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Georgia Power
the southern electric system

J. T. Beckham, Jr.
Vice President and General Manager
Nuclear Generation

SL-1325
0763C

October 2, 1986

U. S. Nuclear Regulatory Commission
Office of Inspection and Enforcement
Region II - Suite 2900
101 Marietta Street, NW
Atlanta, Georgia 30323

REFERENCE:
RII: JNG
50-321/50-366
I&E Bulletin
85-03

ATTENTION: Dr. J. Nelson Grace

Gentlemen:

Georgia Power Company (GPC) in previous conversations with NRC Region II personnel obtained NRC permission to submit this report after the original October 1, 1986, due date. As of the date of this report, GPC has completed the initial actions required by NRC Inspection and Enforcement Bulletin 85-03, "Motor-Operated Valve Common Mode Failure During Plant Transients Due to Improper Switch Settings", for Plant Hatch Units 1 and 2. The bulletin requires GPC to develop and implement programs for Plant Hatch to ensure that certain valve operator switches in the High Pressure Coolant Injection (HPCI) and Rector Core Isolation Cooling (RCIC) systems are properly selected, set, and maintained.

The bulletin further requires:

1. Review and document the design basis for the operation of each valve. This documentation should include the maximum differential pressure expected during both opening and closing the valve for both normal and abnormal events to the extent that these valve operations and events are included in the existing approved design basis.

2. Using the results from the above, establish the correct switch settings. This shall include a program to review and revise, as necessary, the methods for selecting and setting all switches for each valve operation.

IE11
1/1

3. Individual valve settings shall be changed, as appropriate, to those established above. Whether the valve setting is changed or not, the valve will be demonstrated to be operable by testing the valve at the maximum differential pressure determined in item 1 above with the exception that testing motor operated valves under conditions simulating a break in the line containing the valve is not required. Otherwise, justification should be be provided for any cases where testing with the maximum differential pressure cannot practicably be performed. This justification should include the alternative to maximum differential pressure testing which will be used to verify the correct settings. Each valve shall be stroke tested, to the extent practical, to verify that the settings defined in item 2 have been properly implemented even if testing with differential pressure cannot be performed.

4. Prepare or revise procedures to ensure that correct switch settings are determined and maintained throughout the life of the plant. Ensure that applicable industry recommendations are considered in the preparation of these procedures.

5. Submit a written report to the NRC that: 1) reports the results of item 1, and 2) contains the program to accomplish items 2 through 4 including a schedule for completion of these items.

Georgia Power Company participated in the Boiling Water Reactor Owners Group (BWROG) subcommittee that addressed the subject bulletin. The BWROG subcommittee obtained the assistance of the General Electric Company (GE), who provided and developed data and methodology to support plant-specific calculations of the maximum differential pressures requested by action item (a) of the bulletin. The actions included the following specific items:

1. Identify the BWR system valves that are generically subject to the I.E. Bulletin requirements.

2. Identify the conditions within the approved design basis, under which each of the affected valves is subject to the maximum differential pressure.

3. Develop a generic methodology in determining the maximum fluid differential pressure across the affected valves.

4. Recommend generic guidelines for valve testing.

The results of the GE research is documented in GE report NEDC 31322 "BWR Owners Group Report on the Operational Design Basis of Selected Safety Related Motor Operated Valves", dated September 1986. A copy of this report was forwarded to the NRC on September 2, 1986. This report was used to address item (a) of I.E. Bulletin 85-03.

The technical information in NEDC 31322, and additional information provided by GE, were used by Georgia Power Company's Architect/Engineer (AE), Southern Company Services, to calculate the maximum expected differential pressures across the identified valves. Enclosures 1 and 2 provide the results of these calculations for the Plant Hatch Unit 1 HPCI and RCIC systems, respectively. Similarly, Enclosures 3 and 4 pertain to Plant Hatch Unit 2. These enclosures contain the following information:

1. Drawings which show the valves analyzed as part of the I.E. Bulletin 85-03 effort.

   The valves were chosen based on the previously referenced GE document. The drawings show:

   a. Plant specific Master Parts List (MPL) numbers for valves and pumps.
   b. A table that relates the MPL to the part description.
   c. Process fluid flow direction.
   d. That all listed valves on the drawings are subject to full differential pressure test requirements unless otherwise designated.

2. Documentation packages for the HPCI and RCIC systems of both Unit 1 and Unit 2. There is a total of four packages (Enclosures 1-4).

Each package generally includes: 1) introduction, 2) criteria and assumptions, 3) summary of conclusions, 4) listed references, 5) definition of terms, 6) derivation of values, 7) body of calculations, and 8) computer printouts.

The documentation packages have summary tables of the results of the calculations for each valve addressed by the bulletin. The summary tables provide a quick overview, for each system of each unit, of the valves that are subject to the bulletin's requirements. The tables contain the following information:

a. Valve MPL number.
b. Valve description.
c. Valve function.
d. Indication if the valve has a safety related function on opening or closing.
e. The governing formula used to calculate the differential pressure for the valve.
f. An indication of when the maximum pressure occurs, either upon opening or closing of the valve.
g. An indication of where the maximum pressure occurs, either upstream or downstream of the valve.
h. The maximum anticipated differential pressure.
i. An indication if the valve has a safety related function.

The information in the tables is supported by the additional information in the body of the design packages.

A schedule for responding to the remaining I.E. Bulletin 85-03 requirements is also provided as Enclosure 5.

Based on the above information, Georgia Power Company believes it has satisfied the requirements to provide a written report showing the results of item 1 of the Bulletin and to provide a program to accomplish the remaining bulletin requirements including time frames.

Georgia Power

J. T. Beckham, Jr. states that he is Vice President of Georgia Power Company and is authorized to execute this oath on behalf of Georgia Power Company, and that to the best of his knowledge and belief the facts set forth in this letter are true.

GEORGIA POWER COMPANY

By: J T Beckham Jr
J. T. Beckham, Jr.

Sworn to and subscribed before me this 2nd day of October, 1986.

