the negative effects of high flow rates. Such effects may be accelerated wear and/or mechanical damage of sliding surfaces, cavitation and other damage which would cause increased valve factors. The reason for performing the tests under flow conditions in lieu of no flow are many and compelling. The goal is to determine where the threshold is for such flow induced concerns if it exists in the range of flows involved.

4.0 **Test Guideline**

4.1 Purpose

This guideline provides a method for verifying the functional capability of the valve and valve actuator as defined in Section 3.2. Also, this guideline provides sufficient detail on required data collection and acquisition for the purpose of test data extrapolation and correlation to the recommended in situ test conditions.

4.2 Test Equipment

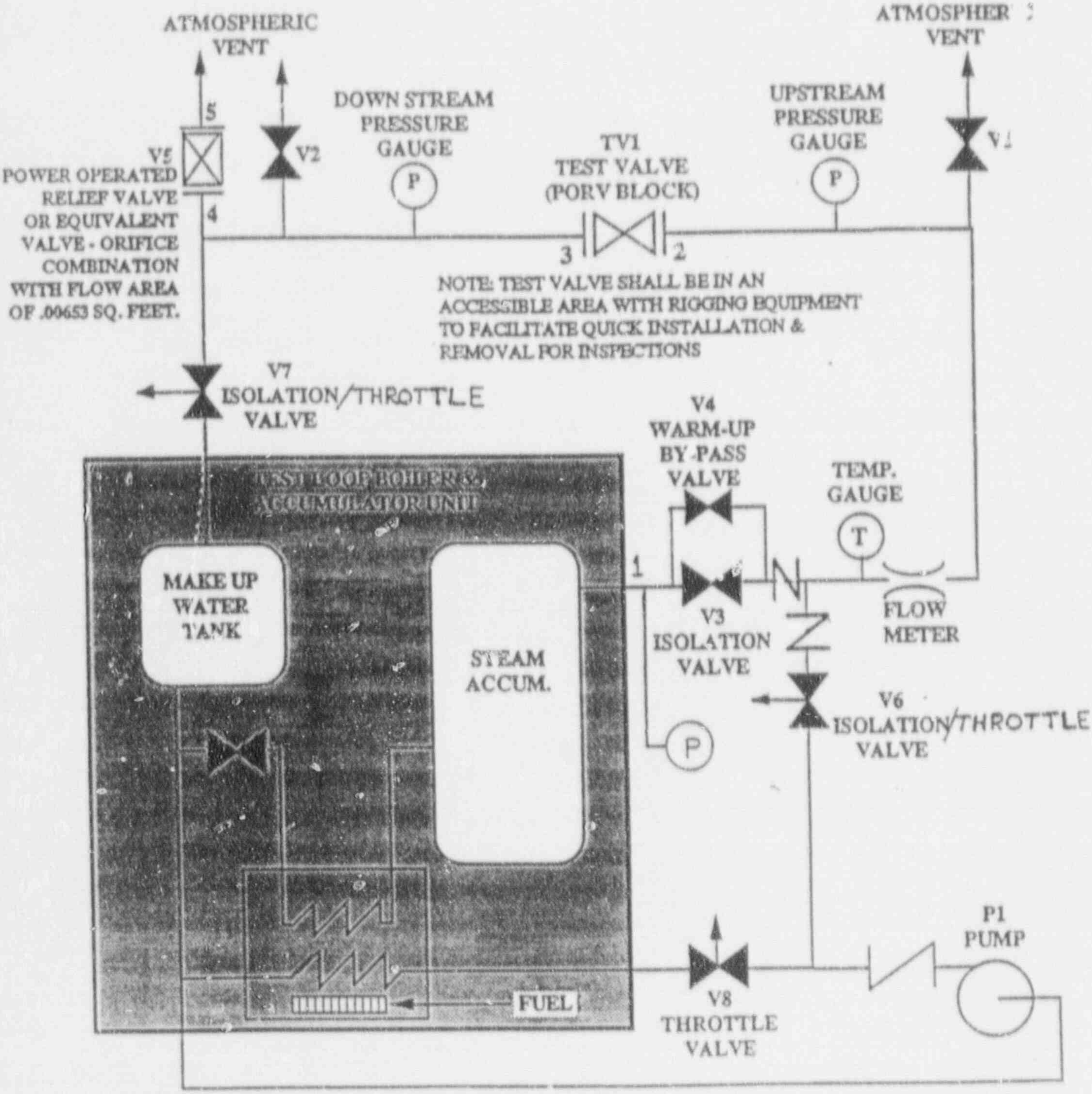
4.2.1 A test loop facility and all required instrumentation necessary to ensure proper operation of the facility. The test loop(s) should be capable of providing 130,000 lb/hr of saturated steam at 668°F and 2500 psia; 160,000 lb/hr of two phase water media at 587°F and 1400 psia, and 368,480 lb/hr of water at 540°F and 1400 psia. The above conditions shall be available continuously for a period of time sufficient to establish steady state conditions and to then perform the open-to-close and/or close-to-open stroke tests specified in this guideline. See Figure 1 for additional detail on arrangement.

FIGURE 1
CONCEPTUAL TEST VALVE ARRANGEMENT

Piping between points 1 and 2 shall have an effective Resistance Coefficient of K = 4.6. The pipe shall be 2 1/2 inch schedule 160 for at least 10 pipe diameters upstream of point 2.

Piping between points 3 and 4 shall be: 2 1/2 inch size, Schedule 160, 2 feet long.

Piping down-stream of point 5 shall be 4 inch size for a minimum length of 5 pipe diameters. Beyond that point, any larger pipe size may be used.



4.2.2 A data acquisition system(s) capable of recording analog or digital time history input for each of the system process and motor operated valve parameters identified below. If multiple systems are used for data acquisition (i.e. a MOV performance and data acquisition and diagnostic test system such as MOVATS, VOTES, etc. is used to collect some or all of the MOV related data and another system is used to collect the remaining information), all inputs shall be referenceable to a common point in time. The data acquisition system(s) shall provide for data point collection, storage, manipulation and real time display of each measured parameter at the sampling frequencies indicated below. The real time display outputs may be via LCD/CRT screen or multichannel chart recorder plots. The data acquisition system(s) shall also support data download to an IBM PC based syste format.

4.2.2.1 Pressure shall be monitored for both the upstream and downstream conditions using pressure transducers connected at pressure taps as close to the test valve as practical. The pressure transducers shall have a response time of 50 milliseconds or less. The acquisition system shall have a sampling rate consistent with or greater than the transducers' response time. The transducer accuracy shall be 0.5% or better. If the transducers are used to

provide for pressure indication in lieu of gauges, the overall instrument loop accuracy shall be 1% or better.

4.2.2.2 The process fluid temperature shall be monitored upstream of the test valve using a thermocouple or RTD with a response time less than or equal to 100 milliseconds and accurate to within ±2°F. The sampling rate shall be consistent with or greater than the measuring devices response time. If the RTD or thermocouple is used to provide temperature indication, the overall instrument loop accuracy shall be 2% or better.

4.2.2.3 The process fluid flow shall be monitored upstream of the test valve using an orifice, venturi or clamp on ultrasonic flow meter with a response time less than or equal to 100 milliseconds and accurate to within 2% of full scale. The sampling rate shall be consistent with or greater than the measuring device's response time. If this flow meter is used to provide flow indication, the overall loop accuracy shall be within 3% of full scale.

4.2.2.4 The actuator motor voltage and current shall be monitored using appropriate voltage and current measuring devices

which have response times of 1 millisecond or less and are accurate to within 1% of scale. The sampling rate shall be consistent with or greater than the measuring device's response time.

4.2.2.5 The test valve stem torque and thrust shall be monitored at the valve stem using standard strain gauge technology. The total torque or thrust measurement system accuracy shall be 5% or better. The strain gauge sampling rate shall be 1 millisecond or less.

4.2.2.6 The test valve's actuator spring pack linear displacement shall be monitored using a LVDT installed on the spring pack assembly. Displacement shall be measured with respect to the preload position. The accuracy of measurement shall be within 0.5% of actual displacement. The sampling rate shall be 1 millisecond or less.

4.2...7 The test valve's stem position shall be monitored using a LVDT (or equivalent) installed on the valve's stem and yoke to obtain a 2% accuracy or better. The LVDT's response time shall be 100 milliseconds or less. The sampling rate shall be consistent with or greater than the response time.

4.2.2.8 The motor control switch actuation contact, the torque switch contacts and any limit switch contacts which provide a control function shall be monitored for state or condition using any excepted method (such as monitoring voltage across contacts or condition of auxiliary contacts). The sampling rate shall be 1 millisecond or less.

4.2.3 Pressure gauges, upstream and downstream, shall be installed at pressure taps as close as practical to the test valve. The pressure gauges' range shall be such that the test pressure value of concern is greater than 25% of scale but does not exceed 75% of range. The accuracy shall be $\pm$0.25%. If the pressure transducers used for data acquisition provide indication with total loop accuracy of 1% or better, then the pressure gauges are not required.

4.2.4 Temperature measuring thermocouple or RTD and indication installed upstream of the test valve with a loop accuracy of 2°F or better. This may be the same measuring device as that used for input to the data acquisition system input temperature measurement.

4.2.5 Flow meter installed upstream of the test valve with an accuracy of 2% of full scale or better. This may be the same flow meter as that used for input to the data acquisition system input flow measurement.

4.2.6 Various dial indicators, measuring calipers, micrometers, etc. as needed to make dimensional measurements specified in this guideline are required. They shall be capable of providing measurements to the nearest 0.001 inch with an accuracy of ±0.001 inch.

4.3 Test Prerequisites

4.3.1 The test valve has been completely inspected (internally and externally) and dimensioned per EPRI recommended practices. The results shall be recorded per Appendices A and B.

4.3.2 The test valve is properly assembled, maintained, lubricated, and setup as it would be for normal plant operation.

4.3.3 All instrumentation/equipment is calibrated.

4.3.4 The test instrumentation of Section 4.2 and the test loop monitoring equipment are installed on the test valve and test loop as necessary.

4.3.5 The test loop is operable at the desired pressure and temperature with the test valve installed.

4.4 Test Procedural Guidelines

The PORV Block Valve will be initially tested at static conditions and then the internal pressure, differential pressure, process fluid flow and temperature parameters will be independently and incrementally increased to the maximum design basis conditions. All specified parameters shall be monitored throughout the testing. The Test Engineer shall modify the testing, inspections and dimensioning detailed herein as appropriate to address any observed trends in the test results. These observed trends may be, but are not limited to:

1) An increase in required stem thrust beyond that estimated with accepted industry equations or that extrapolated from earlier test results.

2) An increase in seat leakage.

3) A deviation from the expected motor current signature or RMS motor current during the valve's stroke.

4) A change in valve stroke time.

The test results from each test shall be reviewed and evaluated before proceeding to the next test. If any results deviate from that expected, the Test Engineer

shall determine the cause and perform, as necessary, inspection and dimensional verifications as detailed in Appendices A and B.

Refer to Figure 1 for a schematic diagram of the test set-up and the identity and function of the various valves, pump and other equipment referred to throughout this test guideline. The following tests of 4.4.1, 4.4.2, 4.4.3, 4.4.4 and 4.4.5 shall be performed in order.

4.4.1 Static Test

4.4.1.1 Ensure that all the prerequisites are met.

4.4.1.2 Ensure that upstream and downstream pressure are at atmospheric conditions by checking closed the upstream isolation valve V3 and warmup bypass valve V4 and opening Vent Valves V1 and V2. Record the pressures.

4.4.1.3 Start the Data Acquisition System.

4.4.1.4 Open TV1, allow TV1 to fully open, then close TV1.

4.4.1.5 Stop the Data Acquisition System.

4.4.1.6 Examine the data recordings to ensure that all desired readings have been collected successfully and that the test

results have not deviated from that predicted by the industry equations. If required thrust is significantly different than that predicted, secure the testing and perform the inspection/dimensioning detailed in Appendices A and B. Document any conclusions/justifications for observed conditions.

4.4.1.7 Repeat Steps 4.4.1.3 through 4.4.1.6 for repeat test.

4.4.1.8 Close V1 & V2.Ensure V5 & V7 are closed.

4.4.1.9 Open V6 and V8.

4.4.1.10 Open TV1 valve.

4.4.1.11 Establish Pump P1 water flow on recirculation through Throttle Valve V8 at 15 psia and room temperature. Record upstream pressure.

4.4.1.12 Close TV1 valve.

4.4.1.13 Establish Pump P1 flow on recirculating through throttle valve V8 at 485 psia and room temperature. Record upstream pressure.

4.4.1.14 Ensure downstream pressure is still at 15 psia. Record the pressure.

4.4.1.15 Start t· data acquisition system.

4.4.1.16 Open TV1, .llow TV1 to fully open, then close TV1.

4.4.1.17 Stop the data acquisition system.

4.4.1.18 Examine the data recordings to ensure that all desired readings have been collected successfully and that the test results have not deviated from that predicted by the industry equations. If required thrust is significantly different than that predicted, secure the testing and perform the inspection/dimensioning detailed in Appendices A and B. Document any conclusions/justifications for t.e observed conditions.

4.4.1.19 Vent off downstream pressure by opening V2 until the pressure downstream of TV1 reaches 15 psia, then close V2.

4.4.1.20 Repeat Steps 4.4.1.14 through 4.4.1.19 for repeat test.

4.4.1.21 Repeat Steps 4.4.1.14 through 4.4.1.20 for 1200 psia and 1400 psia pressures upstream with 15 psia downstream pressures.

4.4.1.22 Repeat Steps 4.4.1.10 through 4.4.1.21 at water temperature of 540°F. Document any observable effects as a result of elevated temperature. If there are any significant changes, repeat the testing at room temperature to determine if the effect is reversible.