Linda R Clontz
Notary Public

Notary Public, Clayton County, Georgia
My Commission Expires Dec. 12, 1986

LGB/lc

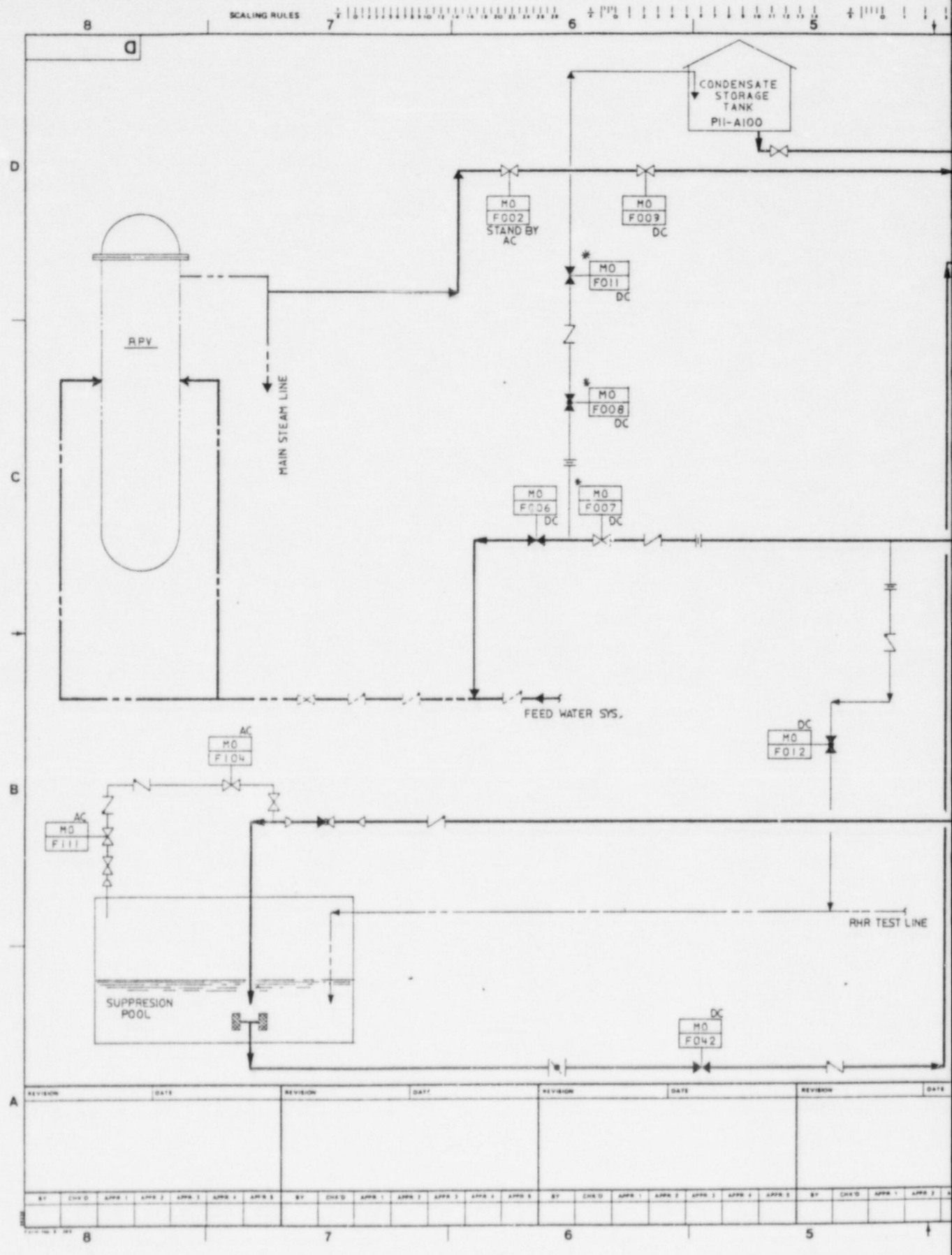
Enclosure

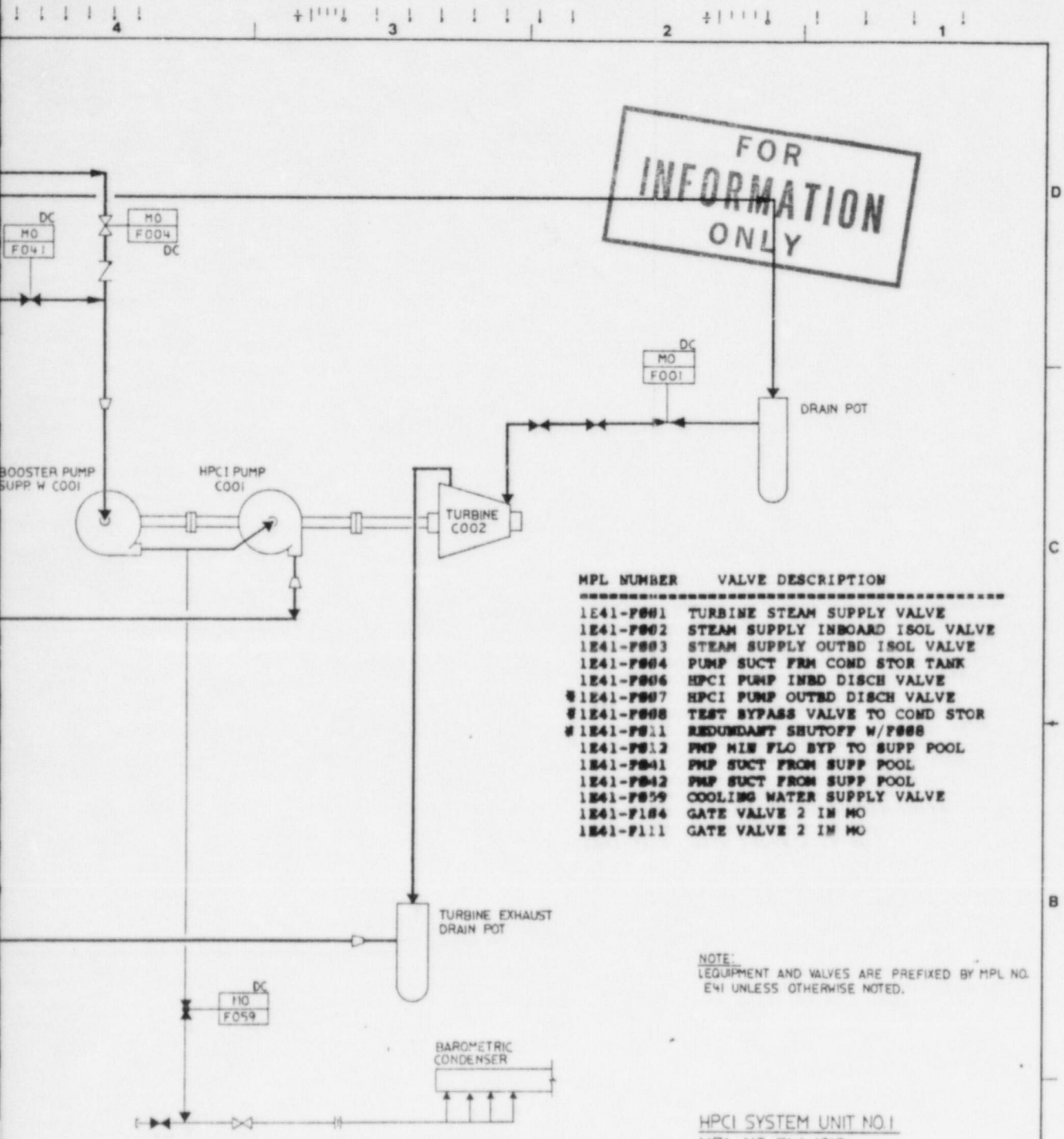
c: Georgia Power Company
Mr. J. P. O'Reilly
Mr. H. C. Nix, Jr.
GO-NORMS

U. S. Nuclear Regulatory Commission
Dr. J. N. Grace, Regional Administrator
Mr. P. Holmes-Ray, Sr. Resident
Inspector - Hatch
Document Control Desk

0763C

ENCLOSURE 1


SCALING RULES
CONDENSATE STORAGE TANK P11-A100
MO F002 STAND BY AC
MO F009 DC
MO F011 DC
MO F008 DC
MO F006 DC
MO F007 DC
RPV
MAIN STEAM LINE
FEED WATER SYS.
MO F012 DC
MO F104 AC
MO F111 AC
RHR TEST LINE
SUPPRESION POOL
MO F042 DC



MPL NUMBER	VALVE DESCRIPTION
1E41-F001	TURBINE STEAM SUPPLY VALVE
1E41-F002	STEAM SUPPLY INBOARD ISOL VALVE
1E41-F003	STEAM SUPPLY OUTBD ISOL VALVE
1E41-F004	PUMP SUCT FRM COND STOR TANK
1E41-F006	HPCI PUMP INBD DISCH VALVE
*1E41-F007	HPCI PUMP OUTBD DISCH VALVE
#1E41-F008	TEST BYPASS VALVE TO COND STOR
#1E41-F011	REDUNDANT SHUTOFF W/F008
1E41-F012	PMP MIN FLO BYP TO SUPP POOL
1E41-F041	PMP SUCT FROM SUPP POOL
1E41-F042	PMP SUCT FROM SUPP POOL
1E41-F059	COOLING WATER SUPPLY VALVE
1E41-F184	GATE VALVE 2 IN MO
1E41-F111	GATE VALVE 2 IN MO

NOTE:
EQUIPMENT AND VALVES ARE PREFIXED BY MPL NO. E41 UNLESS OTHERWISE NOTED.

HPCI SYSTEM UNIT NO.1
MPL NO. E41-1010

* THESE VALVES HAVE NO SAFETY ACTION ON OPEN/CLOSE AND THEREFORE DO NOT REQUIRE DP TESTING.

Southern Company Services, Inc.

EDWIN I. HATCH NUCLEAR PLANT UNIT NO.1
HPCI SYSTEM FLOW DIAGRAM
MOV DIFFERENTIAL PRESSURE STUDY

D DRAW?

8610090442-01

Calculation Cover Sheet

Southern Company Services

	Calculation Number: SNH-86-015
Project: E.I. HATCH NUCLEAR PLANT UNIT 1	Discipline: Mechanical
Objective: Calculate DP for HPCI Motor Operated Valves	SDS Number:
Subject/Title: Unit 1 HPCI Motor Operated Valve Differential Pressure Calculation	

Design Engineer's Signature	Date	Last Page Number
L B Watkins	9-20-86	61

Contents

Record of Revisions

Rev. No.	Description	Originator Date	Reviewer Date	Proj. Engr. Date
0	APPROVED	LBW 9-20-86	WMM 9/21/86	RGM 9/24/86

Notes

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	Dawn Wilson	09/19/86
Subject/Title	Reviewed By	Date
Unit 1 HPCI Motor Operated Valve	W.T. Barr	9/20/86
Differential Pressure Calculation	Calculation Number SNH-86-015	Sheet 1 of 61

INTRODUCTION

The Nuclear Regulatory Commission (NRC) IE Bulletin 85-03 (Motor Operated Valve Common Mode Failure) requested that owners of light water reactors develop and implement a program to ensure that torque switch settings on safety related motor-operated valves on high pressure systems are selected, set and maintained correctly to accomodate the maximum differential pressures expected on these valves during both normal and abnormal events within the design basis. The objective of this calculation is to determine the maximum Differential Pressure across each of the affected Unit 1 HPCI Motor Operated Valves.

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	G B Hatcher	9-20-86
Subject/Title	Reviewed By	Date
Unit 1 HPCI Motor Operated Valve	A D McNutt	9/21/86
Differential Pressure Calculation	Calculation Number SNH-86-015	Sheet 2 of 61

CRITERIA

1) The criteria, assumptions and formulas given in the General Electric "BWR Owner's Group Report on the Operational Design Basis of Selected Safety-Related Motor-Operated Valves," DRF-E12-00100-75, are assumed to be correct.

ASSUMPTIONS

1) PC is assumed to equal PLOC. The terms are defined as follows:
   * PLOC is the maximum wet well LOCA pressure.
   * PC is the maximum wetwell LOCA pressure which the valve is required to operate against.

2) In the PVEL calculation, it is assumed that the time required for a sound wave to travel to and return from an atmospheric vessel is infinity. Thus, the related term in the PVEL equation is equal to zero.

3) Disc and Port diameters are assumed to be equal. Equal diameters for disc and port yield higher rate of change therefore higher DV and is therefore more conservative.

4) The Formula for calculating area of the gate valve available for flow is approximated from a known geometric relationship and is off by a small percentage, however, the overall effect is negligible.

5) In the PVEL calculation, it is assumed that where a small line tees into a much larger line (i.e. Larger being two times or greater in diameter) the boundary for the small line ends at the line intersection.

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	T. B. Hudson	9/20/86
Subject/Title	Reviewed By	Date
Unit 1 HPCI Motor Operated Valve	W. T. Barr	9/20/86
Differential Pressure Calculation	Calculation Number SNH-86-015	Sheet 3 of 61

SUMMARY OF CONCLUSIONS

The following page is a summary table of the results for each HPCI Motor Operated Valve in the Scope of NRC IEB 85-03.

The first column titled "MPL Number" gives the MPL number of the valve.

The second column titled "Valve Description" is the description of the valve given in the equipment location index (ELI).

The third column titled "Valve Function" is the function of the valve as stated in the General Electric "BWR Owners' Group Report on the Operational Design Basis of Selected Safety-Related Motor-Operated Valves."

The fourth column titled "Safety" indicates if the valve has any safety-related action.

The fifth column titled "DP Calculation Formula" gives the formula used to calculate the maximum differential pressure.

The sixth column titled "Maximum DP" indicates whether the maximum DP occurs upstream or downstream of the valve.

The seventh column titled " Max DP ON " indicates whether the maximum DP is calculated for opening or closing.

The eighth column titled "DP (PSID)" gives the calculated maximum DP in psid.

The ninth column titled "Safety On" gives the safety action of the valve.

DESIGN CALCULATIONS — SOUTHERN COMPANY SERVICES

E.I. HATCH NUCLEAR PLANT UNIT 1 — PREPARED BY: T B Harkins — DATE 09/21/86

UNIT 1 HPCI MOTOR OPERATED VALVE — REVIEWED BY: C Sorenson — DATE 09/22/86

DIFFERENTIAL PRESSURE CALCULATION — CALCULATION No. SNH-86-015 — SHEET 4 OF 61

SUMMARY TABLE 09/21/86

MPL NUMBER	VALVE DESCRIPTION	VALVE FUNCTION	SAFETY	DP CALCULATION FORMULA	MAXIMUM DP	MAX DP ON	DP (PSID)	SAFETY ON
1E41-F001	TURBINE STEAM SUPPLY VALVE	HPCI TURBINE STEAM ADMISSION VALVE	YES	DP=PRSS	UPSTREAM	OPEN	1080	OPEN
1E41-F002	STEAM SUPPLY INBOARD ISOL VALVE	HPCI STEAM LINE ISOLATION VALVE	YES	DP=PRSS	UPSTREAM	CLOSE	1080	CLOSE
1E41-F003	STEAM SUPPLY OUTBD ISOL VALVE	HPCI STEAM LINE ISOLATION VALVE	YES	DP=PRSS	UPSTREAM	CLOSE	1080	CLOSE
1E41-F004	PUMP SUCT FRM COND STOR TANK	HPCI CST SUCTION VALVE	YES	DP=PELD+PV+PVEL1	UPSTREAM	CLOSE	29.594	CLOSE
1E41-F006	HPCI PUMP INBD DISCH VALVE	HPCI INJECTION/ISOLATION VALVE	YES	DP=PSOH-PISO-PEL	UPSTREAM	OPEN	1403.81	OPEN/CLOSE
1E41-F006	HPCI PUMP INBD DISCH VALVE	HPCI INJECTION/ISOLATION VALVE	YES	DP=PSOH-PISO-PEL+PVEL2	UPSTREAM	CLOSE	1411.886	OPEN/CLOSE
1E41-F007	HPCI PUMP OUTBD DISCH VALVE	HPCI INJECTION VALVE TEST VALVE	NO	NO SAFETY ACTION	N/A	N/A	N/A	NONE
1E41-F008	TEST BYPASS VALVE TO COND STOR	HPCI CST TEST RETURN VALVE	NO	NO SAFETY ACTION	N/A	N/A	N/A	NONE
1E41-F011	REDUNDANT SHUTOFF W/F008	HPCI CST TEST RETURN VALVE	NO	NO SAFETY ACTION	N/A	N/A	N/A	NONE
1E41-F012	PMP MIN FLO BYP TO SUPP POOL	HPCI PUMP MIN FLO BYP ISOL VALVE	YES	DP=PSOH+PELM	UPSTREAM	OPEN	2289.37	OPEN/CLOSE
1E41-F012	PMP MIN FLO BYP TO SUPP POOL	HPCI PUMP MIN FLO BYP ISOL VALVE	YES	DP=PMF+PELM+PVEL3	UPSTREAM	CLOSE	2289.911	OPEN/CLOSE
1E41-F041	PMP SUCT FROM SUPP POOL	HPCI SUPP POOL SUCT ISOL VALVE	YES	DP=PRV-PELS	DOWNSTREAM	OPEN	95.72	OPEN/CLOSE
1E41-F041	PMP SUCT FROM SUPP POOL	HPCI SUPP POOL SUCT ISOL VALVE	YES	DP=PLOC+PLOM1	UPSTREAM	CLOSE	35.93	OPEN/CLOSE
1E41-F042	PMP SUCT FROM SUPP POOL	HPCI SUPP POOL SUCT ISOL VALVE	YES	DP=PRV-PELS	DOWNSTREAM	OPEN	95.72	OPEN/CLOSE
1E41-F042	PMP SUCT FROM SUPP POOL	HPCI SUPP POOL SUCT ISOL VALVE	YES	DP=PLOC+PLOM1	UPSTREAM	CLOSE	35.93	OPEN/CLOSE
1E41-F059	COOLING WATER SUPPLY VALVE	HPCI TURBINE ACCES COOLING WTR VLV	YES	DP=PC+PLOM2	UPSTREAM	OPEN	36.94	OPEN/CLOSE
1E41-F059	COOLING WATER SUPPLY VALVE	HPCI TURBINE ACCES COOLING WTR VLV	YES	DP=PC+PLOM2+PVEL4	UPSTREAM	CLOSE	37.857	OPEN/CLOSE
1E41-F104	GATE VALVE 2 IN MO	HPCI VAC BREAKER LINE ISOL VALVE	YES	DP=PC+PATM	UPSTREAM	CLOSE	30.5	CLOSE
1E41-F111	GATE VALVE 2 IN MO	HPCI VAC BREAKER LINE ISOL VALVE	YES	DP=PC+PATM	UPSTREAM	CLOSE	30.5	CLOSE

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	[illegible]	9-20-86
Subject/Title: Unit 1 HPCI Motor Operated Valve	Reviewed By: W.T. Barr	Date: 9/20/86
Differential Pressure Calculation	Calculation Number: SNH-86-015	Sheet: 5 of 61

UNIT 1
HPCI MOV CALCULATIONS
REFERENCES

1. A-11000 REV. N/A UNIT 1 PIPE SPECIFICATION
2. A-16360 REV. N/A SHT 2 & SHT 25 MOV DATA SHEETS
3. A-16368 REV. N/A SHT 1 MOV DATA SHEETS
4. A-16397 REV. 12 INSTRUMENT SETPOINT INDEX
5. H-11038 REV. 15 P & ID DEMINERALIZED WATER
6. H-16081 REV. 4 FEEDWATER PIPING INSIDE DRYWELL ELEVATION 130'-0" & ABOVE
7. H-16134 REV. 19 HPCI STEAM TURBINE DRAINAGE PIPING
8. H-16332 REV. 19 HPCI SYSTEM P & ID SHEET 1
9. H-16333 REV. 17 HPCI SYSTEM P & ID SHEET 2
10. S-00010 REV. 0 KELLOGG ISOMETRIC DWG. B21-11
11. S-00079 REV. 0 KELLOGG ISOMETRIC DWG. E41-1
12. S-00081 REV. 0 KELLOGG ISOMETRIC DWG. E41-3
13. S-00086 REV. 0 KELLOGG ISOMETRIC DWG. E41-8
14. S-01388 REV. 0 KELLOGG ISOMETRIC DWG. E41-F6
15. S-01390 REV. 0 KELLOGG ISOMETRIC DWG. E41-F6B
16. S-01441 REV. 0 KELLOGG ISOMETRIC DWG. E41-F61
17. S-11417 REV. B. 18" L 900 WE MANUAL OPERATED 900 LB GATE VALVE
18. S-11423 REV. F 14" L 900 WEOS PRESSURE SEAL GATE, CRANE
19. S-14482 REV. A 16" L 150 WEOS GATE VALVE WITH FLEX DISC, CRANE
20. S-15290 REV. H GENERAL PLAN DRYWELL AND TORUS LAYOUT
21. S-16122 REV. 0 PROCESS DIAGRAM HPCI SYSTEM

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	L B Harkins	9-20-86
Subject/Title	Reviewed By	Date
Unit 1 HPCI Motor Operated Valve	W. T. Barr	9/20/86
Differential Pressure Calculation	Calculation Number SNH-86-015	Sheet 6 of 61

UNIT 1
HPCI MOV CALCULATIONS
REFERENCES CONT'D

22. S-16788 REV. C BYRON JACKSON PUMP MANUAL, PUMP CURVE T-31749

23. S-17514 REV. 0 4" PRESSURE SEAL GLOBE VALVE, VELAN

24. S-18471 REV. C 4" PRESSURE SEAL GLOBE VALVE, VELAN

25. S-18627 REV. D 2" 1500 LB MOTOR OPERATED GLOBE VALVE, VELAN

26. S-18835 REV. C MODEL LCT-20 SERIES RELIEF VALVE

27. SX-11471 REV. 0 16" L-150 WEOS GATE VALVE, CRANE

28. SX-14320 REV. 0 BOM FOR CRANE VALVE MPL NO. E41-F004

29. S-14482 REV. A 16" L-150 WEOS GATE VALVE, CRANE

30. UNIT NO. 1 TECHNICAL SPECIFICATIONS AMENDMENT 128

31. UNIT NO. 2 FSAR TABLE 6.2-5 SHT. 2 NOTE 7

32. SCS MECHANICAL ENGINEERING STANDARDS REV. 1

33. BWR OWNERS GROUP REPORT ON THE OPERATIONAL DESIGN BASIS OF SELECTED SAFETY RELATED MOTOR OPERATED VALVES, DRF-E12-00100-75, AUGUST 1986.

34. NEDO DOCUMENT 24570 REV. 2 FIGURE H1 4.1.2-1

35. CRANE TECHNICAL PAPER NO. 410, 18TH PRINTING

36. ENGINEERS COMPANION 1966 PAGE 13

37. TELECOPY FROM DAN HORASOWYCH OF YARWAY TO JACK ROBYN ON 9-11-86

38. TELECOPY FROM PAUL COUTINHO OF VELAN TO JACK ROBYN ON 9-18-86

39. ENGINEERING FORMULAS 4TH EDITION, PAGE B3

DEFINITION OF TERMS 09/18/86

TERM	DEFINITION OF TERM
DP	VALVE MAXIMUM EXPECTED OPERATING DIFFERENTIAL PRESSURE
PSOH	DIFFERENTIAL PRESSURE DEVELOPED BY SYSTEM MAIN PUMPS AT ZERO FLOW RATE. FOR STEAM TURBINE DRIVEN PUMPS, USE MAXIMUM NORMAL TURBINE SPEED
PEL	MINIMUM HYDROSTATIC PRESSURE DIFFERENCE BETWEEN SUCTION AND DISCHARGE DUE TO ELEVATION. (DISCHARGE ELEVATION IS HIGHER THAN SUCTION)
PISO	LOW REACTOR PRESSURE AT WHICH STEAM SUPPLY LINES AUTOMATICALLY ISOLATE
PELM	MAXIMUM HYDROSTATIC PRESSURE DIFFERENCE BETWEEN SUCTION AND DISCHARGE SOURCE DUE TO ELEVATION
PRSS	REACTOR PRESSURE CORRESPONDING TO THE SPRING SETPOINT OF THE REACTOR SAFETY RELIEF VALVE WITH THE LOWEST NOMINAL SPRING SETPOINT
PELD	HYDROSTATIC PRESSURE DIFFERENCE BETWEEN CST AND SUPPRESSION POOL ASSUMING THE CST TO BE FULL AND THE SUPPRESSION POOL WATER LEVEL AT ITS MAXIMUM ALLOWABLE NORMAL LEVEL
PMF	DIFFERENTIAL PRESSURE DEVELOPED BY THE SYSTEM MAIN PUMPS AT A FLOW RATE EQUAL TO THE REQUIRED MINIMUM BYPASS FLOW RATE. FOR STEAM DRIVEN PUMPS USE MAXIMUM NORMAL TURBINE SPEED

DEFINITION OF TERMS 09/18/86

TERM	DEFINITION OF TERM
PV	VELOCITY HEAD IN THE SUPPRESSION POOL SUCTION LINE AT THE LOCATION WHERE THE CST LINE CONNECTS TO IT
PRV	SYSTEM SUCTION RELIEF VALVE ACTUATION SET PRESSURE
PELS	HYDROSTATIC PRESSURE DIFFERENCE BETWEEN THE MINIMUM SUPPRESSION POOL WATER LEVEL AND THE LOCATION OF THE RELIEF VALVE ON THE PUMP SUCTION LINE
PLOC	LOCA WETWELL PRESSURE WHEN THE SYSTEM IS ISOLATED
PLOM	HYDROSTATIC PRESSURE UPSTREAM OF THE VALVE DUE TO MAXIMUM LOCA SUPPRESSION POOL WATER LEVEL
PC	MAXIMUM LOCA WETWELL PRESSURE WHEN SYSTEM IS REQUIRED TO OPERATE
PATM	ATMOSPHERIC PRESSURE
PVEL	DIFFERENTIAL PRESSURE ASSOCIATED WITH VALVE CLOSURE DUE TO FLUID VELOCITY CHANGES (I.E., WATER HAMMER TYPE PRESSURE INCREASE) INSIDE THE PIPE

DERIVATION OF VALUES 09/19/86

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PSOH	2260	FROM S-16788 REV.C,BYRON JACKSON PUMP MANUAL, PUMP CURVE T-31749 @ A TURBINE SPEED OF 4000 RPM.
PEL	6.19	THE ELEVATION OF THE FEEDWATER PIPING NOZZLE AT THE REACTOR IS GIVEN AS 183' 9 1/2" IN H-16081 REV.4. THE MAXIMUM WATER LEVEL IN THE CST IS GIVEN AS 169' 6" IN H-11038 REV.15. THUS THE DIFFERENCE IN ELEVATION IS: 183' 9 1/2" - 169' 6" = 14' 3 1/2" = 14.29 FT H20. AND THE HYDROSTATIC PRESSURE IS 14.29 FT.H20 X 0.432781 PSIG/FT.H20=6.19 PSIG
PISO	850	FROM A-16397 REV. 12. INSTRUMENT SETPOINT INDEX. USE THE MSL ISOLATION SET POINT AS GIVEN FOR INSTRUMENTS B21-N015 A-D.
PELM	29.37	THE CST IS AT ITS MAXIMUM WATER LEVEL AND THE SUPPRESSION POOL

DERIVATION OF VALUES 09/19/86

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PELM		IS AT ITS MINIMUM WATER LEVEL WHEN THE MINIMUM FLOW BYPASS VALVE IS REQUIRED TO OPERATE. THE MAXIMUM WATER LEVEL IN THE CST IS GIVEN AS 169' 6" IN H-11038 REV. 15. THE MINIMUM WATER LEVEL IN THE SUPPRESSION POOL IS GIVEN AS 12' 2" IN THE UNIT 1 TECHNICAL SPECIFICATION SECTION 3.7. AMENDMENT NO. 128. THE INSIDE BOTTOM ELEVATION OF THE SUPPRESSION POOL IS GIVEN AS 89' 5 3/4", DERIVED FROM 103' 6 1/4" - 14' 0 1/2", IN S-15290 REV.H. THE ELEVATION OF THE SUPPRESSION POOL AT MINIMUM WATER LEVEL IS THE INSIDE BOTTOM ELEVATION PLUS THE MINIMUM WATER LEVEL: 89' 5 3/4" + 12' 2" = 101' 7 3/4" THE HEAD DIFFERENCE IS THEN: 169' 6" - 101' 7 3/4" = 67' 10 1/4" = 67.85 FT H20 THUS THE HYDROSTATIC PRESSURE IS:

DERIVATION OF VALUES 09/19/86

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PELM		67.85 FT H2Ø x Ø.432781 PSIG/FT H2Ø = 29.37 PSIG
PRSS	1Ø8Ø	FROM UNIT 1 TECHNICAL SPECIFICATION SECTION 2.2 AMENDMENT NO. 128.
PELD	29.22	THE MAXIMUM WATER LEVEL IN THE CST IS GIVEN AS 169' 6" IN H-11Ø38 REV. 15. THE MAXIMUM WATER LEVEL IN THE SUPPRESSION POOL IS 12' 6" FROM UNIT 1 TECHNICAL SPECIFICATION SECTION 3.7 AMENDMENT NO. 128. THE INSIDE BOTTOM ELEVATION OF THE SUPPRESSION POOL IS 89' 5 3/4", DERIVED FROM 1Ø3' 6 1/4" - 14' Ø 1/2", IN S-15290 REV. H. THE ELEVATION OF THE SUPPRESSION POOL MAXIMUM WATER LEVEL IS THE INSIDE BOTTOM ELEVATION PLUS THE MAXIMUM WATER LEVEL: 89' 5 3/4" + 12' 6" = 1Ø1' 11 3/4" THE HEAD DIFFERENCE IS THEN:

DERIVATION OF VALUES 09/19/86

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PELD		169' 6" - 101' 11 3/4" = 67' 6 1/4" = 67.52 FT. H2Ø THUS THE HYDROSTATIC PRESSURE IS: 67.52 FT H2O x Ø.432781 PSIG/FT H2Ø = 29.22 PSIG
PMF	2255	FROM S-16788 REV. C., BYRON JACKSON PUMP MANUAL, PUMP CURVE T-31749 AT A MINIMUM FLOW BYPASS RATE OF 450 GPM, S-16122 REV. Ø PROCESS DIAGRAM HPCI SYSTEM, AND 4000 RPM TURBINE SPEED.
PV	Ø.374	THE HPCI SYSTEM RATED FLOW IS GIVEN AS 4250 GPM IN THE UNIT 1 TECHNICAL SPECIFICATION SECTION 4.5.D.1.b AMENDMENT NO. 128. THE INSIDE DIAMETER OF THE SUPPRESSION POOL SUCTION LINE IS 15.250" GIVEN IN H-16332 REV. 19, A-11000 UNIT 1 PIPE SPECIFICATION AND THE CRANE TECHNICAL PAPER NO. 410, 18TH PRINTING.

DERIVATION OF VALUES 09/20/86

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PV		THE VELOCITY HEAD IS EQUAL TO:
		(V)** 2/ 2(gc) WHERE:
		gc IS GRAVITATIONAL CONSTANT
		= 32.2 FT/(SEC)**2
		PI = 3.1416 (dimensionless)
		V = Q/A
		V = (4250 x 0.13368) x (144/60) /
		. [PI x ((15.250)**2)/4]
		. = 7.46 FT/SEC
		THUS VELOCITY HEAD IS:
		(7.46)**2/2(32.2) = 0.865 FT H20
		AND VELOCITY HEAD PRESSURE IS:
		0.865 FT H20 x 0.432781 PSIG/FT H20
		= 0.374 PSIG
PRV	100	FROM S-18835 REV. C MODEL LCT-20 SERIES RELIEF VALVE.
PELS	4.28	THE MINIMUM SUPPRESSION POOL ELEVATION WAS DETERMINED TO BE 101' 7 3/4" IN THE CALCULATION FOR PELM ABOVE.

DERIVATION OF VALUES 09/20/86

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PELS		THE ELEVATION FOR THE SUCTION RELIEF VALVE E41-F020 IS GIVEN AS 91' 9" ON S-01441 REV. 0. THUS THE HYDROSTATIC HEAD IS: 101' 7 3/4" - 91' 9" = 9' 10 3/4" = 9.90 FT H20 AND THE HYDROSTATIC PRESSURE IS: 9.90 FT. X 0.432781 PSIG/FT H20 = 4.28 PSIG
PLOC	30.5	PLOC=PC. THE ECCS OPERATION MAY REQUIRE THE CLOSURE OF THE SUPPRESSION POOL ISOLATION VALVES TO PROVIDE PRIMARY CONTAINMENT ISOLATION FOR EXTREME LOCA CONDITIONS FOLLOWING UTILIZATION OF THE WETWELL INVENTORY.
PLOM1	5.43	THE MAXIMUM LOCA SUPPRESSION POOL WATER LEVEL IS 102' 7 1/2" GIVEN IN S-15290 REV. H. THE CENTERLINE ELEVATION OF VALVES E41-F041 AND E41-F042 IS 90' 1" FROM S-00081 REV. 0.

DERIVATION OF VALUES 09/19/86

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PLOM1		THE HEAD DIFFERENCE IS: 102' 7 1/2" - 90' 1" = 12' 6 1/2" = 12.54 FT H20. THUS THE HYDROSTATIC PRESSURE IS: 12.54 FT H20 X 0.432781 PSIG/FT H20 = 5.43 PSIG
PLOM2	6.44	THE MAXIMUM LOCA SUPPRESSION POOL WATER LEVEL IS 102' 7 1/2" GIVEN IN S-15290 REV. H. THE CENTERLINE ELEVATION OF VALVE E51-F059 IS 87' 9" FROM H-16134 REV. 19. THE HEAD DIFFERENCE IS: 102' 7 1/2" - 87' 9" = 14' 10 1/2" = 14.88 FT H20 THUS THE HYDROSTATIC PRESSURE IS: 14.88 FT H20 X 0.432781 PSIG/FT H20=6.44 PSIG
PC	30.5	FROM NEDO DOCUMENT 24570 REV. 2 FIGURE H1 4.1.2-1

DERIVATION OF VALUES 09/19/86

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PATM	Ø	NORMAL ATMOSPHERIC PRESSURE = 14.696 PSIA PSIG = PSIA - 14.696 = Ø
PVEL1	Ø	KELLOGG ISOMETRIC DRAWINGS S-ØØØ86 REV. Ø, AND S-ØØØ81 REV. Ø SHOW THAT THE UPSTREAM PIPING IS CONNECTED TO THE CONDENSATE STORAGE TANK. IT IS ASSUMED THAT ANY WATER HAMMER EFFECTS IN THE UPSTREAM PIPING WOULD BE DISSIPATED WITHIN THE CST VOLUME AND PRODUCE NO RESULTANT PRESSURE RISE ON THE VALVE. THE REFERENCED DRAWINGS ALSO SHOW THAT THE DOWNSTREAM PIPING IS INTERCONNECTED WITH THE SUPPRESSION POOL SUCTION LINE. IT IS ASSUMED THE HPCI PUMP IS OPERATING TO DRAW A SUCTION FROM THE SUPPRESSION POOL WHEN 1E41-FØØ4 BEGINS TO CLOSE. THEREFORE NO DOWNSTREAM FLUID DECELERATION WILL RESULT. IT MAY BE CONCLUDED THAT NO INCREASE IN PRESSURE RESULTS BECAUSE OF WATER HAMMER. CONSIDERING THE ABOVE FACTS VALVE 1E41-FØØ4

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PVEL1		CAN BE CONSIDERED TO HAVE NO WATER HAMMER PRESSURE INCREASE.
PVEL2	8.076	DIFFERENTIAL PRESSURE ACROSS THE VALVE DUE TO WATER HAMMER FOR 1E41-F006; THE VALUE FOR PVEL2 IS CALCULATED BY COMPUTER. A DERIVATION FOR PVEL AND THE GATE VALVE AREA VS PERCENT OPEN CURVE USED IN THE CALCULATION ARE FOUND ATTACHED. THE FOLLOWING DATA IS USED IN THE CALCULATION TO DERIVE PVEL2:

SYSTEM VELOCITY UPSTREAM (Vsu) AND SYSTEM VELOCITY DOWNSTREAM (Vsd), WHERE:

. FLOWRATE = 4250 GPM FROM S-16122 REV. 0.

. AREA OF 14" SCH 80 PIPE = 122.72 IN SQ

. AREA OF 14" SCH 100 PIPE = 115.49 IN SQ

. FROM CRANE TECHNICAL PAPER NO. 410

THEN:

. Vsu=(4250 GPM x 0.321) / 122.72 IN SQ

. = 11.12 FT/SEC

DERIVATION OF VALUES 09/21/86

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PVEL2		. Vsd=(4250 GPM x 0.321) / 115.49 IN SQ . = 11.81 FT/SEC CLOSURE TIME = 20 SEC FROM A-16360 SH 2 VALVE THROAT DIAMETER . DIAM VALVE = 12.25" FROM S-11423 REV. F LENGTH UPSTREAM (LU) AND DOWNSTREAM (LD) . LU = 244.14 FT FROM S-00079 REV. A . LD = 155.95 FT FROM S-00079 REV. A . S-00010 REV. 0, H-16081 REV. 4, . S-11417 REV. B AND SCS MECHANICAL ENG . STANDARDS REV. 1. PVEL2 = 8.076 FROM COMPUTER PRINTOUT
PVEL3	5.541	DIFFERENTIAL PRESSURE ACROSS THE VALVE DUE TO WATER HAMMER FOR 1E41-F012; THE VALUE FOR PVEL3 IS CALCULATED BY COMPUTER. A DERIVATION FOR PVEL AND THE GLOBE VALVE CV VS PERCENT OPEN CURVE USED IN THE CALCULATION ARE FOUND ATTACHED. THE FOLLOWING DATA IS USED IN THE CALCULATION TO DERIVE PVEL3:

DERIVATION OF VALUES 09/21/86

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PVEL3		SYSTEM VELOCITY UPSTREAM (Vsu) AND SYSTEM VELOCITY DOWNSTREAM (Vsd) WHERE: . FLOWRATE = 450 GPM FROM S-16122 REV. 0 . AREA OF 4" SCH 80 PIPE = 11.5 IN SQ . AREA OF 4" SCH 40 PIPE = 12.73 IN SQ . FROM CRANE TECHNICAL PAPER No. 410 THEN: . Vsu=(450 GPM x 0.321) / 11.5 IN SQ . = 12.561 FT/SEC . Vsd=(450 GPM x 0.321) / 12.73 IN SQ . = 11.347 FT/SEC CLOSURE TIME = 10 SEC FROM A-16360 SH 25 VALVE THROAT DIAMETER . DIAM VALVE = 2.5" PER . TELECOPY TO JACK ROBYN OF SCS . FROM PAUL COUTINHO OF VELAN ON 9/18/86. LENGTH UPSTREAM (LU) AND LENGTH DOWNSTREAM (LD) . LU = 61.05 FT FROM S-00079 REV. A . LD = 38.958 FT FROM S-00079 REV. A . FOR LD IT IS ASSUMED THAT THE WATER HAMMER .