4.4.1.23 Stop Pump P1, close V6 and V8.

4.4.1.24 Adjust steam accumulator pressure to 500 psia. The accumulator should be at the saturation temperature for 500 psia.

4.4.1.25 Open warmup bypass valve V4. Record upstream pressure.

4.4.1.26 Repeat Steps 4.4.1.14 through 4.4.1.20.

4.4.1.27 Repeat Steps 4.4.1.24 through 4.4.1.26 for 1000 psia, 1500 psia, 2000 psia, 2376 psia, 2500 psia upstream pressures and 15 psia (in all cases) downstream pressure.

4.4.1.28 Close V4. Open V1 and V2 to ensure atmospheric pressure upstream and downstream of the test valve. Close V1 and V2.

4.4.1.29 Repeat Steps 4.4.1.2 through 4.4.1.7 to confirm static condition baseline.

4.4.1.30 The above testing completes the recommended static and no flow differential pressure testing portion of this guideline. To verify the extent of valve degradation, if any, visually inspect and dimension the Test Valve per Appendices A and B. Compare the results from this round of inspection and dimensioning to the baseline inspection and dimensioning results performed prior to the start of the static testing. Provide documented justification and evaluation of any observed differences and provide correlation to that predicted by the accepted industry equations. Specifically, an increase in required thrust beyond that predicted by industry equation or extrapolation of previous test data should have a corresponding degradation observed in the valve. Such degradation may be a change in metal-to-metal sliding contact surface areas and finish (resulting in increased coefficient of friction), a change in internal tolerances, a deformation or erosion of disc guides, flow induced tilting of the disc resulting in premature disc-to-seat contact or single point contact, etc. The goal is to determine the operating condition threshold where any of these mechanisms begin to impact the valve's performance or operability.

4.4.2 Water Flow Test

4.4.2.1 Ensure that all prerequisites are met.

4.4.2.2 For the flow test with water at ambient temperature, establish Pump P1 water flow on recirculation to stabilize water temperature at 82°F and a discharge pressure of 485 psia.

4.4.2.3 Open Test Valve TV1, Valve V7 and slowly open Valve V6 to establish flow through Test Valve TV1 at 50,000 lbm/hr, 82°F and upstream pressure of 485 psia. Throttle Valve V7 and Valve V8 as necessary to stabilize at these conditions.

4.4.2.4 Stop Pump P1. Allow flow to decay to 0.

4.4.2.5 Close Test Valve TV1.

4.4.2.6 Open, then close vent valve V2 to vent downstream to atmospheric pressure. Record the pressure.

4.4.2.7 Start Pump P1. Record the upstream pressure. If pressure at this time is significantly above 485 psia, record the position of V8 by counting the number of turns in the open direction which are required to obtain an upstream pressure of 485 psia. Record the number of turns.

4.4.2.8 Start the Data Acquisition System.

4.4.2.9 Open Test Valve TV1. Immediately close V8 the number of turns recorded in step 4.4.2.7 to maintain the upstream pressure at 485 psia.

4.4.2.10 Stop the Data Acquisition System.

4.4.2.11 Review the test results to determine if actual thrust is consistent with that predicted. If it is not, determine the reason by performing inspection and dimensioning per Appendices A and B. Document the results.

4.4.2.12 Repeat Steps 4.4.2.4 through 4.4.2.11 for a repeat test. Evaluate test results for repeatability and any evidence of degradation from repeated valve strokes at these conditions.

4.4.2.13 Start the Data Acquisition System.

4.4.2.14 Close Test Valve TV1 and then open V8 the number of turns recorded in 4.4.2.7.

4.4.2.15 Stop the Data Acquisition System.

4.4.2.16 Review the test results to determine if actual thrust is consistent with that predicted. If it is not, determine the

reason by performing inspection and dimensioning per Appendices A and B. Document the results.

4.4.2.17 Open Test Valve TV1. Close V8 the number of turns recorded in Step 4.4.2.7.

4.4.2.18 Repeat Steps 4.4.2.13 through 4.4.2.16 for a repeat test. Evaluate test results for repeatability and any evidence of degradation from repeated valve strokes at these conditions.

4.4.2.19 Repeat Steps 4.4.2.3 through 4.4.2.18 for flow at 100,000 lbm/hr, 160,000 lbm/hr and 225,000 lbm/hr.

4.4.2.20 Secure Pump P1.

4.4.2.21 Close valves V6, V7, V8.

4.4.2.22 This completes the water flow test at ambient temperature. To verify the extent of valve functional degradation, if any, compare the water flow test results with those of the static testing. Provide documented justification and evaluation of any observed differences and provide correlation to that predicted by accepted industry equations. Specifically, an increase in required

thrust beyond that predicted by industry equation or extrapolation of previous test data should have a corresponding degradation observed in the valve. This shall determine if the operating condition threshold is being approaching or has been exceeded.

4.4.2.23 Ensure that all prerequisites are met.

4.4.2.24 For the flow test with water at high temperature, establish Pump P1 water flow on recirculation to stabilize water temperature at 540°F and a discharge pressure of 1200 psia.

4.4.2.25 Repeat Steps 4.4.2.3 through 4.4.2.18 for an initial flow rate of 50,000 lbs/hr at 540°F and upstream pressure of 1200 psia.

4.4.2.26 Repeat Steps 4.4.2.3 through 4.4.2.18 for flow rates of 100,000 lbs/hr, 150,000 lbs/hr, and 180,000 lbs/hr.

4.4.2.27 Secure Pump P1.

4.4.2.28 Close valves V6, V7, V8.

4.4.2.29 This completes the first hot water flow test. To verify the extent of valve degradation, if any, compare the test results of this test with those of the

static testing and water flow test at ambient temperature. Provide documented justification and evaluation of any observed differences and provide correlation to that predicted by accepted industry equations. Specifically, an increase in required thrust beyond that predicted by industry equation or extrapolation of previous test data should have a corresponding degradation observed in the valve. This shall determine if the operating condition threshold is being approached or has been exceeded.

4.4.2.30 Ensure that all prerequisites are met.

4.4.2.31 For the flow test with water at high temperature, establish Pump P1 water flow on recirculation to stabilize water temperature at 540°F and a discharge pressure of 1400 psia.

4.4.2.32 Repeat Steps 4.4.2.3 through 4.4.2.18 for an initial flow rate of 50,000 lbs/hr at 540°F and upstream pressure of 1400 psia.

4.4.2.33 Repeat Steps 4.4.2.3 through 4.4.2.18 for flow rates of 200,000 lbs/hr, 300,000 lbs/hr, and 368,480 lbs/hr.

4.4.2.34 Secure Pump P1.

4.4.2.35 Close valves V6, V7, V8.

4.4.2.36 This completes the last hot water flow test. To verify the extent of valve degradation, if any, compare the test results of this test with those of the static testing and water flow test at ambient temperature from the first hot water flow test. Visually inspect and dimension the test valve per Appendices A and B. Compare the results with those of the inspection and dimensioning performed following static testing. Provide documented justification and evaluation of any observed differences and provide correlation to that predicted by accepted industry equations. Specifically, an increase in required thrust beyond that predicted by industry equation or extrapolation of previous test data should have a corresponding degradation observed in the valve. This shall determine if the operating condition threshold is being approached or has been exceeded.

4.4.3 Steam Flow Test

4.4.3.1 Ensure that all the prerequisites are met.

4.4.3.2 Establish the accumulator full of saturated steam at 500 psia.

4.4.3.3 Open Test Valve TV1 and Valve V5.

4.4.3.4 Slowly throttle open warmup bypass valve V4 to warmup the downstream piping and test valve. Allow this small steam flow to flow until all piping appears to be warm, close Valve V4.

4.4.3.5 Close Test Valve TV1.

4.4.3.6 Slowly open Valve V4 to allow upstream pressure to stabilize at the accumulator pressure, then open Valve V3.

4.4.3.7 Close Valve V4.

4.4.3.8 Record upstream pressure. The downstream pressure should be at atmospheric level. Record the downstream pressure.

4.4.3.9 Start the data acquisition system.

4.4.3.10 Open Test Valve TV1. The flow and temperature will stabilize as TV1 fully opens.

4.4.3.11 Record temperature, flow, upstream pressure and downstream pressure.

4.4.3.12 Stop the data acquisition system.

4.4.3.13 Close Valve V5.

4.4.3.14 Examine the data recordings to ensure that all desired reading have been collected successfully and that the test results have not deviated from that predicted by the industry equations or extrapolation of test data. If required thrust is significantly different than that predicted, secure the testing and perform the inspection/dimensioning detailed in Appendices A and B. Document any conclusions/justifications for the observed conditions.

4.4.3.15 Close Test Valve TV1.

4.4.3.16 Open Valve V5.

4.4.3.17 Repeat Steps 4.4.3.8 through 4.4.3.14 for a repeat test. Evaluate test results for repeatability and any evidence of degradation from repeated valve strokes at these conditions.

4.4.3.18 Open Valve V5.

4.4.3.19 When flow and temperature stabilize, record flow, temperature, upstream pressure and downstream pressure.

4.4.3.20 Start the data acquisition system.

4.4.3.21 Close Test Valve TV1.

4.4.3.22 Stop the data acquisition system.

4.4.3.23 Close Valve V5.

4.4.3.24 Examine the data recordings to ensure that all desired readings have been collected successfully and that the test results have not deviated from that predicted by the industry equations or extrapolation of test data. If required thrust is significantly different than that predicted, secure the testing and perform the inspection/dimensioning detailed in Appendices A and B. Document any conclusions/justifications for the observed conditions.

4.4.3.25 Open Test Valve TV1.

4.4.3.26 Repeat Steps 4.4.3.18 through 4.4.3.24 for a repeat test. Evaluate test results for repeatability and any evidence of degradation from repeated valve strokes at these conditions.

4.4.3.27 Close Valve V3.

4.4.3.28 Repeat Steps 4.4.3.2 through 4.4.3.27 for steam accumulator pressures of 1000 psia, 1500 psia, 2000 psia, 2376 psia, 2500 psia.

4.4.3.29 This completes the saturated steam flow

test. To verify the extent of valve degradation, if any, visually inspect and dimension the test valve per Appendices A and B. Compare the results with those of the inspection and dimensioning performed following the static testing. Provide documented justification and evaluation of any observed differences and provide correlation to that predicted by accepted industry equations. Specifically, an increase in required thrust beyond that predicted by industry equation or extrapolation of previous test data should have a corresponding degradation observed in the valve. This shall determine if the operating condition threshold is being approached or has been exceeded.

4.4.4 Two Phase Flow Test

4.4.4.1 Ensure that the prerequisites are met.

4.4.4.2 Establish the steam accumulator full of saturated steam at 500 psia and place Pump P1 on recirc at, or slightly greater than, 500 psia by opening Valve V8 and starting Pump P1.

4.4.4.3 Open Test Valve TV1 and Valve V5.

4.4.4.4 Slowly throttle open warmup bypass valve

V4 to warmup the downstream piping and test valve. Allow this small steam flow to flow until all piping appears to be warm, close Valve V4.

4.4.4.5 Close Test Valve TV1.

4.4.4.6 Slowly open Valve V4 to allow upstream pressure to stabilize at the accumulator pressure, then open Valve V3.

4.4.4.7 Close Valve V4.

4.4.4.8 Open Valve V6.

4.4.4.9 Record upstream pressure and downstream pressure. The downstream pressure should be at atmospheric level.

4.4.4.10 Start the data acquisition system.

4.4.4.11 Open Test Valve TV1. The flow and temperature will stabilize (to the extent possible under these conditions) as TV1 fully opens.

4.4.4.12 Record temperature, flow, upstream pressure and downstream pressure.

4.4.4.13 Stop the data acquisition system.

4.4.4.14 Close Valve V5.

4.4.4.15 Examine the data recording. Ensure that all test results have been collected successfully and have not deviated from that predicted by industry equation and previous test data. If required thrust is significantly different than that predicted, secure the testing and perform the inspection/dimensioning detailed in Appendices A and B. Document any conclusions/justifications for the observed conditions.

4.4.4.16 Close Test Valve TV1.

4.4.4.17 Open Valve V5.

4.4.4.18 Repeat Steps 4.4.4.9 through 4.4.4.15 for a repeat test. Evaluate test results for repeatability and any evidence of degradation from repeated valve strokes at these conditions.

4.4.4.19 Open Valve V5.

4.4.4.20 When flow and temperature stabilize, record flow temperature, upstream pressure and downstream pressure.

4.4.4.21 Start the data acquisition system.

4.4.4.22 Close Test Valve TV1.

4.4.4.23 Stop the data acquisition system.

4.4.4.24 Close Valve V5.

4.4.4.25 Examine the data recordings to ensure that all desired recordings have been collected successfully and that the test results have not deviated from that predicted by the industry equations or extrapolation of test data. If the required thrust is significantly different than that predicted, secure the testing and perform the inspection/dimensioning detailed in Appendices A and B. Document any conclusions/justifications for the observed conditions.

4.4.4.26 Open Test Valve TV1.

4.4.4.27 Repeat Steps 4.4.4.19 through 4.4.4.25 for a repeat test. Evaluate test results for repeatability and any evidence of degradation from repeated valve strokes at these conditions.

4.4.4.28 Close Valve V3 and Valve V6.

4.4.4.29 Repeat Steps 4.4.4.2 through 4.4.4.28 for two phase flow at 1000 psia, 1400 psia accumulator pressures with Pump P1 discharge pressure at 1000 psia, 1400 psia respectively.