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PVEL3		. BOUNDARY ENDS AT THE TIE IN TO THE . RHR TEST LINE. PVEL3 = 5.541 FROM COMPUTER PRINTOUT
PVEL4	0.917	DIFFERENTIAL PRESSURE ACROSS THE VALVE DUE TO WATER HAMMER FOR 1E41-F059. THE VALUE FOR PVEL4 IS CALCULATED BY COMPUTER. A DERIVATION FOR PVEL AND THE GLOBE VALVE CV VS PERCENT OPEN CURVE USED IN THE CALCULATION ARE FOUND ATTACHED. THE FOLLOWING DATA IS USED IN THE CALCULATION TO DERIVE PVEL4: SYSTEM VELOCITY UPSTREAM (Vsu) AND SYSTEM VELOCITY DOWNSTREAM (Vsd) WHERE: . FLOWRATE = 70 GPM FROM S-16122 REV. 0 . AREA OF 2" SCH 80 PIPE = 2.953 IN SQ . FROM CRANE TECHNICAL PAPER No. 410 THEN: . Vsu=(70 GPM x 0.321) / 2.953 IN SQ . = 7.601 FT/SEC

DERIVATION OF VALUES 09/21/86

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PVEL4		. Vsd=Vsu CLOSURE TIME = 1Ø SEC FROM A-16368 SH 1 . . PER STD. STROKE TIME HNP2 . FSAR TABLE 6.2-5 SH 2 NOTE 7 VALVE THROAT DIAMETER . DIAM VALVE = 1 3/4" FROM S-18627 REV. C LENGTH UPSTREAM (LU) AND LENGTH DOWNSTREAM (LD) . LU = 25.Ø FT FROM S-Ø1388 REV. Ø . LD = 31.42 FT FROM S-Ø1388 REV.Ø AND S-Ø139Ø . REV.Ø PVEL4 = Ø.917 FROM COMPUTER PRINTOUT

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	[signature]	9-19-86
Subject/Title	Reviewed By	Date
Unit 1 HPCI Motor Operated Valve	[signature]	9-20-86
Differential Pressure Calculation	Calculation Number SNH-86-015	Sheet 22 of 61

DETERMINE THE PRESSURE INCREASE DUE TO THE RAPID DECELERATION OF FLUID CAUSED BY THE MOVEMENT OF A PROCESS GATE OR GLOBE VALVE

ASSUMPTIONS

1) Valve openings result in no waterhammer effects. The differential pressure across a valve during opening is decreased by an increase in fluid velocity. The maximum actuator loading takes place before the valve lift occurs.

2) Steam valve closure results in only minor or no waterhammer effect. The compressible nature of the fluid medium coupled with maximum anticipated velocity changes make the pressure addition insignificant.

3) Area of flow through a gate valve is a direct and linear relation to system velocity.

4) The percentage of valve opening is a direct relation to opening time.

5) It is assumed that flowing pressure does not drop below the fluids vapor pressure.

The pressure increase due to sudden deceleration of fluid may be expressed as:

$$PVEL = P1 + P2$$

Where P1 is the upstream pressure change, and P2 is the downstream pressure change.

The respective valves for P1 and P2 may be calculated as follows:

$$P_1, P_2 = \frac{\rho C \Delta V_{MAX}}{144\ g}$$

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	T B Harkins	9-19-86
Subject/Title	Reviewed By	Date
Unit 1 HPCI Motor Operated Valve	A. S. Kirk	9-20-86
Differential Pressure Calculation	Calculation Number SNH-86-015	Sheet 23 of 61

Where: ρ is the fluid density

C is the speed of sound through the fluid

Δ VMAX is the maximum system fluid differential velocity

144 is a conversion factor

and g is the Gravatational Constant

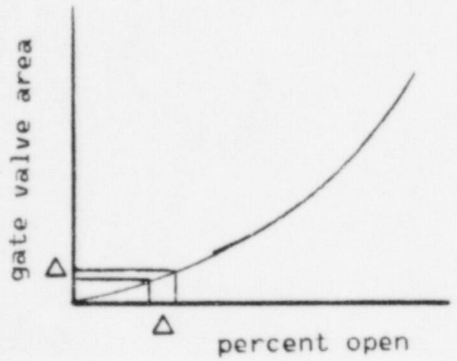
The fluid ΔV is assumed to be a direct relation to flow area, as shown in the gate valve area - percent open curves, and is a direct relation to Cv, as shown on the globe valve Cv - percent open curves.

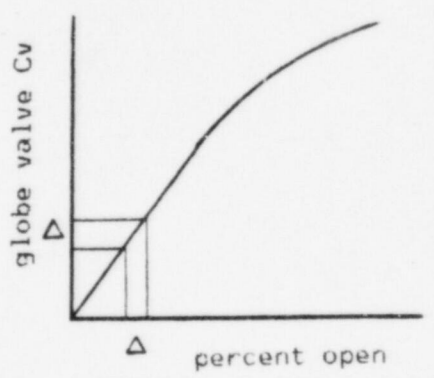
The valve Δt is a direct relation to Δ percentage open.

Therefore:

$$\frac{\Delta A}{\Delta \% \text{ Open}} \approx \frac{\Delta Cv}{\Delta \% \text{ Open}} \approx \frac{\Delta V}{\Delta t}$$

Having plotted a velocity relation against a time relation the region of highest differential velocity is examined.





Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	T.B. Harkleroad	9-19-86
Subject/Title	Reviewed By	Date
Unit 1 HPCI Motor Operated Valve	A.S. Kirk	9-20-86
Differential Pressure Calculation	Calculation Number SNH-86-015	Sheet 24 of 61

Incremental time is Defined As:

$$\Delta t = t2 - t1 = \frac{2L}{c}$$

Where the term 2L/C is the time require for a pressure wave to travel down a pipe's flow length and rebound to it's source valve.

Knowing the equation of the curve, the maximum ΔV for Δt (ie; greatest slope) is calculated and entered into the pressure equations.

The procedure is once again performed for the down stream side of the valve and added as follows to produce PVEL

$$PVEL = P1 + P2$$

Reference: BWROG REPORT APP. B

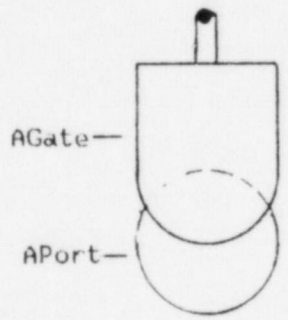
0082d

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	[signature]	9-19-86
Subject/Title: Unit 1 HPCI Motor Operated Valve	Reviewed By: [signature]	Date: 9/21/86
Differential Pressure Calculation	Calculation Number: SNH-86-015	Sheet: 25 of 61

RELATIONSHIP OF THE GATE VALVE FLOW AREA TO THE PERCENTAGE OPENING OF A TYPICAL GATE VALVE

It is assumed that the diameter of the gate is equal to the port diameter of the valve since the difference in diameters is insignificantly small.

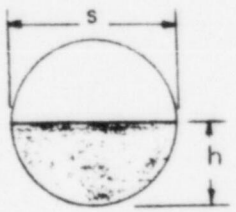
THE FLOW AREA OF THE VALVE MAY BE DETERMINED BY SUBTRACTING THE AREA OF THE GATE OCCLUDING THE TOTAL PORT AREA.



A = Area

AFlow = APort - AGate

THE AREA OF THE PORT IS CALCULATED USING THE CIRCULAR SEGMENT CALCULATION



$ASEG = h/6s\ (3h^2 + 4s^2)$

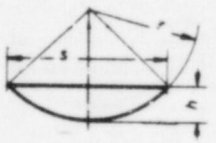
WITH h = RISE = RADIUS
AND s = CHORD = DIAMETER

THE AREA OF THE PORT IS EQUAL TO TWICE ASEG

APORT = 2ASEG = R/6D (3R**2 + 4D**2)

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	C Sorenson	9-19-86
Subject/Title	Reviewed By	Date
Unit 1 HPCI Motor Operated Valve	A D McGahee	9/21/86
Differential Pressure Calculation	Calculation Number SNH-86-015	Sheet 26 of 61

THE OCCLUDING AREA OF THE GATE IS FOUND BY USING THE AREA OF A CIRCULAR SEGMENT CALCULATION.



$$ASEG = h/6s\ (3h^2 + 4s^2)$$

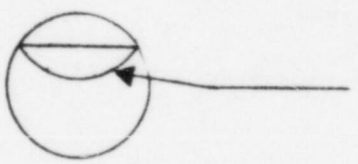
$$r = h/2 + s^2/8h$$

TRANSFORMING THE LATER EQUATION

$$s = (\ 8h\ (r-(h/2)))^{1/2}$$

WHICH COMBINED WITH THE ASEG CALCULATION MAY BE READILY SOLVED.

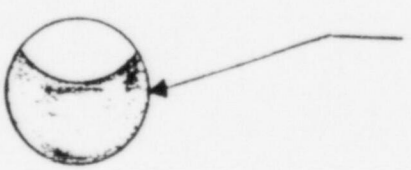
THE AREA OCCLUDED IS EQUAL TO TWICE ASEG.



AGATE = 2 ASEG.

THUS THE AREA OF FLOW THROUGH THE VALVE IS CALCULATED AS:

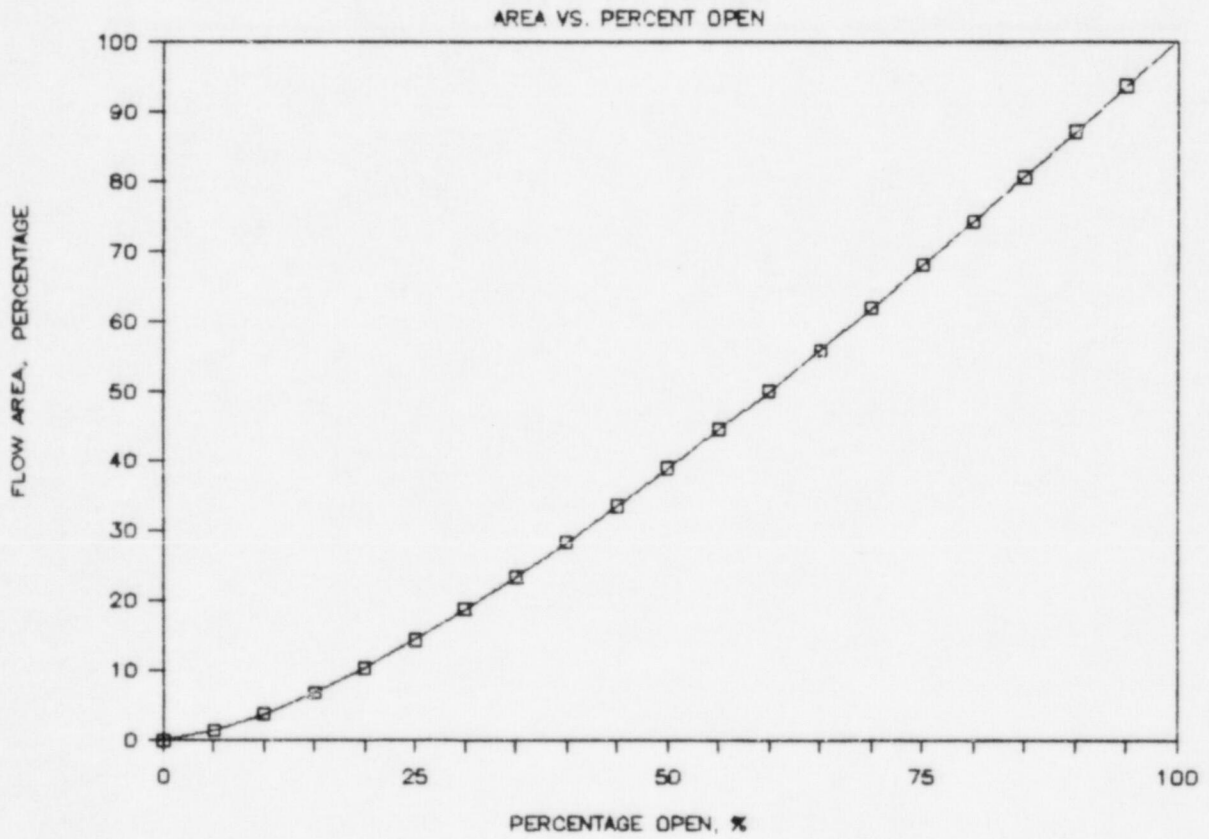
AFlow = APORT - AGATE



AFlow

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	C Lorenzo	9.19.86
Subject/Title	**Reviewed By**	**Date**
Unit 1 HPCI Motor Operated Valve	G.D. McNutt	9/21/86
Differential Pressure Calculation	Calculation Number SNH-86-015	Sheet 27 of 61

A GRAPHIC PRESENTATION OF THE TYPICAL FLOW AREA VS. PERCENT VALVE OPENING IS GIVEN AS FOLLOWS.