4.4.4.30 Stop Pump P1.

4.4.4.31 Close or check close Valves V3, V4, V5, V6, V7, V8.

4.4.4.32 This completes the Two Phase Flow Test. To verify the extent of valve degradation, if any, visually inspect and dimension the Test Valve per Appendices A and B. Compare the result from this round of inspection and dimensioning to the baseline, inspection and dimensioning performed following the static testing. Provide documented justification and evaluation of any observed differences and provide correlation to that predicted by accepted industry equations. Specifically, an increase in required thrust beyond that predicted by industry equation or extrapolation of previous test data should have a corresponding degradation observed in the valve. This shall determine if the operating condition threshold is being approached or has been exceeded.

4.4.5 Results Evaluation

4.4.5.1 The Test Engineer shall evaluate all test results to determine if any of the tests must be repeated. If no test need to be repeated, prepare a summary report of all testing results, any conclusions, justifications or failures. This shall

include a discussion of extrapolation of data to the line break condition. This shall also include a discussion on correlation to in situ testing and any extrapolation of the in situ test results to verify operability at design basis conditions.

APPENDIX A

FORMS AND FIGURES FOR MEASURING GATE VALVE INTERNAL DIMENSIONS AND PERFORMING INTERNAL INSPECTIONS

EXTRACTED FROM EPRI'S
IN SITU TEST GUIDE FOR
MOTOR OPERATED VALVES
APPENDIX L
PAGES L1 THROUGH L17

RESEARCH PROJECT 3433-03
REV. 01, OCTOBER 1990

MPR ASSOCIATES
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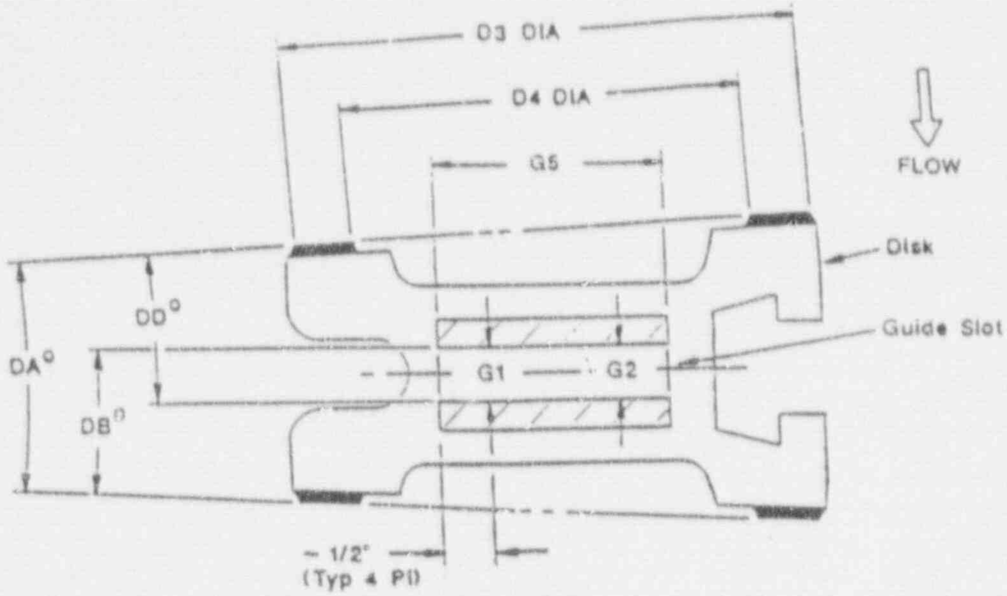
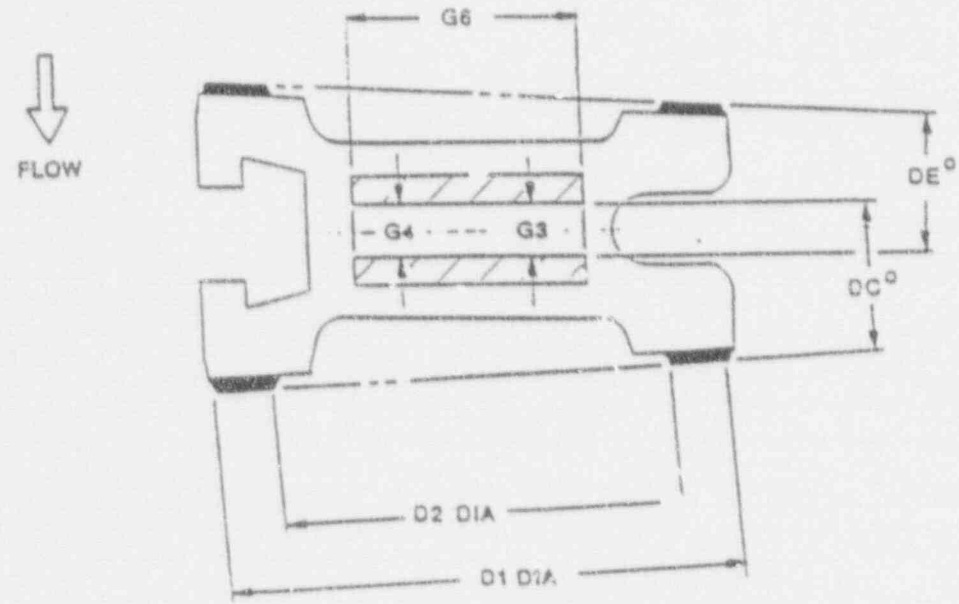
[illegible]



MEASURED DIMENSIONS

D3 DIA	D4 DIA	G1	G2	G5	DA°	DB°	DD°

See Notes on Sheet 2



Plant Name: ____

Valve I.D. Number: ____

Preparer: ____

MEASURED DIMENSIONS

D1 DIA	D2 DIA	G3	G4	G6	DC°	DE°

See Notes on Sheet 2

VALVE DISK MEASUREMENTS

FIGURE 1

SHEET 1

L-1

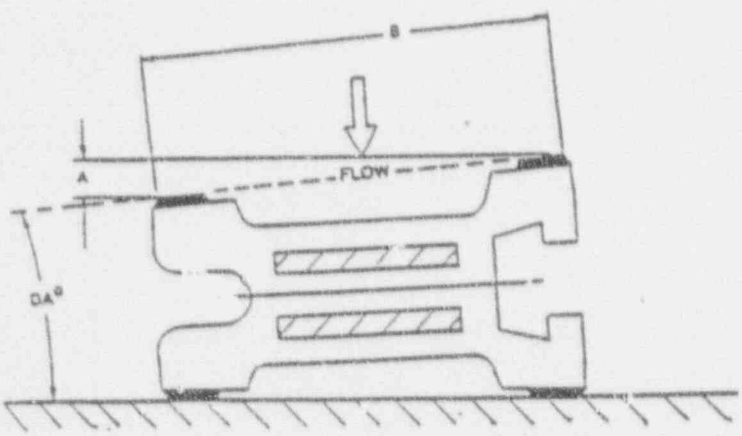
MPR ASSOCIATES
F-140-48-14
1/6/90

Notes:

1. If disk seats are solid circles (rather than rings as shown), then dimensions D2 and D4 are inapplicable (mark NA).

2. Measure dimensions G1, G2, G3, G4, D1, D2, D3 and D4 using dial calipers. Measure diameters to edge of polished seat surface.

3. Measure angles DA, DB, DC, DD and DE by placing disk on surface plate and using a universal bevel protractor (with optical magnifier). If a bevel protractor of sufficient accuracy (0.1°) is not available or cannot be adapted to this measurement, an alternative approach to measuring the above angles can be used. One such approach is to measure the "rise" and "run" dimensions of the desired surface relative to the plate. For example:



$DA^{\circ} = \arcsin(A/B)$

4. G5 and G6 measured per Figure 4.

VALVE DISK MEASUREMENTS

FIGURE 1

SHEET 2

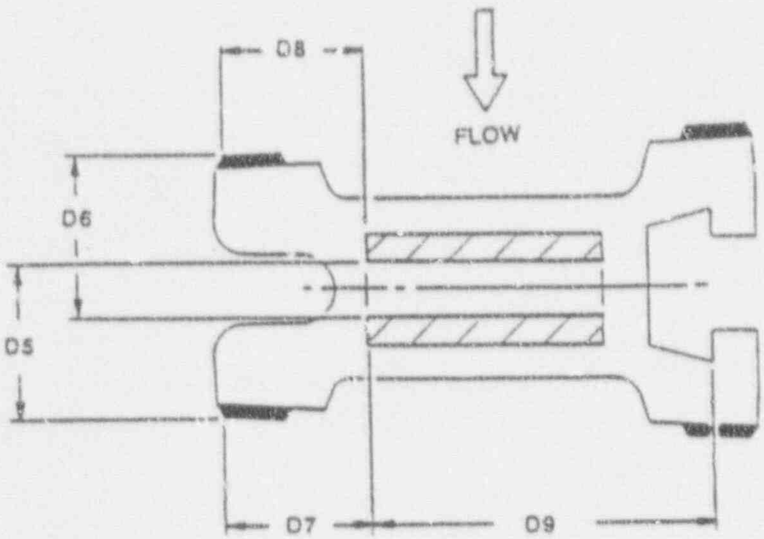
L-2

MPR ASSOCIATES
[illegible]
[illegible]

Plant Name: ______________________

Valve I.D. Number: ______________________

Preparer: ______________________



MEASURED DIMENSIONS

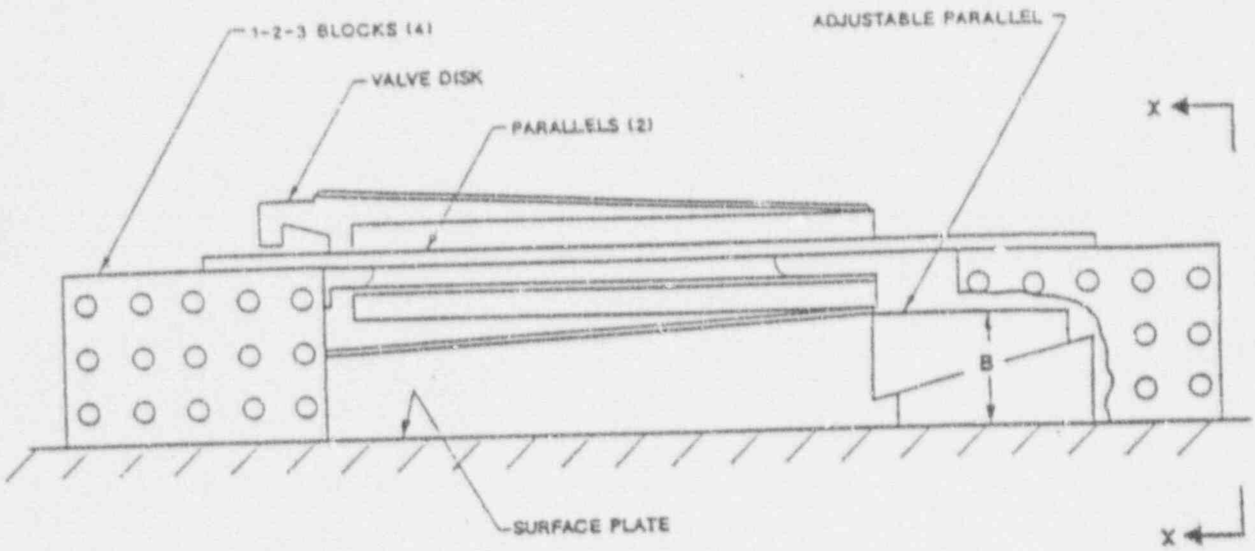
D5	D6	D7	D8	D9

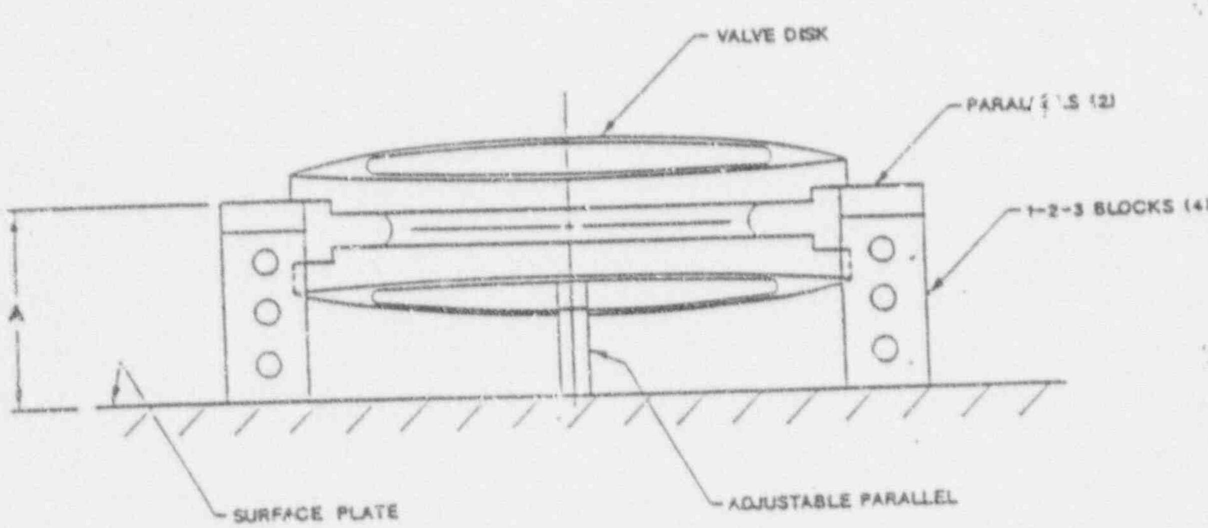
NOTES:
1. D5 and D6 Measured Per Figure 3
2. D7 , D8 and D9 Measured Per Figure 4

VALVE DISK SEAT-TO-GUIDE MEASUREMENTS
FIGURE 2

L-3

MPR ASSOCIATES





VIEW X-X

NOTE: FOR MEASUREMENT PROCEDURE, SEE SHEET 2.

APPROACH FOR MEASURING DISK DIMENSIONS
D5 AND D6

FIGURE 3

SHEET 1

MPR ASSOCIATES
F-140-48-46
8/24/88

Plant Name:	
Valve I.D. Number:	
Preparer:	

Procedure and Worksheet for Obtaining Disk Dimensions D5 and D6 (Figure 3, Sheet 1

1. Working on surface plate, set up valve disk so that each guide surface rests on a parallel supported by two 1-2-3 blocks. Ensure that guide surfaces resting on parallels are smooth and free from damage. Shift disk on parallels as needed to ensure that the disk is supported on clean guide surfaces. Also, ensure parallels do not bend more than 0.001" due to disk weight. (Verify using feeler gage). Use thicker parallels or move 1-2-3 blocks closer to disk as needed to minimize bending.

2. Record dimension A (nominal combined height of 1-2-3 block and parallel) below. It is not necessary to measure this dimension; use the nominal dimensions of 1-2-3 block and parallel.

3. Set an adjustable parallel at such a dimension so that it just spans the height from the table to the bottom edge of the disk seating surface (as shown). Measure dimension B (height of adjusted parallel) using a micrometer to the nearest 0.001", and record below.

4. An acceptable alternative to measuring dimension B is to use a machinist's height gage to determine the height of the lower edge of the disk seating surface above the surface plate.

5. The desired dimension (D5 or D6) is computed on the worksheet below as A minus B.

6. Dimension D5 is obtained when steps 1 through 5 are performed with the downstream face of the disk facing downward. Dimension D6 is obtained when Steps 1 through 5 are performed with the downstream face of the disk facing upward.

7. Enter results for D5 and D6 on Figure 2.

Worksheet	
Downstream Face Downward	Downstream Face Upward
A = ________ in.	A = ________ in.
B = ________ in.	B = ________ in.
D5 = A - B = ________ in.	D6 = A - B = ________ in.

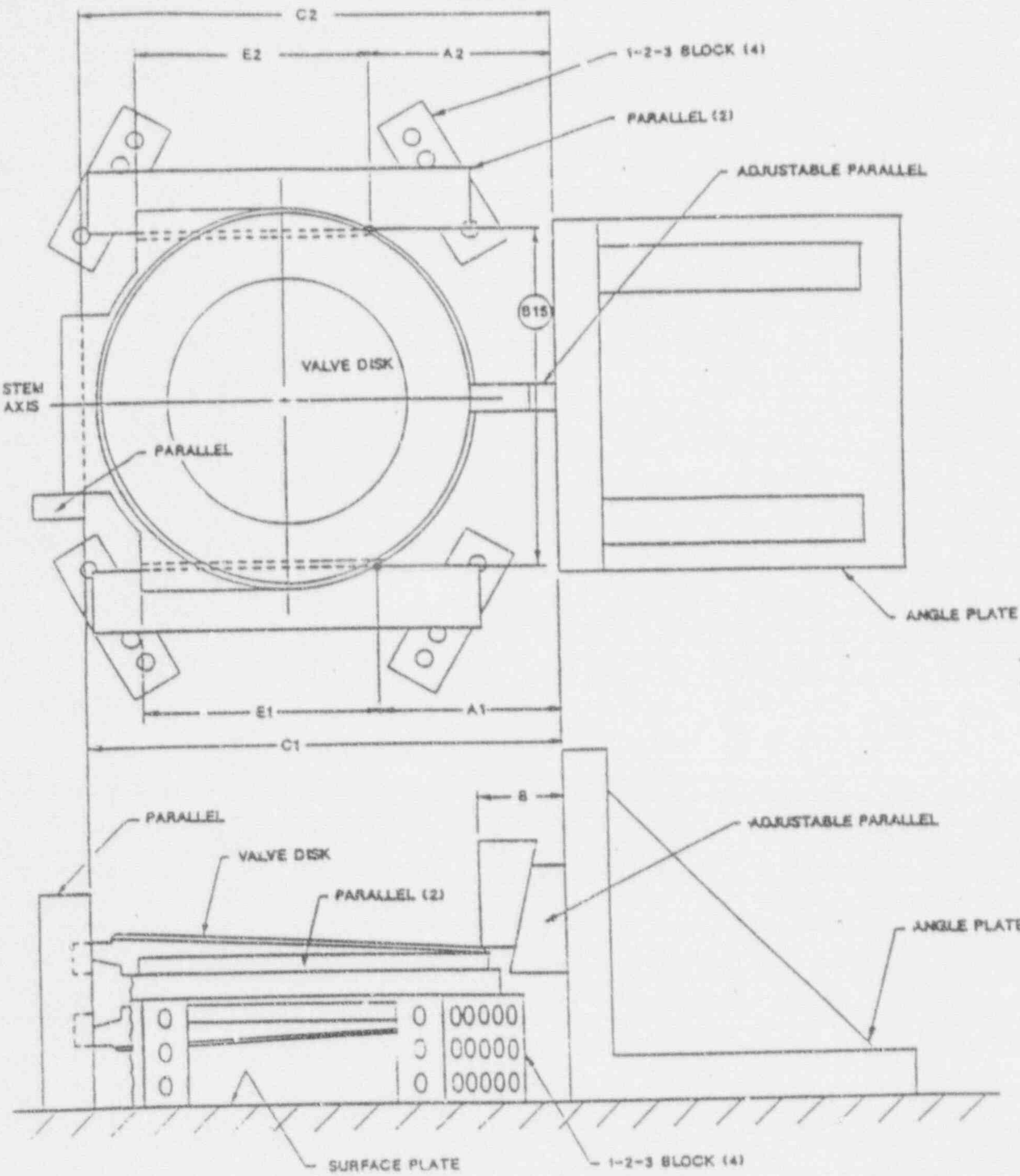
APPROACH FOR MEASURING DISK DIMENSIONS D5 AND D6

FIGURE 3

SHEET 2

L-5

MPR ASSOCIATES
F-140-40-47
8/24/90



NOTE: FOR MEASUREMENT PROCEDURE, SEE SHEET 2.

APPROACH FOR MEASURING DISK DIMENSIONS
D7, D8, D9, G5 AND G6

FIGURE 4

SHEET 1

L-6

MPR ASSOCIATES
F-[illegible]
[illegible]

Plant Name:	______________
Valve I.D. Number:	______________
Preparer:	______________

Procedure and Worksheet for Obtaining Disk Dimensions D7, D8, D9, G5 and G6 (Figure 4, Sheet 1)

1. Working on surface plate, set up valve disk so each guide surface rests on a parallel supported by two 1-2-3 blocks. The two parallels should be parallel, with their facing edges a distance "B15" apart, where B15 is measured from the valve body (Figure 9, Sheet 1). Verify the dimension between parallels is equal to B15 at each end (using dial calipers) within ± 0.001". Align stem axis of disk with parallels and center disk between parallels (by eye).

2. Set up angle plate near valve disk so that vertical surface is perpendicular to parallels. If parallels are long enough, they can be butted squarely against angle plate; otherwise, use an "L"-square to set up.

3. Set an adjustable parallel at such a dimension that it just spans the distance from the angle plate to the edge of the seating surface (as shown). Measure dimension B (span of adjusted parallel) using a micrometer to the nearest 0.001" and record below.

4. Obtain dimensions A1 and A2 using calipers to gage the dimension and dial calipers to measure the gaged dimension (to the nearest 0.001"), and record below.

5. Measure dimensions E1 and E2 using dial calipers (to the nearest 0.001"), and record below.

6. Measure dimensions C1 and C2 by setting a parallel on the surface plate and aligning it with the T-slot upper inside surface (by hand). Measure C1 and C2 using a machinist's scale on the surface plate (to the nearest 0.01"), and record below.

7. All dimensions should be obtained with the downstream face up and with the downstream face down. The desired dimensions are calculated as shown on the worksheet below.

8. Enter results for D7, D8 and D9 on Figure 2. Enter results for G5 and G6 on Figure 1, Sheet 1.

Worksheet

B15 = __________ in. (Fig. 9, Sheet 1)

Downstream Face Down	Downstream Face Up
A1 = __________ in.	A1 = __________ in.
A2 = __________ in.	A2 = __________ in.
B = __________ in.	B = __________ in.
C1 = __________ in.	C1 = __________ in.
C2 = __________ in.	C2 = __________ in.
E1d = __________ in.	E1u = __________ in.
E2d = __________ in.	E2u = __________ in.
D8 = 1/2(A1 + A2) - B = __________ in.	D7 = 1/2(A1 + A2) - B = __________ in.
D9d = 1/2(C1 + C2) - 1/2(A1 + A2) = _____ in.	D9u = 1/2(C1 + C2) - 1/2(A1 + A2) = _____ in.

G5 = 1/2(E2d + E1u) = __________ in.

G6 = 1/2(E1d + E2u) = __________ in.

D9 = 1/2(D9d + D9u) = __________ in.

APPROACH FOR MEASURING DISK DIMENSIONS
D7, D8, D9, G5 AND G6

FIGURE 4

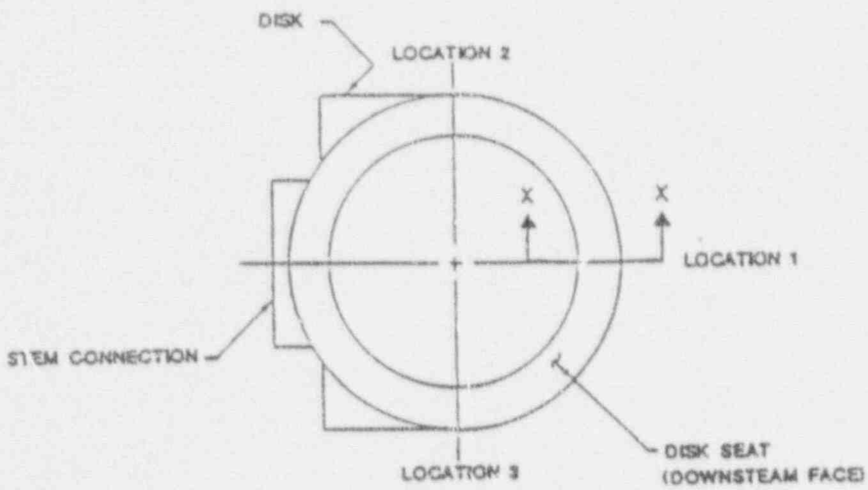
SHEET 2

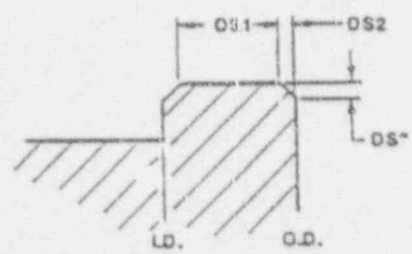
L-7

Plant Name: ______________________

Valve I.D. Number: ______________________

Preparer: ______________________





TYPICAL SECTION X–X
DOWNSTREAM SEAT

MEASURED DIMENSIONS

	DS1	DS2	DS3
LOCATION 1			
LOCATION 2			
LOCATION 3			

NOTES: 1. IF DISK SEAT IS SOLID CIRCLE (RATHER THAN RING AS SHOWN) - THEN DIMENSION DS1 IS INAPPLICABLE (MARK NA)

2. DIMENSIONS CAN BE OBTAINED BY DIRECT MEASUREMENT ON THE DISK OR ON IMPRESSION MOLDS OF THE DISK SEAT. USE DIAL CALIPERS FOR DS1. USE MACHINIST SCALE FOR DS2 AND DS3. CITRICON (MANUFACTURED BY KERR) IS AN ACCEPTABLE MOLDING COMPOUND FOR USE IN THIS PROCEDURE.

DISK SEAT MEASUREMENTS

FIGURE 5

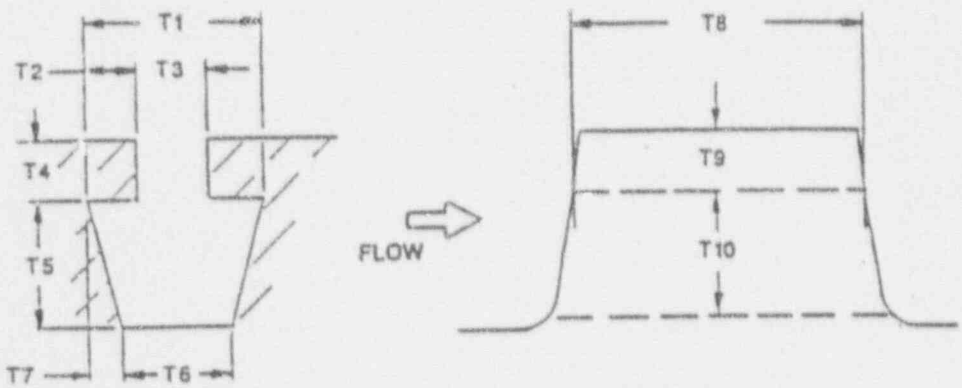
L-6

MPR ASSOCIATES
[illegible]
[illegible]

Plant Name: ____________________

Valve I.D. Number: ____________________

Preparer: ____________________



Flow Perpendicular to T-Slot OR Flow Parallel to T-Slot

MEASURED DIMENSIONS

T1	T2	T3	T4	T5	T6	T7

MEASURED DIMENSIONS

T8	T9	T10

NOTES:

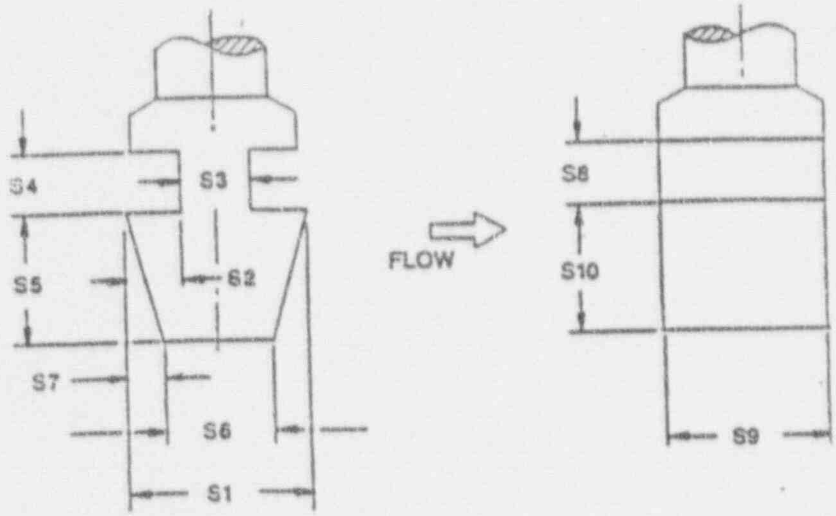
Fill in One Set of Boxes Only, As Appropriate.
Use Dial Calipers to Measure Dimensions.