REFERENCE: ENGINEERING FORMULAS 4th EDITION, PAGE B3.

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	C Lorenzo	9.19.86
Subject/Title	Reviewed By	Date
Unit 1 HPCI Motor Operated Valve	A.S. Kirk	9-19-86
Differential Pressure Calculation	Calculation Number SNH-86-015	Sheet 28 of 61

NUMERICAL RELATIONSHIP BETWEEN A GRAPHICAL PRESENTATION OF MANUFACTURER'S 2" GLOBE VALVE OPENING VS. MANUFACTURER'S CV DATA

Given a curve of 0-100 % opening (see attached), It is Desired to numerically relate the first 60% of opening to CV.

The First 60% of opening is a linear function thus, the curve may be equated using linear regression of the point-slope form.

$$y - y1 = m(x-x1)$$

Using the points (0,0) and (50,40)

$$40-0 = m(50-0)$$

Solving for m

$$m = 40/50 = 0.8$$

The equation of a line is given as:

$$y = mx$$

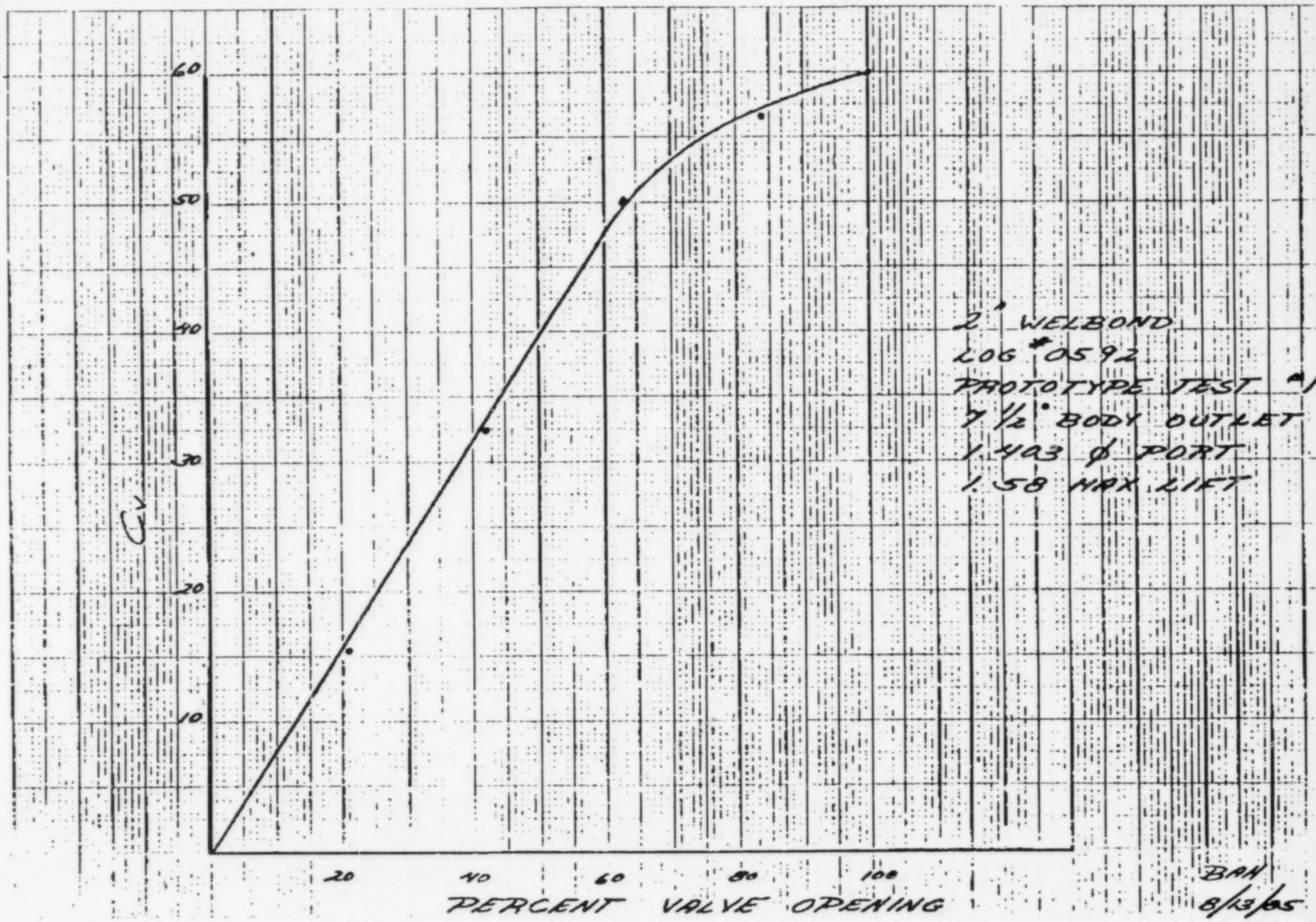
Hence, the equation relating cv with percent opening is:

$$CV = 0.8 \text{ (percentage opening)}$$

FOR ALL OPENINGS LESS THAN 60%.

Reference: THE ENGINEER'S COMPANION 1966 PG. 13.

SHT 290F 91


60
50
40
30
20
10
Cv
20
40
60
80
100
PERCENT VALVE OPENING
2" WELBOND
206 #0592
PROTOTYPE TEST #1
2 1/2" BODY OUTLET
1.493 Ø PORT
1.58 MAX LIFT
BAH
8/13/85

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	T B Harbins	9-19-86
Subject/Title	Reviewed By	Date
Unit 1 HPCI Motor Operated Valve	A. S. Kirk	9-19-86
Differential Pressure Calculation	Calculation Number SNH-86-015	Sheet 30 of 61

NUMERICAL RELATIONSHIP BETWEEN A GRAPHICAL PRESENTATION OF MANUFACTURER'S 4" GLOBE VALVE OPENING VS. MANUFACTURER'S CV DATA

Given a curve of 0-100 % opening (see attached), It is Desired to numerically relate the first 45% of opening to CV.

The First 45% of opening is a linear function thus, the curve may be equated using linear regression of the point-slope form.

$$y - y1 = m(x-x1)$$

Using the points (10,15) and (30,49)

$$49-15 = m(30-10)$$

Solving for m

$$m = 34/20 = 1.7$$

The equation of a line is given as:

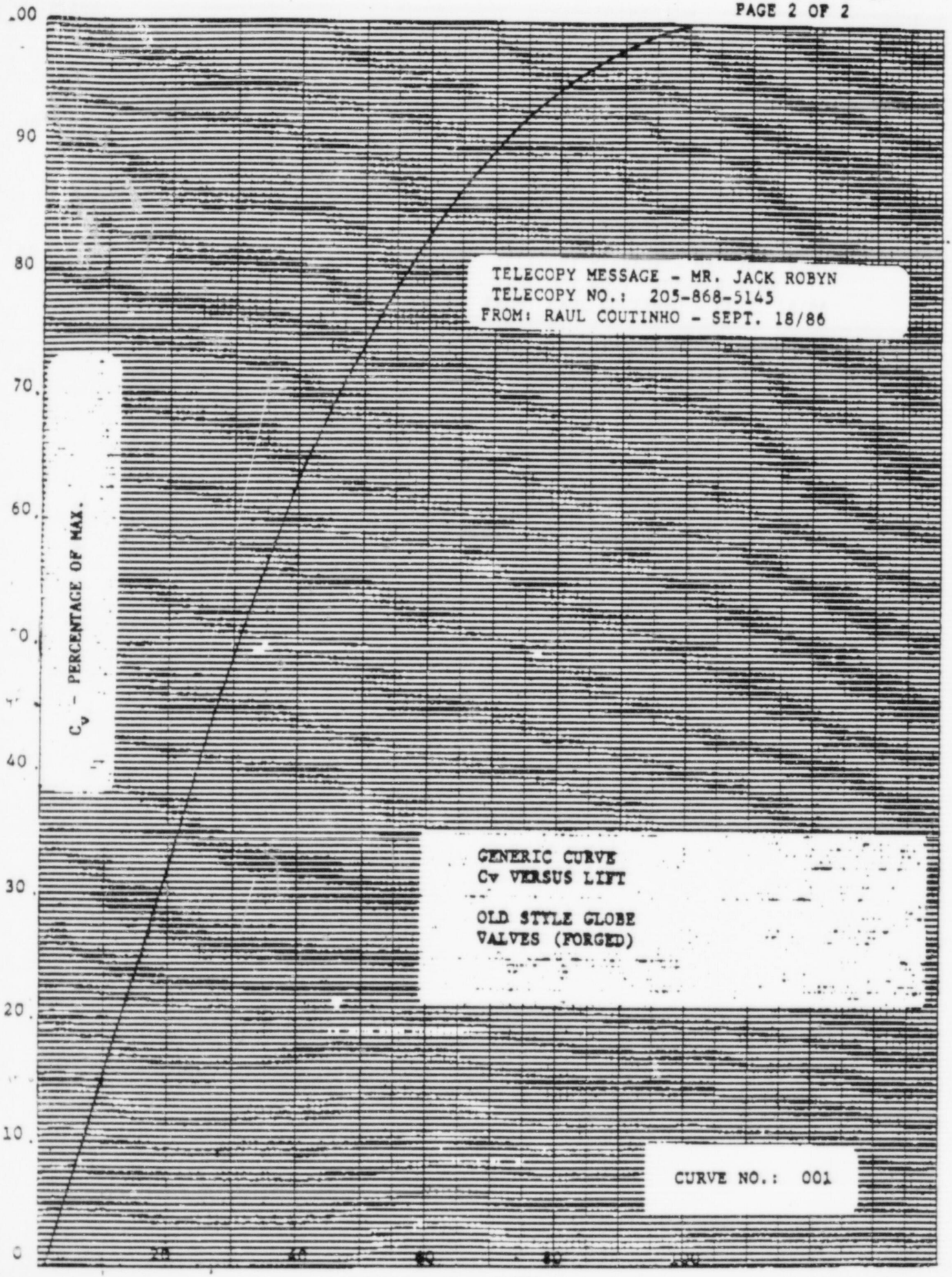
$$y = mx$$

Hence, the equation relating cv with percent opening is:

$$CV = 1.7 \text{ (percentage opening)}$$

FOR ALL OPENINGS LESS THAN 49%.

Reference: THE ENGINEER'S COMPANION 1966 PG. 13.


.00
90
80
70
60
0
40
30
20
10
0
C_v - PERCENTAGE OF MAX.
TELECOPY MESSAGE - MR. JACK ROBYN
TELECOPY NO.: 205-868-5145
FROM: RAUL COUTINHO - SEPT. 18/86
GENERIC CURVE
Cv VERSUS LIFT
OLD STYLE GLOBE
VALVES (FORGED)
CURVE NO.: 001
PERCENTAGE OF LIFT

GATE VALVE PVEL CALCULATION

MPL NUMBER	1E41-F006
VALVE DIAMETER (INCHES)	12.25
CLOSING TIME (SECONDS)	20
UPSTREAM PIPE LENGTH (FT)	244.14
DOWNSTREAM PIPE LENGTH (FT)	155.95
UPSTREAM SYSTEM VEL (FT/SEC)	11.12
DOWNSTREAM SYSTEM VEL (FT/SEC)	11.81
delta TIME UPSTREAM (SECONDS)	0.12207
delta TIME DWNSTREAM (SECONDS)	0.077975
TIME UPSTREAM 1 (SECONDS)	19.87793
TIME UPSTREAM 2 (SECONDS)	20
TIME DOWNSTREAM 1 (SECONDS)	19.922025
TIME DOWNSTREAM 2 (SECONDS)	20
RISE UPSTREAM 1	6.0876161
RISE UPSTREAM 2	6.125
RISE DOWNSTREAM 1	6.1011202
RISE DOWNSTREAM 2	6.125
CHORD UPSTREAM 1	12.249772
CHORD UPSTREAM 2	12.25
CHORD DOWNSTREAM 1	12.249907
CHORD DOWNSTREAM 2	12.25
MAX AREA (IN SQ)	118.79948
AREA FLOW UPSTREAM 1	0.9534862
AREA FLOW UPSTREAM 2	0
AREA FLOW DOWNSTREAM 1	0.6091957
AREA FLOW DOWNSTREAM 2	0
a/Au1	0.0080901
a/Au2	0
a/Ad1	0.0051689
a/Ad2	0
VELOCITY UPSTREAM 1 (FT/SEC)	0.0899616
VELOCITY UPSTREAM 2 (FT/SEC)	0
VELOCITY DOWNSTREAM 1 (FT/SEC)	0.0610442
VELOCITY DOWNSTREAM 2 (FT/SEC)	0
delta VEL UPSTREAM (FT/SEC)	0.0899616
delta VEL DOWNSTREAM (FT/SEC)	0.0610442
Pvu UPSTREAM PRESSURE (PSIG)	4.8112999
Pvd DOWNSTREAM PRESSURE (PSIG)	3.2647504

Pvel (PSIG) 8.0760503

FOUR INCH GLOBE VALVE PVEL CALCULATIONS

MPL NUMBER	1E41-F012
VALVE DIAMETER (INCHES)	2.5
CLOSING TIME (SECONDS)	10
UPSTREAM PIPE LENGTH (FT)	61.05
DOWNSTREAM PIPE LENGTH (FT)	38.958
UPSTREAM SYSTEM VEL (FT/SEC)	12.561
DOWNSTREAM SYSTEM VEL (FT/SEC)	11.347
delta TIME UPSTREAM (SECONDS)	0.030525
delta TIME DWNSTREAM (SECONDS)	0.019479
TIME UPSTREAM 1 (SECONDS)	5
TIME UPSTREAM 2 (SECONDS)	5.030525
TIME DOWNSTREAM 1 (SECONDS)	5
TIME DOWNSTREAM 2 (SECONDS)	5.019479
% OPEN UPSTREAM 1	50
% OPEN UPSTREAM 2	50.30525
% OPEN DOWNSTREAM 1	50
% OPEN DOWNSTREAM 2	50.19479
% CV UPSTREAM 1	85.7
% CV UPSTREAM 2	86.223198
% CV DOWNSTREAM 1	85.7
% CV DOWNSTREAM 2	86.03387
delta VEL UPSTREAM (FT/SEC)	0.065719
delta VEL DOWNSTREAM (FT/SEC)	0.0378842
Pvu UPSTREAM (PSIG)	3.5147627
Pvd DOWNSTREAM (PSIG)	2.0261138

Pvel3(PSIG) 5.5428764

TWO INCH GLOBE VALVE PVEL CALCULATIONS

MPL NUMBER	1E41-F059
VALVE DIAMETER (INCHES)	1.75
CLOSING TIME (SECONDS)	10
UPSTREAM PIPE LENGTH (FT)	25
DOWNSTREAM PIPE LENGTH (FT)	31.42
UPSTREAM SYSTEM VEL (FT/SEC)	7.601
DOWNSTREAM SYSTEM VEL (FT/SEC)	7.601
delta TIME UPSTREAM (SECONDS)	0.0125
delta TIME DWNSTREAM (SECONDS)	0.01571
TIME UPSTREAM 1 (SECONDS)	5
TIME UPSTREAM 2 (SECONDS)	5.0125
TIME DOWNSTREAM 1 (SECONDS)	5
TIME DOWNSTREAM 2 (SECONDS)	5.01571
% OPEN UPSTREAM 1	50
% OPEN UPSTREAM 2	50.125
% OPEN DOWNSTREAM 1	50
% OPEN DOWNSTREAM 2	50.1571
% CV UPSTREAM 1	40
% CV UPSTREAM 2	40.1
% CV DOWNSTREAM 1	40
% CV DOWNSTREAM 2	40.12568
delta VEL UPSTREAM (FT/SEC)	0.007601
delta VEL DOWNSTREAM (FT/SEC)	0.0095529
Pvu UPSTREAM (PSIG)	0.4065145
Pvd DOWNSTREAM (PSIG)	0.5109074

Pvel¼(PSIG) 0.9174219

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	1E41-F001
VALVE DESCRIPTION	TURBINE STEAM SUPPLY VALVE
VALVE FUNCTION	HPCI TURBINE STEAM ADMISSION VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PRSS
MAXIMUM DP ON OPEN OR CLOSE	OPEN
MAXIMUM DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ACTION ON OPEN/CLOSE	OPEN

VALUES USED:

PRSS = 1080

DP (PSID) 1080

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	1E41-F002
VALVE DESCRIPTION	STEAM SUPPLY INBOARD ISOL VALVE
VALVE FUNCTION	HPCI STEAM LINE ISOLATION VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PRSS
MAXIMUM DP ON OPEN OR CLOSE	CLOSE
MAXIMUM DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ACTION ON OPEN/CLOSE	CLOSE

VALUES USED:

PRSS = 1080

DP (PSID)	1080

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	1E41-F003
VALVE DESCRIPTION	STEAM SUPPLY OUTBD ISOL VALVE
VALVE FUNCTION	HPCI STEAM LINE ISOLATION VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PRSS
MAXIMUM DP ON OPEN OR CLOSE	CLOSE
MAXIMUM DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ACTION ON OPEN/CLOSE	CLOSE

VALUES USED:

PRSS = 1080

DP (PSID) 1080

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	1E41-F004
VALVE DESCRIPTION	PUMP SUCT FRM COND STOR TANK
VALVE FUNCTION	HPCI CST SUCTION VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PELD+PV+PVEL1
MAXIMUM DP ON OPEN OR CLOSE	CLOSE
MAXIMUM DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ACTION ON OPEN/CLOSE	CLOSE

VALUES USED:

PELD	= 29.22
PV	= 0.374
PVEL1	= 0

DP (PSID)	29.594

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	1E41-F006
VALVE DESCRIPTION	HPCI PUMP INBD DISCH VALVE
VALVE FUNCTION	HPCI INJECTION/ISOLATION VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PSOH-PISO-PEL
MAXIMUM DP ON OPEN OR CLOSE	OPEN
MAXIMUM DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ACTION ON OPEN/CLOSE	OPEN/CLOSE

VALUES USED:

PSOH = 2260
PISO = 850
PEL = 6.19

DP (PSID) 1403.81

DIFFERENTIAL PRESSURE CALCULATION 09/21/86

MPL NUMBER	1E41-F006
VALVE DESCRIPTION	HPCI PUMP INBD DISCH VALVE
VALVE FUNCTION	HPCI INJECTION/ISOLATION VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PSOH-PISO-PEL+PVEL2
MAXIMUM DP ON OPEN OR CLOSE	CLOSE
MAXIMUM DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ACTION ON OPEN/CLOSE	OPEN/CLOSE

VALUES USED:

PSOH = 2260
PISO = 850
PEL = 6.19
PVEL2 = 8.076

[redacted]

DP (PSID) 1411.886

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	1E41-F006
VALVE DESCRIPTION	HPCI PUMP INBD DISCH VALVE
VALVE FUNCTION	HPCI INJECTION/ISOLATION VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PSOH-PISO-PEL+PVEL2
MAXIMUM DP ON OPEN OR CLOSE	CLOSE
MAXIMUM DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ACTION ON OPEN/CLOSE	OPEN/CLOSE

VALUES USED:

PSOH	= 2260
PISO	= 850
PEL	= 6.19
PVEL2	= 8.377

DP (PSID) 1412.187

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	1E41-F007
VALVE DESCRIPTION	HPCI PUMP OUTBD DISCH VALVE
VALVE FUNCTION	HPCI INJECTION VALVE TEST VALVE
SAFETY ACTION (YES/NO)	NO
DP CALCULATION FORMULA	NO SAFETY ACTION
MAXIMUM DP ON OPEN OR CLOSE	N/A
MAXIMUM DP UPSTREAM/DOWNSTREAM	N/A
SAFETY ACTION ON OPEN/CLOSE	NONE

VALUES USED:

DP (PSID) N/A

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	1E41-F008
VALVE DESCRIPTION	TEST BYPASS VALVE TO COND STOR
VALVE FUNCTION	HPCI CST TEST RETURN VALVE
SAFETY ACTION (YES/NO)	NO
DP CALCULATION FORMULA	NO SAFETY ACTION
MAXIMUM DP ON OPEN OR CLOSE	N/A
MAXIMUM DP UPSTREAM/DOWNSTREAM	N/A
SAFETY ACTION ON OPEN/CLOSE	NONE

VALUES USED:

DP (PSID) N/A

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	1E41-F011
VALVE DESCRIPTION	REDUNDANT SHUTOFF W/F008
VALVE FUNCTION	HPCI CST TEST RETURN VALVE
SAFETY ACTION (YES/NO)	NO
DP CALCULATION FORMULA	NO SAFETY ACTION
MAXIMUM DP ON OPEN OR CLOSE	N/A
MAXIMUM DP UPSTREAM/DOWNSTREAM	N/A
SAFETY ACTION ON OPEN/CLOSE	NONE

VALUES USED:

DP (PSID)	N/A

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	1E41-F012
VALVE DESCRIPTION	PMP MIN FLO BYP TO SUPP POOL
VALVE FUNCTION	HPCI PUMP MIN FLO BYP ISOL VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PSOH+PELM
MAXIMUM DP ON OPEN OR CLOSE	OPEN
MAXIMUM DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ACTION ON OPEN/CLOSE	OPEN/CLOSE

VALUES USED:

PSOH = 2260
PELM = 29.37

DP (PSID) 2289.37

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	1E41-F012
VALVE DESCRIPTION	PMP MIN FLO BYP TO SUPP POOL
VALVE FUNCTION	HPCI PUMP MIN FLO BYP ISOL VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PMF+PELM+PVEL3
MAXIMUM DP ON OPEN OR CLOSE	CLOSE
MAXIMUM DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ACTION ON OPEN/CLOSE	OPEN/CLOSE

VALUES USED:

PMF = 2255
PELM = 29.37
PVEL3 = 5.541

DP (PSID) 2289.911

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	1E41-F041
VALVE DESCRIPTION	PMP SUCT FROM SUPP POOL
VALVE FUNCTION	HPCI SUPP POOL SUCT ISOL VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PRV-PELS
MAXIMUM DP ON OPEN OR CLOSE	OPEN
MAXIMUM DP UPSTREAM/DOWNSTREAM	DOWNSTREAM
SAFETY ACTION ON OPEN/CLOSE	OPEN/CLOSE

VALUES USED:

PRV = 100
PELS = 4.28

DP (PSID) 95.72

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	1E41-FØ41
VALVE DESCRIPTION	PMP SUCT FROM SUPP POOL
VALVE FUNCTION	HPCI SUPP POOL SUCT ISOL VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PLOC+PLOM1
MAXIMUM DP ON OPEN OR CLOSE	CLOSE
MAXIMUM DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ACTION ON OPEN/CLOSE	OPEN/CLOSE

VALUES USED:

PLOC = 3Ø.5
PLOM1 = 5.43

DP (PSID) 35.93

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	1E41-F042
VALVE DESCRIPTION	PMP SUCT FROM SUPP POOL
VALVE FUNCTION	HPCI SUPP POOL SUCT ISOL VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PRV-PELS
MAXIMUM DP ON OPEN OR CLOSE	OPEN
MAXIMUM DP UPSTREAM/DOWNSTREAM	DOWNSTREAM
SAFETY ACTION ON OPEN/CLOSE	OPEN/CLOSE