DISK T-SLOT MEASUREMENTS
FIGURE 6

L-9

MPR ASSOCIATES
F-140-48-90
6/6/90

Plant Name:	
Valve I.D. Number	
Preparer :	



Flow Perpendicular to T-Slot OR Flow Parallel to T-Slot

MEASURED DIMENSIONS

S1	S2	S3	S4	S5	S6	S7

MEASURED DIMENSIONS

S8	S9	S10

NOTES:

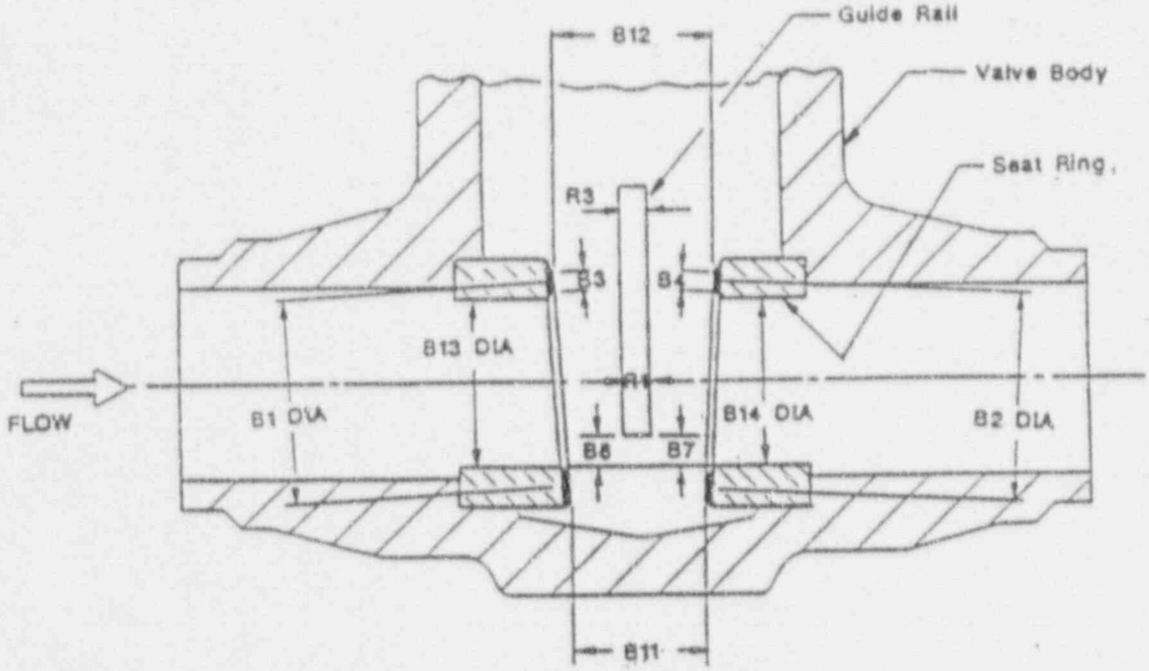
Fill in One Set of Boxes Only, As Appropriate.
Use Dial Calipers to Measure Dimensions.

STEM T-HEAD MEASUREMENTS
FIGURE 7

Plant Name: ____________________

Valve I.D. Number: ____________________

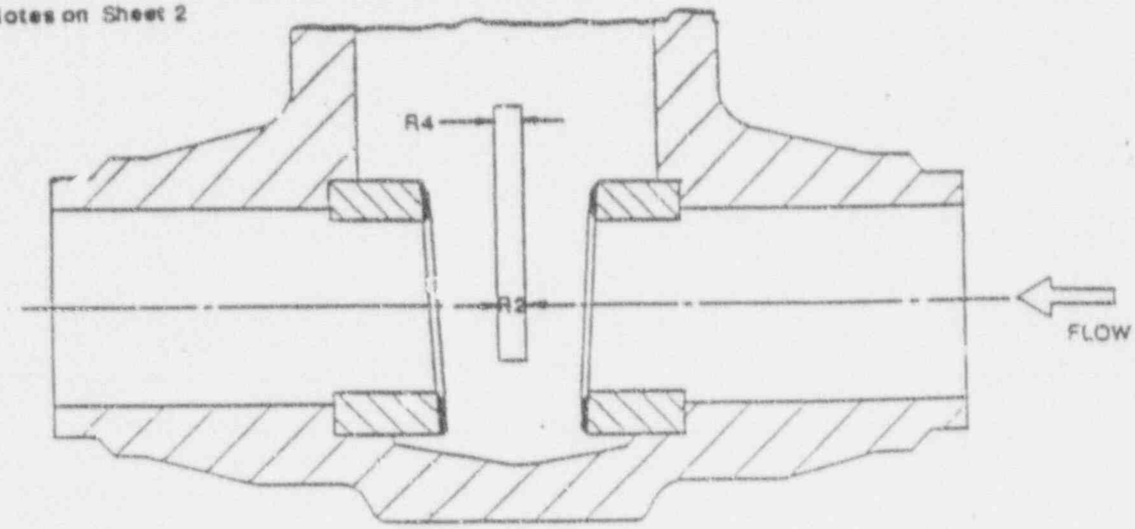
Preparer: ____________________



MEASURED DIMENSIONS

B1 DIA	B2 DIA	B3	B4	B7	B8	B11	B12	B13 DIA	B14 DIA	R1	R2	R3	R4

See Notes on Sheet 2



VALVE BODY MEASUREMENTS

FIGURE 8

SHEET 1

L-11

Notes:

1. If valve body has a single-piece "U"-type guide rail, B7 and B8 are not applicable (mark NA). Also, if guide rail extends past bottom of seat ring, B7 and B8 are not applicable (mark NA). Otherwise measure B7 and B8 per Figure 10.

2. Measure mean diameters B1 and B2 when a blue check is performed on the valve. Use calipers to gage the mean diameters off the disk which has been blue checked. Use dial calipers to measure the gaged mean diameters.

3. Measure seat contact widths B3 and B4 when a blue check is performed on the valve. Use a machinists scale to measure the seat contact width. Take measurements at least four places around the disk face and record the average contact width.

4. Measure diameters B13 and B14 using calipers or snap blocks to gage the diameter and dial calipers to measure the gaged diameter.

5. Measure dimensions B11 and B12 using inside calipers or snap blocks to gage the dimension and dial calipers to measure the gaged dimension.

6. Measure dimensions R1, R2, R3 and R4 using outside calipers to gage the dimension and dial calipers to measure the gaged dimension. R1 and R3 should be taken at a location approximately on pipe centerline (± 1/2 inch). R2 and R4 should be taken at the top of the guide.

VALVE BODY MEASUREMENTS

FIGURE 8

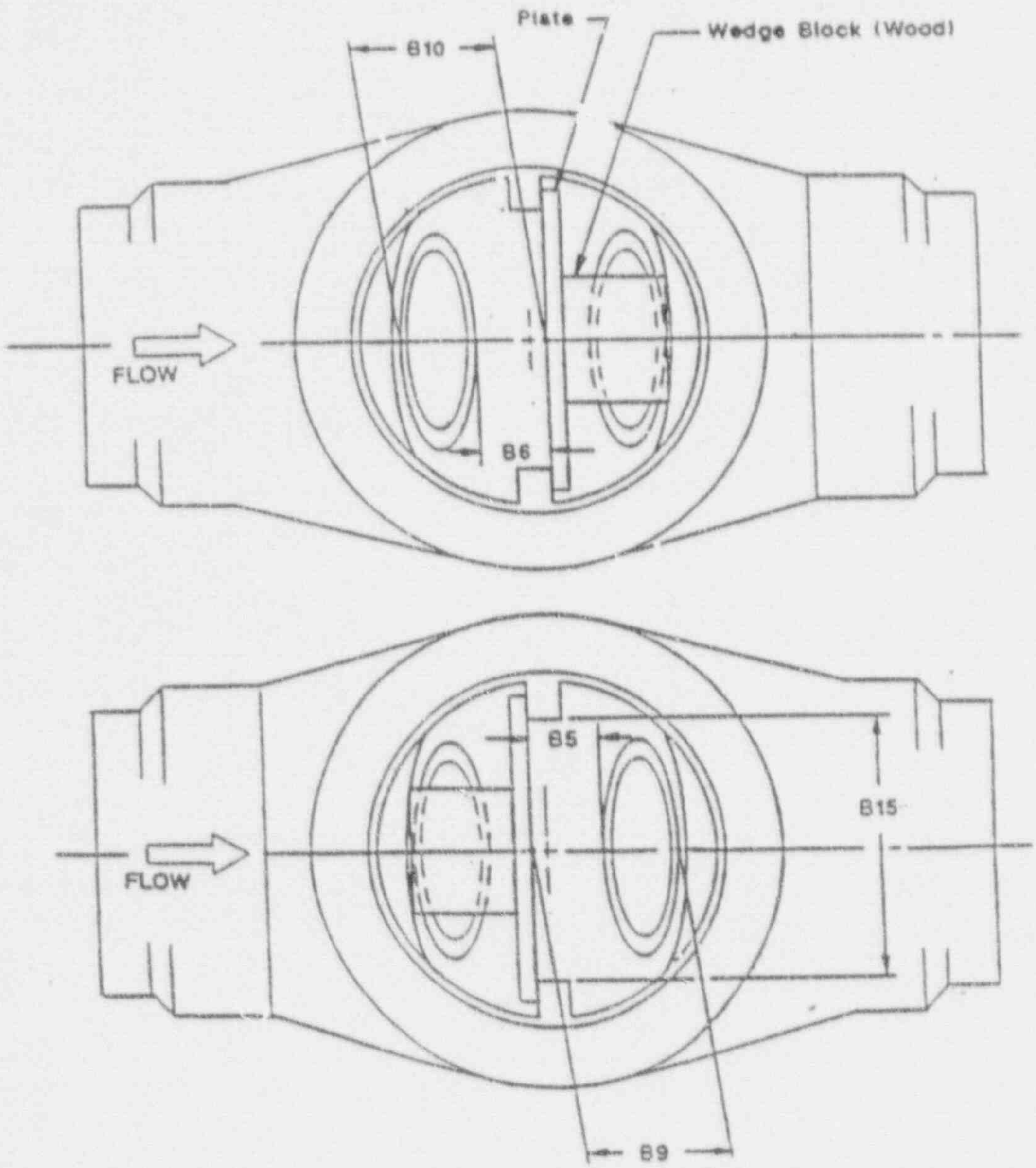
SHEET 2

MPR ASSOCIATES
[illegible]
[illegible]

Plant Name: ______________________

Valve I.D. Number: ______________________

Preparer: ______________________



MEASURED DIMENSIONS

B5	B6	B9	B10	B15

See Notes on Sheet 2

VALVE BODY SEAT-TO-GUIDE RAIL MEASUREMENTS

FIGURE 9

SHEET 1

L-13

MPR ASSOCIATES
F-145-49-16
4/6/90

Notes:

1. Install machined flat plate in valve body against guide rail sliding surfaces. Fix plate in position with wooden wedge block. (Do not deform plate.) Dimensions B6 and B10 are obtained when flat plate is installed against downstream face of guide rails. Dimensions B5 and B9 are obtained when flat plate is installed against upstream face of guide rails.

2. Measure dimensions B5, B6, B9, B10 and B15 using adjustable parallels or snap blocks to gage the dimension and dial calipers to measure the gaged dimension. B15 is taken at a location approximately on pipe centerline (± 1/2 inch).

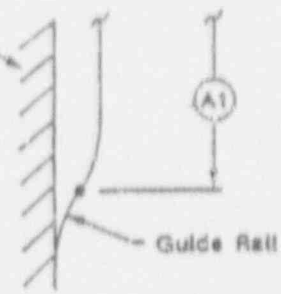
VALVE BODY SEAT-TO-GUIDE RAIL MEASUREMENTS

FIGURE 9

SHEET 2

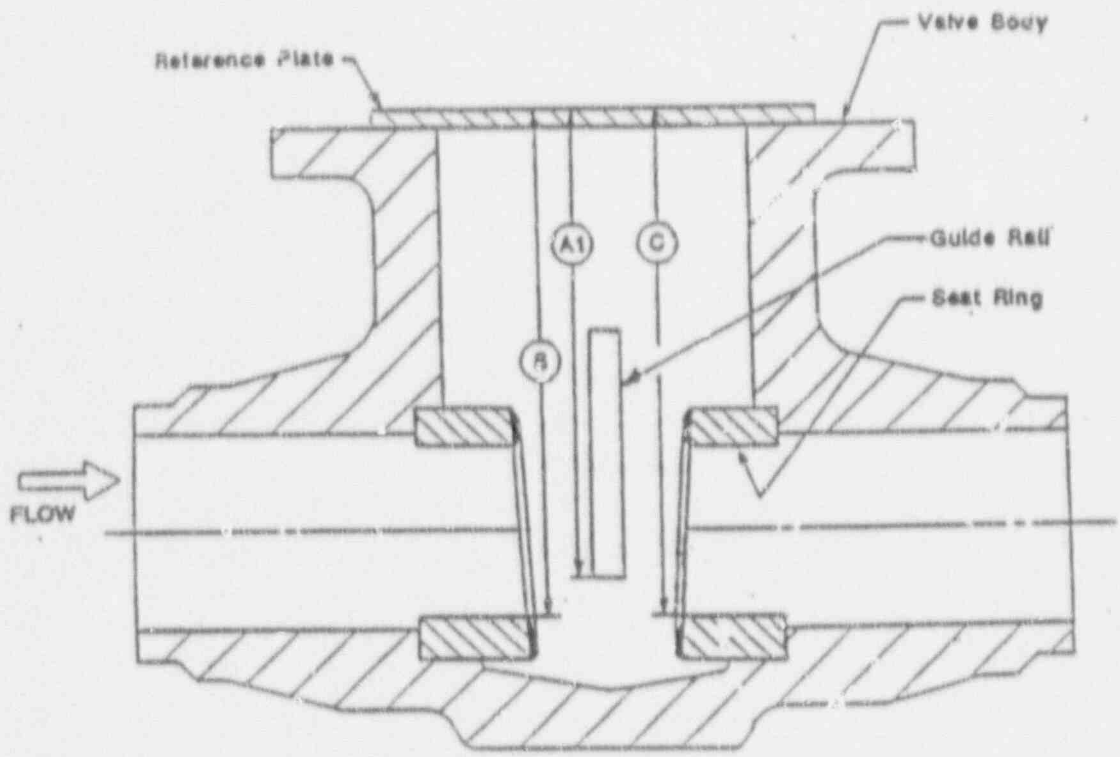
L-14

MPR ASSOCIATES



Note:

If bottom of guide rail is not square, measure to midpoint



(A2) measured on opposite side of valve from (A1)

For Measurement Procedure see Sheet 2

APPROACH FOR MEASURING BODY DIMENSIONS
B7 AND B8

FIGURE 10

SHEET 1

L-15

MPR ASSOCIATES
[illegible]
[illegible]

Plant Name:	______________________
Valve I.D. Number:	______________________
Preparer:	______________________

Procedure for Measuring Dimensions B7 and B8

1. With valve body open at bonnet flange and stem and disc removed, establish a reference plane by resting a flat plate across the top of the flange. The plate should not completely cover the opening.

2. Using a machinist's scale, measure dimensions A1, A2, B, and C from the top surface of the plate to the appropriate points, to the nearest 1/64 of an inch. If the bottom edges of the guide rails in the body are not square, use a midpoint of the end of the guide rail for measuring A1 and A2. Record results below.

3. Enter results for B7 and B8 on figure 8, Sheet 1.

Worksheet A1 = __________ in. A2 = __________ in.	
Upstream Valve Body Seat	Downstream Valve Body Seat
B = __________ in.	C = __________ in.
B7 = B - 1/2(A1 + A2) = __________ in.	B8 = C - 1/2(A1 + A2) = __________ in.

APPROACH FOR MEASURING BODY DIMENSIONS B7 AND B8

FIGURE 10

SHEET 2

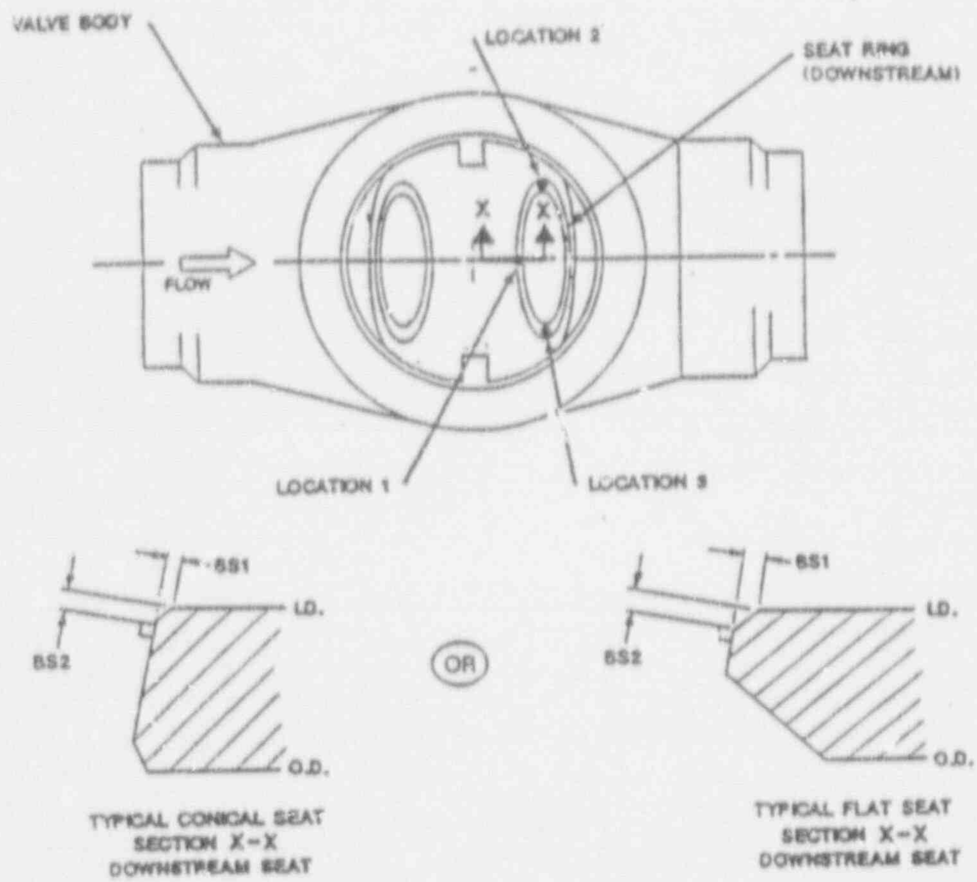
L-16

MPR ASSOCIATES

Plant Name: ______________________

Valve I.D. Number: ______________________

Preparer: ______________________



MEASURED DIMENSIONS

	BS1	BS2
LOCATION 1		
LOCATION 2		
LOCATION 3		

NOTE: DIMENSIONS ARE OBTAINED BY MEASUREMENT ON IMPRESSION MOLDS OF THE SEAT RING. USE A MACHINIST SCALE FOR DS4 AND DS5. CITRICON (MANUFACTURED BY KERR) IS AN ACCEPTABLE MOULDING COMPOUND FOR USE IN THIS PROCEDURE.

VALVE BODY SEAT RING MEASUREMENTS

FIGURE 11

APPENDIX B

GATE VALVE INTERNAL INSPECTIONS
GATE VALVE VISUAL INSPECTION INFORMATION
RECORDING SHEET

EXTRACTED FROM EPRI'S
IN SITU TEST GUIDE
FOR
MOTOR OPERATED VALVES
APPENDIX M
PAGES M1 THROUGH M8

RESEARCH PROJECT 3433-03
REV. 01, OCTOBER 1990

GATE VALVE INTERNAL INSPECTIONS

GATE VALVE VISUAL INSPECTION INFORMATION RECORDING SHEET

Plant Name: ______________________________

Valve I.D. Number: ______________________

1. Disk Guide Surfaces Hard-Faced (Yes/No): ______
2. Valve Body Guide Rail Surfaces Hard-Faced (Yes/No): ______
3. Stuffing Box Inside Diameter: _______ in
4. Stem Surface Finish in Packing Region: _____ rms
5. Stuffing Box Inner Wall Finish: _____ rms
6. Describe wear or damage to disk guides. Focus on ends of guide slots. Include extent and depth of wear areas if possible. Indicate wear or damage areas on Figure 12 of this data sheet:

____

____

____

____

____

____

7. Describe wear or damage to valve body guide rails. Focus on upstream face of guide rails. Include extent and depth of wear areas if possible. Look for deformation of unsupported lengths of guide rails. Indicate wear or damage areas on Figures 13 and 14 of this data sheet:

____

____

____

____

____

____

Sheet ____ of ____

MOV No. ________

Preparer: _______

M-1

GATE VALVE INTERNAL INSPECTIONS

GATE VALVE VISUAL INSPECTION INFORMATION RECORDING SHEET

8. Describe wear or damage to disk seat surfaces. Focus on lower half of downstream seat surface. Include extent and depth of wear areas if possible. Indicate wear or damage areas on Figure 12 of this data sheet:

____

____

____

____

____

____

____

9. Describe wear or damage to valve body seat rings. Focus on lower half of downstream seat ring. Include extent and depth of wear areas if possible. Indicate wear or damage areas on Figures 13 and 14 of this data sheet:

____

____

____

____

____

____

____

10. Describe valve body guide rail configuration. Select type of configuration from examples provided on Figure 15. If type of guide rail configuration is not shown, draw in configuration on sketch marked "Other Type Guide Rail Configuration". Fill in answers to questions opposite appropriate rail configuration sketch.

Sheet ____ of ____

MOV No. __________

Preparer: ________

M-2

GATE VALVE INTERNAL INSPECTIONS

GATE VALVE VISUAL INSPECTION INFORMATION RECORDING SHEET

11. Other Remarks:

____
____
____
____
____
____
____
____
____
____
____
____
____
____

Sheet ____ of ____
MOV No. __________
Preparer: _______

M-3

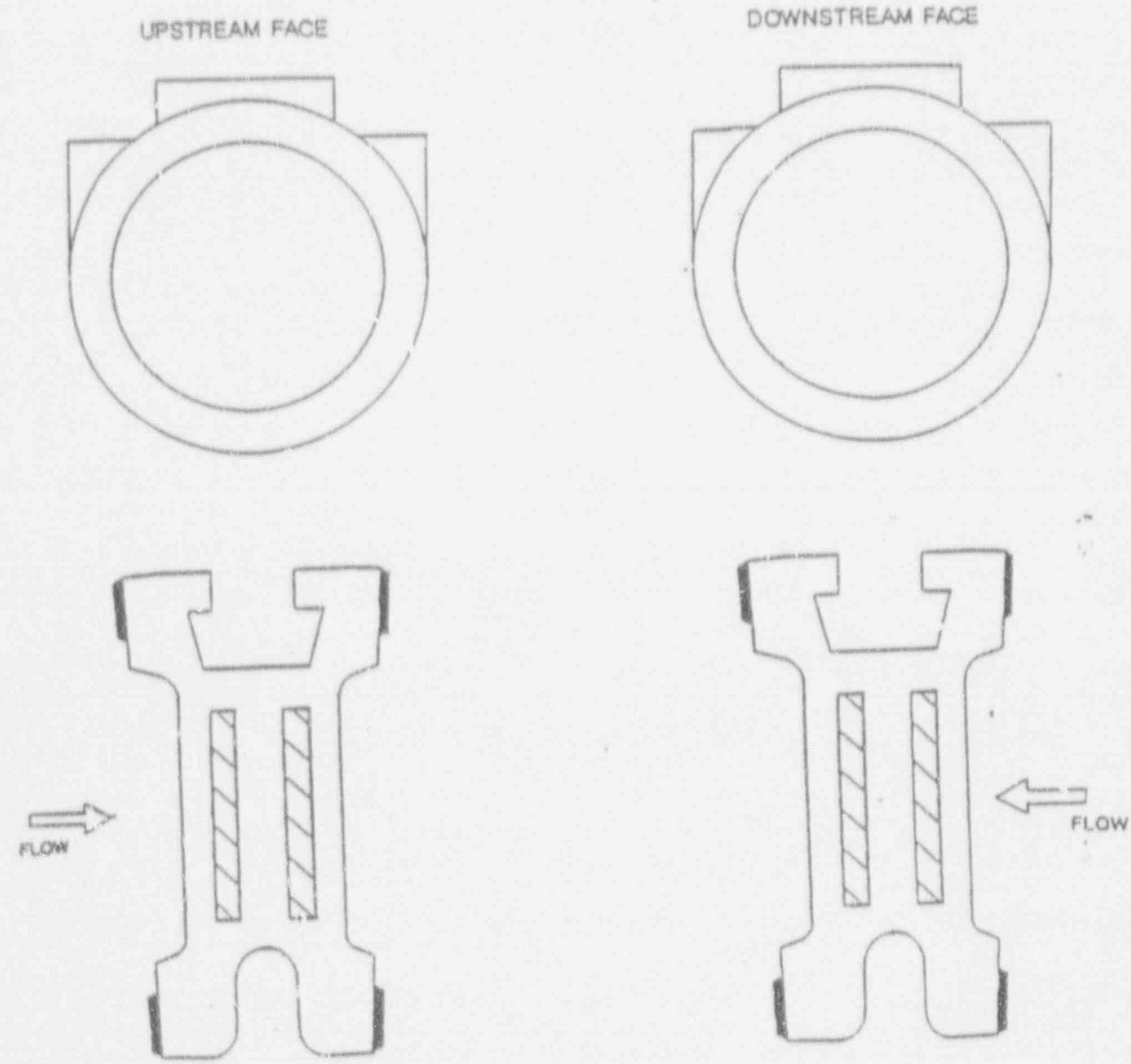
Sheet _____ of _____

MOV No. __________

Preparer: __________

GATE VALVE INTERNAL INSPECTIONS

GATE VALVE VISUAL INSPECTION INFORMATION RECORDING SHEET



VALVE DISK WEAR/DAMAGE LOCATIONS

FIGURE 12

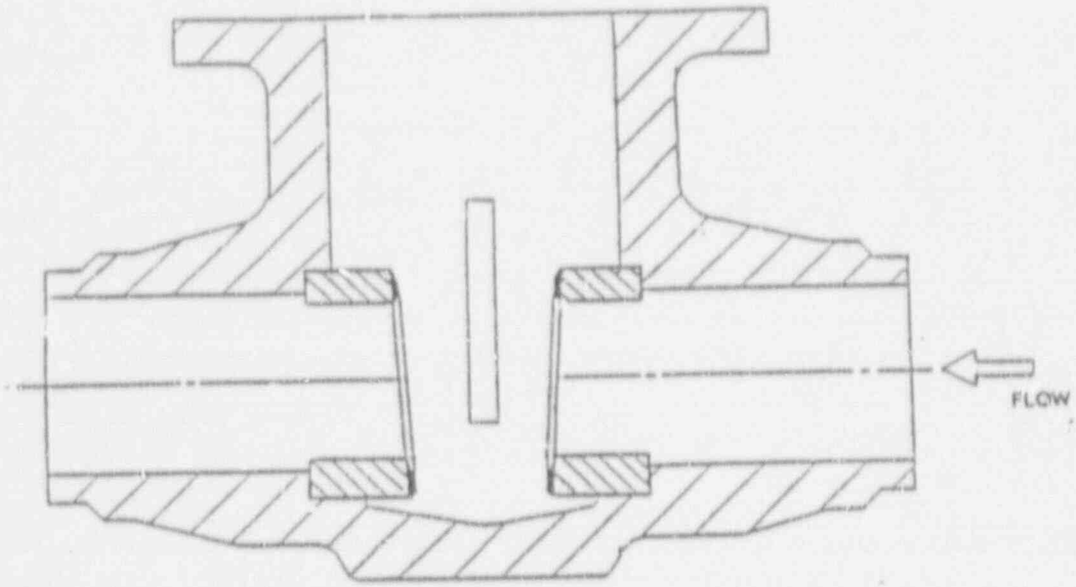
Sheet _____ of _____

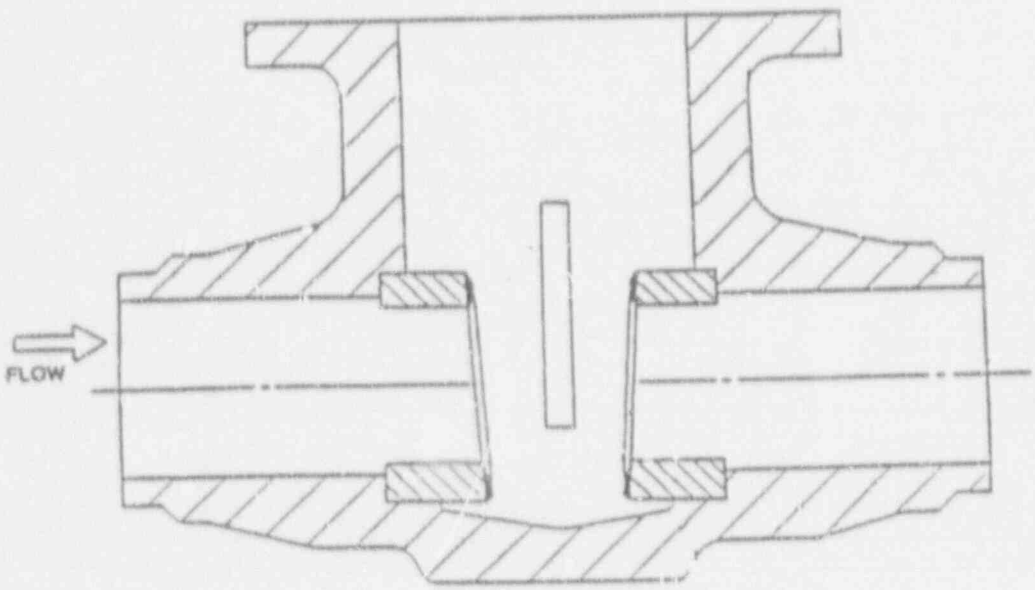
MOV No. __________

Preparer: __________

GATE VALVE INTERNAL INSPECTIONS

GATE VALVE VISUAL INSPECTION INFORMATION RECORDING SHEET





VALVE BODY WEAR/DAMAGE LOCATIONS

FIGURE 13

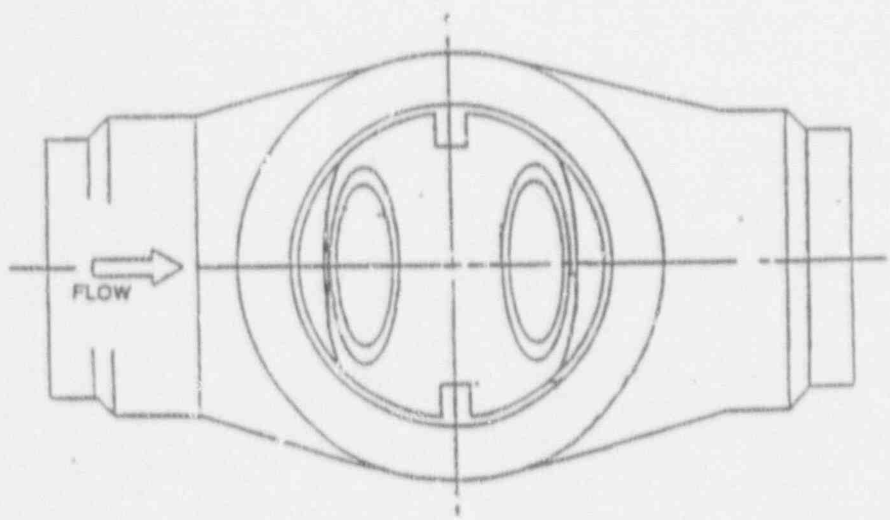
Sheet _____ of _____

MOV No. __________

Preparer: __________

GATE VALVE INTERNAL INSPECTIONS

GATE VALVE VISUAL INSPECTION INFORMATION RECORDING SHEET



VALVE BODY WEAR/DAMAGE LOCATIONS

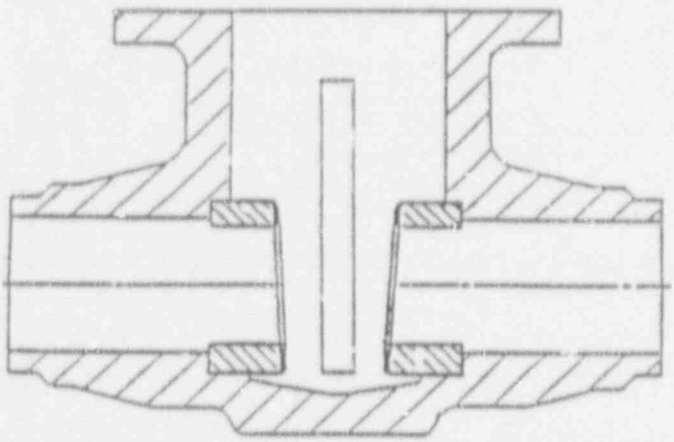
FIGURE 14

Sheet ______ of ______

MOV No. __________

Preparer: __________

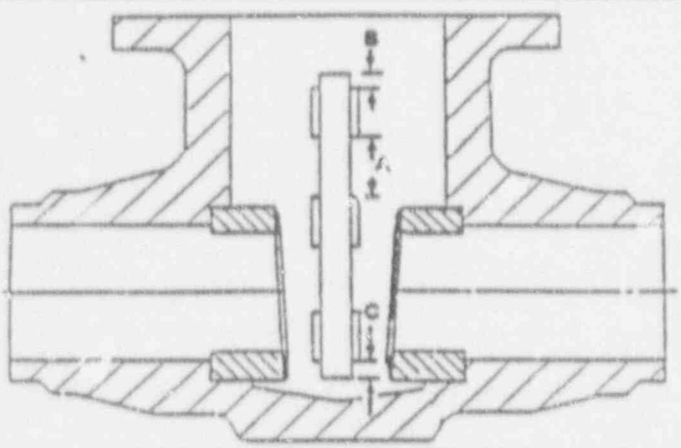
GATE VALVE INTERNAL INSPECTIONS
GATE VALVE VISUAL INSPECTION INFORMATION RECORDING SHEET



Use This Figure For
Valve Body Guide Rails Cast in Place

- Guide rail faces machined, as-cast, or hand-ground?

  ____



Use This Figure For
Valve Body Guide Rails Welded in Place

- Continuous or discontinuous weld? ______________
- Distance between welds (dimension A): ________ in
- Free length at top of rail (dimension B): ________ in
- Free length at bottom of rail (dimension C): ________ in

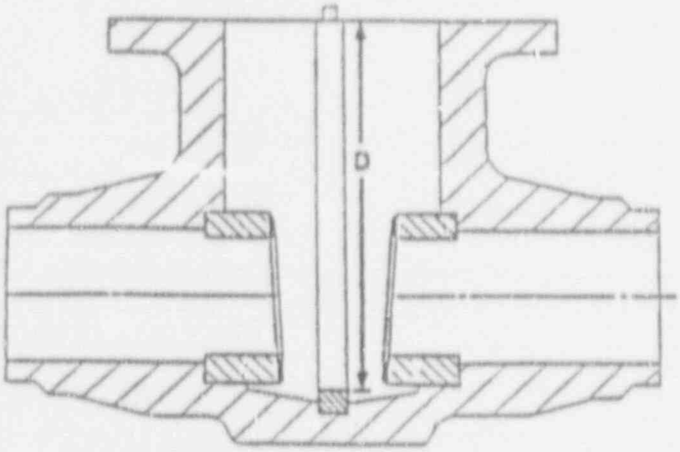
VALVE BODY GUIDE RAIL CONFIGURATION

FIGURE 15
SHEET 1

M-7

Sheet _____ of _____
MOV No. __________
Preparer: __________

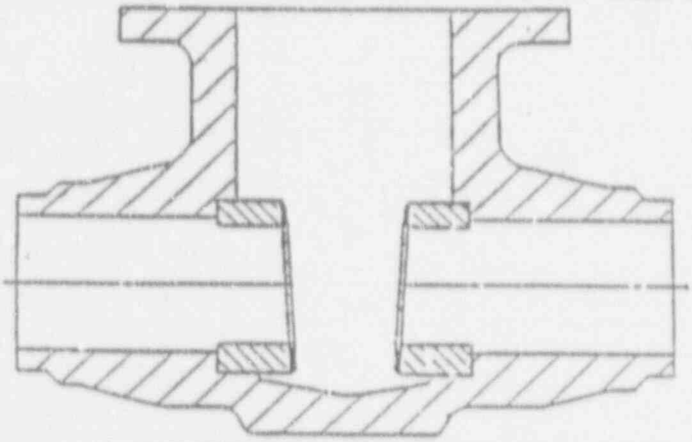
GATE VALVE INTERNAL INSPECTIONS
GATE VALVE VISUAL INSPECTION INFORMATION RECORDING SHEET



Use This Figure For
Captured (or Removable) Valve Body Guide Rails

- Note unsupported length of guide rail (dimension D): __________ in

---



Use This Figure For
Other Type Guide Rail Configuration

- Draw in guide rail configuration.
- Guide rail faces machined, as-cast, or hand-ground?

  ____

- Note unsupported length of guide rail: ________ in

VALVE BODY GUIDE RAIL CONFIGURATION

FIGURE 15
SHEET 2

APPENDIX C

COPY OF LETTER

0-MPS-91-098, REV. 01

DATED JULY 12, 1991

FROM

A. A. OSTROV (ABB-CENP)

TO

P. A. ADAMO (ABB-CENP)

OPPD FORT CALHOUN BLOCK VALVES

HCV-150, HCV-151

OPERATING CONDITIONS

ABB
ASEA BROWN BOVERI

Inter-Office Correspondence

July 12, 1991
O-MPS-91-098, Rev. 01
Supersedes the original memo
dated July 3, 1991

To: P. Adamo

xc: F. P. Ferraraccio
R. F. Paakkonen
D. L. Sibiga
MPS File
Quality Records

From: A. A. Ostrov

Subject: OPPD Fort Calhoun Block Valves HCV-150 and -151: Operating Conditions

References:

1. Fort Calhoun Design Basis Document SDBD-RC-128, Reactor Coolant, March 1990.
2. CE Report CEN-114-P, Review of Small Break Transients in Combustion Engineering Nuclear Steam Supply Systems, Amendment 1-P, July 1979.
3. Fort Calhoun Station Unit No. 1 Operating Instructions OI-RC-1, RCS Normal Operation, March 1984.
4. Fort Calhoun Operating License DPR-40 and Technical Specifications, Amendment 109, May 1987.
5. Calculation 83888-MPS-5CALC-012, Rev. 00, Low Temperature Overpressure Protection for 20 EFPY, issued May 18, 1990.
6. Memo PSA-85-042, Dresser PORV Capacity for Liquid Upstream Conditions, February 20, 1985.
7. Supplement 1 to Generic Letter 89-10: Results of the Public Workshops, Issued June 13, 1990.
8. EPRI/Wyle Power Operated Relief Valve Phase III Test Report, Volume 3: Summary of Phase III Testing of the Dresser Relief Valve, NP-2670-LD, Interim Report, October 1982.
9. Fort Calhoun Updated Safety Analysis Report (USAR), Rev. July 1987.

Ref. (cont.) 10. Engineering Evaluation of Feed and Bleed for TLOFW Events at Fort Calhoun Station, Report, December 1988.

11. Fort Calhoun Station Unit No. 1 Emergency Operating Procedure EOP-20, "Functional Recovery Procedure", Rev. 07.

Enclosure: FCS Block Valve Functions and Operating Conditions [for Various Events] - Tables I thru VII.

The Enclosure provides Fort Calhoun Station (FCS) PORV block valve functions and expected operating conditions for seven events during which block valve operations may be required. These data are generated in response to your request to support the effort to develop testing guidelines for the block valves.

Two of the events addressed, namely, A Stuck-Open PORV (Enclosure, Table I), and A Leaking PORV (Table II) are the original design basis events for these block valves. The remaining five events are included herein as a result of

(1) New safety-related functions, beyond the original design basis, that PORVs are now required to perform, and/or

(2) Generic Letter 89-10 recommendation to consider MOV mispositioning in addition to design basis events in determining limiting operating conditions during block valve opening and closing on demand.

These remaining five events are as follows:

- Enabling the LTOP System (Table III),
- FSAR Chapter 14 Events (Table IV),
- Once-Through-Cooling Following TLOFW (Table V),
- Functional Recovery of RCS Pressure Control Using PORVs as a Success Path (Table VI), and
- Long Term Cooling Following a Small Break LOCA

The cases in each table identify various scenarios for a particular event. These scenarios result from different initial conditions, operator actions and/or equipment availability.

The data in the tables were derived from the references. Although some of these references such as References 2,6, and 10, were not originally QA-verified, there is high confidence in the accuracy of the data contained therein, since in each case, the data were verified through independent engineering review.

The parameters provided in the enclosed tables are as follows:

- P_{omax} is the maximum block valve upstream (line) pressure in a particular case (scenario) at the end of the valve closing stroke or at the beginning of the opening stroke.

- P_{bmin} is the minimum block valve downstream pressure during valve operation. Generally, this parameter is not readily available; it depends on flow rate through the PORV, PORV discharge piping resistance and quench tank pressure, and needs to be calculated. A conservative value of 15 psia is assumed for each case to maximize ΔP_{max} (see below). This value represents the containment atmospheric pressure assuming that the quench tank rupture disc is ruptured.

- ΔP_{max} is the maximum differential pressure across the block valve in each case.

- Q is the maximum flow rate through the block valve in the fully open position.

- Temperature and phase refer to the conditions of the fluid flowing through the block valve.

The information contained in the enclosed tables provides a sufficient data base to appropriately identify testing conditions. It should be noted that both the block valves and the PORVs at FCS are located in the loop seal inlet piping configuration. Based on information recently obtained from OPPD, this loop seal is normally filled with condensate. This condition may need to be accounted for in testing of the block valves to the most limiting scenarios in Tables I thru VII.

This memo has been QA-verified in accordance with the applicable requirements of QAM-101.

AAO:slt
AAO004.WP

VERIFICATION STATUS: COMPLETE

The Safety-Related design information contained in this document has been verified to be correct by means of Design Review using Checklist(s) 1 of QAM-101.

R. Parkkonen R. Parkkonen 7/12/91

Independent Reviewer: Name Signature/Date

Table I
FCS PORV Block Valve Functions and Operating Conditions,
Event: A STUCK-OPEN PORV(1)

CASE NO	VALVE FUNCTION	$P_{o\,max}$ psia	$P_{b\,min}$ psia	ΔP_{max} psi	Q lbm/hr	TEMPERATURE & PHASE	NOTE
I-1	CLOSE	2376	15	2361	110,220	sat. steam	(2) (3)
I-2	CLOSE	2180	15	2165	100,400	sat. steam	(4)
I-3	CLOSE	1400	15	1385	(6) 160,000 (6)	sat. steam, two-phase, liquid	(5) (7)
I-4	CLOSE	1130	15	1115	(6) 137,000 (6)	sat. steam, two-phase, liquid	(8) (7)
I-5	CLOSE	1200	15	1185	(6)	sat. steam	(9)

NOTE:

(1) This is one of the original design bases of the subject block valves.

(2) This is a hypothetical case (scenario) based on Reference 1 (Attachment 18) data.

(3) $P_{o\,max}$ is assumed to equal PORV blowdown pressure.

(4) This case is for LOFW event with two stuck-open PORVs, per Reference 2, Section 3.10.3.3.

(5) This case is for LOFW event, per Reference 2, Section 3.11.3.6. The PORVs are assumed to stick-open when RCS pressure starts decreasing at t ~ 10,000 sec., per Fig. 3.11-19.

(6) Q is not calculated.

(7) Q is conservatively calculated based on a critical flow model for saturated water.

(8) This case is for isolation of small breaks, per Reference 3, Section 4.2.

(9) This case is for inadvertent opening of a PORV, per Reference 2, Case 4.

Table II
FCS PORV Block Valve Functions and Operating Conditions.
Event: A LEAKING PORV[1]

CASE NO	VALVE FUNCTION	$P_{o\ max}$ psia	$P_{b\ min}$ psia	ΔP_{max} psi	Q lbm/hr	TEMPERATURE & PHASE	NOTE
II-1	CLOSE	2150	(3)	(4)	3,050	sat. water	(2)

NOTE:

(1) This is one of the original design bases of the subject block valves.

(2) This case assumes that leaking occurs during plant normal operation at full power. $P_{o\ max}$ = normal operating pressure plus 50 psi tolerance, per Reference 3; Q is assumed to equal the maximum allowable reactor coolant leakage rate (10 gpm, Reference 4, LCO 2.1.4).

(3) This pressure is close to $P_{o\ max}$ since the flow rate through the closed PORV is low (Q = 3050 lbm/hr).

(4) In light of Note (3) above, this pressure differential is negligible.

Table III
FCS PORV Block Valve Functions and Operating Conditions.
Event: Enabling the LTOP System[1]

CASE NO	VALVE FUNCTION	$P_{o\ max}$ psia	$P_{b\ min}$ psia	ΔP_{max} psi	Q lbm/hr	TEMPERATURE & PHASE	NOTE
III-1	OPEN	485	15	470	225,000	Water, 82°F	(2)
III-2	OPEN	1743	15	1720	68,000	sat. steam	(3) (5)
III-3	OPEN	2500	15	2485	130,000	sat. steam	(4) (5)

NOTE:

(1) Block valve mispositioning is postulated for this event.

(2) This case represents the lower pressure - temperature boundary of the LTOP region. $P_{o\ max}$ is equal to the maximum transient pressure in that region (see Reference 5); Q is calculated using Equation (1) of Reference 6.

(3) This case represents the upper pressure - temperature boundary of the LTOP region for 20 EFPY. $P_{o\ max}$ is equal to the maximum transient pressure in that region (see Reference 5).

(4) This hypothetical case assumes both PORVs are unavailable for LTOP transient mitigation: one, due to a single failure, another, due to a closed block valve. This assumption is based upon interpretations of responses to Questions 7 and 8 of Reference 7. It is assumed that an attempt to open the mispositioned block valve is taken during an LTOP transient when pressure approaches the safety valve setpoint ($P_{o\ max}$).

(5) Q is calculated based on actual Dresser PORV flow test data obtained from Reference 8 and a critical flow model.

Table IV
FCS PORV Block Valve Functions and Operating Conditions,
Event: FSAR CHAPTER 14 EVENTS[1]

CASE NO	VALVE FUNCTION	$P_{o\ max}$ psia	$P_{b\ min}$ psia	ΔP_{max} psi	Q lbm/hr	TEMPERATURE & PHASE	NOTE
IV-1	OPEN	2500	15	2485	130,000	sat. steam	(2)

NOTE: (1) Block valve mispositioning is postulated for this event.

(2) This case is for a Loss of Load event (see Reference 9) during which pressure can reach the safety valve setpoint. Q is the same as in Case III-3.

Table V

FCS PORV Block Valve Functions and Operating Conditions.

Event: Once-Through-Cooling Following TLOFW[1]

CASE NO	VALVE FUNCTION	$P_{o\ max}$ psia	$P_{b\ min}$ psia	ΔP_{max} psi	Q lbm/hr	TEMPERATURE & PHASE	NOTE
V-1	OPEN	1700	15	1685	72,000	sat. steam	(2)
V-2	CLOSE	1200	15	1185	180,000	water 540°F	
V-3	OPEN	2500	15	2485	126,000	sat. steam	

NOTE: (1) Block valve mispositioning is postulated for this event.

(2) This and other cases in the table represent various scenarios addressed in Reference 10. $P_{o\ max}$ and Q for each case are per Reference 10.

Table VI
FCS PORV Block Valve Functions and Operating Conditions.
Event: Functional Recovery of RCS Pressure Control Using PORVs as a Success Path[1]

CASE NO	VALVE FUNCTION	$P_{o\ max}$ psia	$P_{b\ min}$ psia	ΔP_{max} psi	Q lbm/hr	TEMPERATURE & PHASE	NOTE
VI-1	OPEN	2500	15	2485	130,000	sat. steam	(2) (4)
VI-2	CLOSE	2300	15	2285	110,220	sat. steam	(4)
VI-3	OPEN	1200	15	1185	180,000	water 540°F	(3) (4)

NOTE: (1) Block valve mispositi ning is postulated for this event.

(2) This case has the same fluid conditions as Case III-3.

(3) This case is similar to Case V-2.

(4) This case is identified based upon Reference 11, pp. 183-184.

Table VII
FCS PORV Block Valve Functions and Operating Conditions.
Event: Long Term Cooling Following A Small Break LOCA[1]

CASE NO	VALVE FUNCTION	$P_{o\ max}$ psia	$P_{b\ min}$ psia	ΔP_{max} psi	Q lbm/hr	TEMPERATURE & PHASE	NOTE
(2)							

NOTE: (1) Block valve mispositioning is postulated for this event.

(2) This event, described in Reference 9, Section 14.15.4, is similar to the Once-Through-Cooling Following TLOFW event addressed in Table V (page 5) in that during both events EOPs instruct the operators to open PORVs for RCS heat removal. In the subject event however pressure generally tends to be lower than in the other event because of a break in the RCS pressure boundary.

As a result, it is concluded that block valve functions and operating conditions during the subject event are enveloped by those in Table V.

APPENDIX D

LETTER FROM OPPD
STATING

THE MAXIMUM AMOUNT OF CONDENSATE
UPSTREAM

OF A

CLOSED PORV BLOCK VALVE

AT

FORT CALHOUN STATION

Omaha Public Power District
P.O. Box 399 Hwy. 75 - North of Ft. Calhoun Fort Calhoun, NE 68023-0399
402/636-2000

July 24, 1991
PED-91-NP-064E

Mr. Peitro Adamo
ABB Combustion Engineering Nuclear Power
1000 Prospect Hill Road
P. O. Box 500
Windsor, Connecticut 06095-0500

SUBJECT: Omaha Public Power District (OPPD) Determination of Water Weights in the PORV Relief Lines

Dear Mr. Adamo:

The purpose of this letter is to officially transmit the values of water weight in the pressurizer relief lines if the lines are completely filled with water. These water weights are for the relief lines to the Power Operated Relief Valves (PORVs) only.

The attached sketch shows the piping configuration with corresponding pipe lengths and size. This sketch was developed using Fort Calhoun Station Isometric Drawing IC-15B, Revision 2, GSE File 35712.

By using the piping size and lengths, the weight of water per unit length of pipe for the corresponding pipe size was obtained using the tables in "Mark's Standard Handbook for Mechanical Engineer's," Seventh Edition.

Using this methodology, the results from the attached sketch are as follows:

LINE	WATER WEIGHT (LBS)
Pressurizer to PCV-102-1	66.37
Pressurizer to PCV-102-2	64.51

If you have any questions regarding the above, please feel free to call me at 402-533-7303.

Ralph K. Schwartzbeck

Ralph K. Schwartzbeck
MOV Program Engineer

RKS:cjf

c: T. J. McIvor
R. E. Lewis

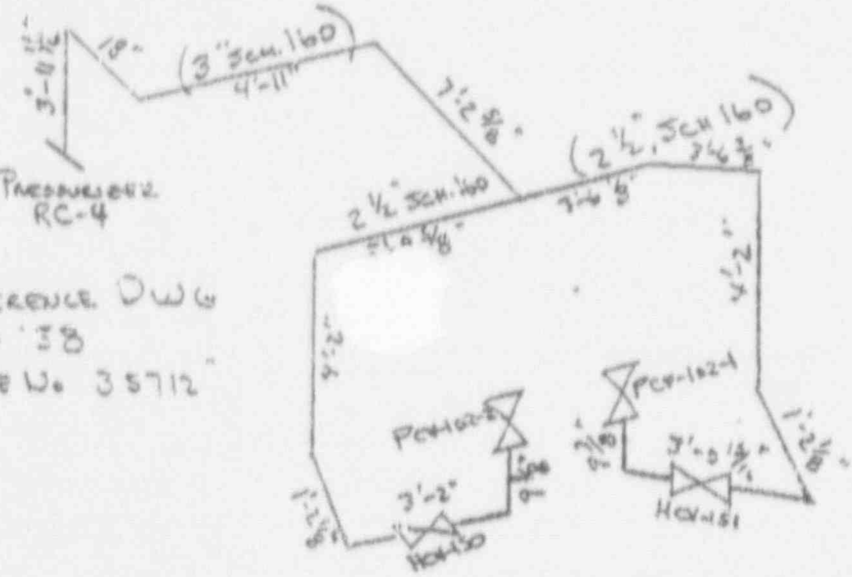
GENERATING STATION ENGINEERING CALCULATION SHEET

PROJECT Motor Operated Valve Project REVISION No ______

SUBJECT Water Weight In PORV Block Valve Piping PAGE No ____ OF ____

7/16/91

7/22/91



Reference DWG 1C-138 File No. 35712

- Total Length of 3" Sch. 160 Pipe = 17.61'
  - Weight of Water In Pipe = 2.348#/ft. (*Ref. 1) = 41.35#
- Length of 2-1/2" (Sch. 160) Pipe To PCV-102-1 = 16.30'
  - Weight of Water In Pipe = 1.535#/ft (*Ref 1) = 25.02#
- Length of 2 1/2" (Sch. 160) Pipe To PCV-102-2 = 15.09'
  - Weight of Water In Pipe = 1.535#/ft (*Ref. 1) = 23.16#

→ Total Water Weight = **89.53#**

*Reference 1: Standard Handbook for Mechanical Engineer Baumeister & Marks, Seventh Edition

TOTAL P.03