VALUES USED:

PRV = 100
PELS = 4.28

DP (PSID) 95.72

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	1E41-F042
VALVE DESCRIPTION	PMP SUCT FROM SUPP POOL
VALVE FUNCTION	HPCI SUPP POOL SUCT ISOL VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PLOC+PLOM1
MAXIMUM DP ON OPEN OR CLOSE	CLOSE
MAXIMUM DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ACTION ON OPEN/CLOSE	OPEN/CLOSE

VALUES USED:

PLOC = 30.5
PLOM1 = 5.43

DP (PSID) 35.93

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	1E41-F059
VALVE DESCRIPTION	COOLING WATER SUPPLY VALVE
VALVE FUNCTION	HPCI TURBINE ACCES COOLING WTR VLV
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PC+PLOM2
MAXIMUM DP ON OPEN OR CLOSE	OPEN
MAXIMUM DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ACTION ON OPEN/CLOSE	OPEN/CLOSE

VALUES USED:

PC = 30.5
PLOM2 = 6.44

DP (PSID) 36.94

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	1E41-F059
VALVE DESCRIPTION	COOLING WATER SUPPLY VALVE
VALVE FUNCTION	HPCI TURBINE ACCES COOLING WTR VLV
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PC+PLOM2+PVEL4
MAXIMUM DP ON OPEN OR CLOSE	CLOSE
MAXIMUM DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ACTION ON OPEN/CLOSE	OPEN/CLOSE

VALUES USED:

PC	= 30.5
PLOM2	= 6.44
PVEL4	= 0.917

DP (PSID)	37.857

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	1E41-F111
VALVE DESCRIPTION	GATE VALVE 2 IN MO
VALVE FUNCTION	HPCI VAC BREAKER LINE ISOL VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PC+PATM
MAXIMUM DP ON OPEN OR CLOSE	CLOSE
MAXIMUM DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ACTION ON OPEN/CLOSE	CLOSE

VALUES USED:

PC = 30.5
PATM = 0

DP (PSID)	30.5

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	1E41-F104
VALVE DESCRIPTION	GATE VALVE 2 IN MO
VALVE FUNCTION	HPCI VAC BREAKER LINE ISOL VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PC+PATM
MAXIMUM DP ON OPEN OR CLOSE	CLOSE
MAXIMUM DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ACTION ON OPEN/CLOSE	CLOSE

VALUES USED:

PC = 30.5
PATM = 0

DP (PSID)	30.5

GATE VALVE PVEL CALCULATIONS PAGE 1 OF 3

```
A3: [W11] ^MPL
B3: ^VALVE
C3: ^CLOSING
D3: ^UPSTR
E3: ^DNSTR
F3: 'UPSTRSYS
G3: 'DNSTRSYS
I3: ^dT UP
J3: ^dTDN
K3: ^TIMEu1
L3: ^TIMEu2
M3: ^TIMEd1
N3: ^TIMEd2
O3: ^RISEu1
P3: ^RISEu2
Q3: ^RISEd1
R3: ^RISEd2
S3: ^CHORDu1
T3: ^CHORDu2
U3: ^CHORDd1
V3: ^CHORDd2
W3: 'MAX AREA
X3: ^Aflu1
Y3: ^Aflu2
Z3: ^Afld1
AA3: ^Afld2
AB3: ^a/Au1
AC3: ^a/Au2
AD3: ^a/Ad1
AE3: ^a/Ad2
AF3: ^Vu1
AG3: ^Vu2
AH3: ^Vd1
AI3: ^Vd2
AJ3: ^dVu
AK3: ^dVd
AL3: ^Pvu
AM3: ^Pvd
AN3: ^Pvel
A4: [W11] ^NUMBER
B4: ^DIA, "
C4: ^T, SECS
D4: ^PIPE L'
E4: ^PIPE L'
F4: ^VEL FPS
G4: ^VEL FPS
W4: 'FLOW
A5: [W11] \-
```

B5: \-
C5: \-
D5: \-
E5: \-
F5: \-
G5: \-
H5: [W2] \-
I5: \-
J5: \-
K5: \-
L5: \-
M5: \-
N5: \-
O5: \-
P5: \-
Q5: \-
R5: \-
S5: \-
T5: \-
U5: \-
V5: \-
W5: \-
X5: \-
Y5: \-
Z5: \-
AA5: \-
AB5: \-
AC5: \-
AD5: \-
AE5: \-
AF5: \-
AG5: \-
AH5: \-
AI5: \-
AJ5: \-
AK5: \-
AL5: \-
AM5: \-
AN5: \-
A6: [W11] '1E51-FØ13
B6: 3+5/16
C6: 15
D6: 99.9
E6: 16.6
F6: 11.62
G6: 12.46
H6: [W2] '|
I6: (2*D6)/$D$29

GATE VALVE PVEL CALCULATIONS


```
J6: (2*E6)/$D$29
K6: ($D$30*$C6)-I6
L6: +$D$30*$C6
M6: ($D$30*$C6)-J6
N6: +$D$30*$C6
O6: (K6/$C6)*($B6/2)
P6: (L6/$C6)*($B6/2)
Q6: (M6/$C6)*($B6/2)
R6: (N6/$C6)*($B6/2)
S6: @SQRT(8*O6*(($B6/2)-(O6/2)))
T6: @SQRT(8*P6*(($B6/2)-(P6/2)))
U6: @SQRT(8*Q6*(($B6/2)-(Q6/2)))
V6: @SQRT(8*R6*(($B6/2)-(R6/2)))
W6: 2*((1/12)*(((3*B6*B6)/4)+(4*B6*B6)))
X6: (F6) (W6)-(2*((O6/(6*S6))*((3*O6*O6)+(4*S6*S6))))
Y6: (F6) (W6)-(2*((P6/(6*T6))*((3*P6*P6)+(4*T6*T6))))
Z6: (F6) ($W6)-2*((Q6/(6*U6))*((3*Q6*Q6)+(4*U6*U6)))
AA6: (F6) ($W6)-2*((R6/(6*V6))*((3*R6*R6)+(4*V6*V6)))
AB6: (F6) +X6/((@PI*$B6*$B6)/4)
AC6: (F6) +Y6/((@PI*$B6*$B6)/4)
AD6: (F6) +Z6/((@PI*$B6*$B6)/4)
AE6: (F6) +AA6/((@PI*$B6*$B6)/4)
AF6: (F6) +AB6*$F6
AG6: (F6) +AC6*$F6
AH6: (F6) +AD6*$G6
AI6: (F6) +AE6*$G6
AJ6: (F6) +AF6-AG6
AK6: (F6) +AH6-AI6
AL6: (F6) (AJ6*$D$28*$D$29)/(144*32.2)
AM6: (F6) (AK6*$D$28*$D$29)/(144*32.2)
AN6: (F6) +AL6+AM6
C28: 'DENSITY
D28: 61.996
E28: 'LB/FT3
C29: 'C
D29: 4000
E29: 'FT/SEC
C30: 'FUDGE FAC
D30: 1
E30: 'DIMLESS
```

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	Dawn C. Wilson	09/19/86
Subject/Title	Reviewed By	Date
Unit 1 HPCI Motor Operated Valve	[illegible]	9/21/86
Differential Pressure Calculation	Calculation Number SNH-86-015	Sheet 58 of 61

FOUR INCH GLOBE VALVE PVEL CALCULATIONS PAGE 1 OF 2

```
A3: [W11] ^MPL
B3: ^VALVE
C3: ^CLOSING
D3: ^UPSTR
E3: ^DNSTR
F3: 'UPSTRSYS
G3: 'DNSTRSYS
I3: ^dT UP
J3: ^dTDN
K3: ^TIMEu1
L3: ^TIMEu2
M3: ^TIMEd1
N3: ^TIMEd2
O3: ^% OPEN
P3: ^% OPEN
Q3: ^% OPEN
R3: ^% OPEN
S3: ^% CV
T3: ^% CV
U3: ^% CV
V3: ^% CV
W3: ^dVu
X3: ^dVd
Y3: ^Pvu
Z3: ^Pvd
AA3: ^Pvel
A4: [W11] ^NUMBER
B4: ^DIA, "
C4: ^T, SECS
D4: 'PIPE L'
E4: 'PIPE L'
F4: ^VEL FPS
G4: ^VEL FPS
O4: ^UPSTR1
P4: ^UPSTR2
Q4: ^DNSTR1
R4: ^DNSTR2
S4: ^UPSTR1
T4: ^UPSTR2
U4: ^DNSTR1
V4: ^DNSTR2
A5: [W11] \-
B5: \-
C5: \-
D5: \-
E5: \-
F5: \-
G5: \-
```

FOUR INCH GLOBE VALVE PVEL CALCULATIONS PAGE 2 OF 2

```
H5: [W2] \-
I5: \-
J5: \-
K5: \-
L5: \-
M5: \-
N5: \-
O5: \-
P5: \-
Q5: \-
R5: \-
S5: \-
T5: \-
U5: \-
V5: \-
W5: \-
X5: \-
Y5: \-
Z5: \-
AA5: \-
A6: [W11] '1E41-F012
B6: 2.5
C6: 10
D6: 61.05
E6: 38.958
F6: 12.561
G6: 11.347
H6: [W2] '|
I6: (2*D6)/$D$24
J6: (2*E6)/$D$24
K6: +$C6*0.5
L6: +$C6*0.5+I6
M6: +$C6*0.5
N6: +$C6*0.5+J6
O6: (+K6*100)/$C6
P6: (+L6*100)/$C6
Q6: (+M6*100)/$C6
R6: (+N6*100)/$C6
S6: +O6*1.714
T6: +P6*1.714
U6: +Q6*1.714
V6: +R6*1.714
W6: (+F6*(T6-S6))/100
X6: (+G6*(V6-U6))/100
Y6: (W6*$D$23*$D$24)/(144*32.2)
Z6: (X6*$D$23*$D$24)/(144*32.2)
AA6: +Y6+Z6

C23: 'DENSITY
D23: 61.996
E23: 'LB/FT3
C24: 'C
D24: 4000
E24: 'FT/SEC
```

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	Dawn C. Wilson	09/19/86
Subject/Title	Reviewed By	Date
Unit 1 HPCI Motor Operated Valve	[illegible]	9/21/86
Differential Pressure Calculation	Calculation Number SNH-86-015	Sheet 60 of 61

TWO INCH GLOBE VALVE PVEL CALCULATIONS PAGE 1 OF 2

```
A3: [W11] ^MPL
B3: ^VALVE
C3: ^CLOSING
D3: ^UPSTR
E3: ^DNSTR
F3: 'UPSTRSYS
G3: 'DNSTRSYS
I3: ^dT UP
J3: ^dTDN
K3: ^TIMEu1
L3: ^TIMEu2
M3: ^TIMEd1
N3: ^TIMEd2
O3: ^% OPEN
P3: ^% OPEN
Q3: ^% OPEN
R3: ^% OPEN
S3: ^% CV
T3: ^% CV
U3: ^% CV
V3: ^% CV
W3: ^dVu
X3: ^dVd
Y3: ^Pvu
Z3: ^Pvd
AA3: ^Pvel
A4: [W11] ^NUMBER
B4: ^DIA, "
C4: ^T, SECS
D4: ^PIPE L'
E4: ^PIPE L'
F4: ^VEL FPS
G4: ^VEL FPS
O4: ^UPSTR1
P4: ^UPSTR2
Q4: ^DNSTR1
R4: ^DNSTR2
S4: ^UPSTR1
T4: ^UPSTR2
U4: ^DNSTR1
V4: ^DNSTR2
A5: [W11] \-
B5: \-
C5: \-
D5: \-
E5: \-
F5: \-
G5: \-
```

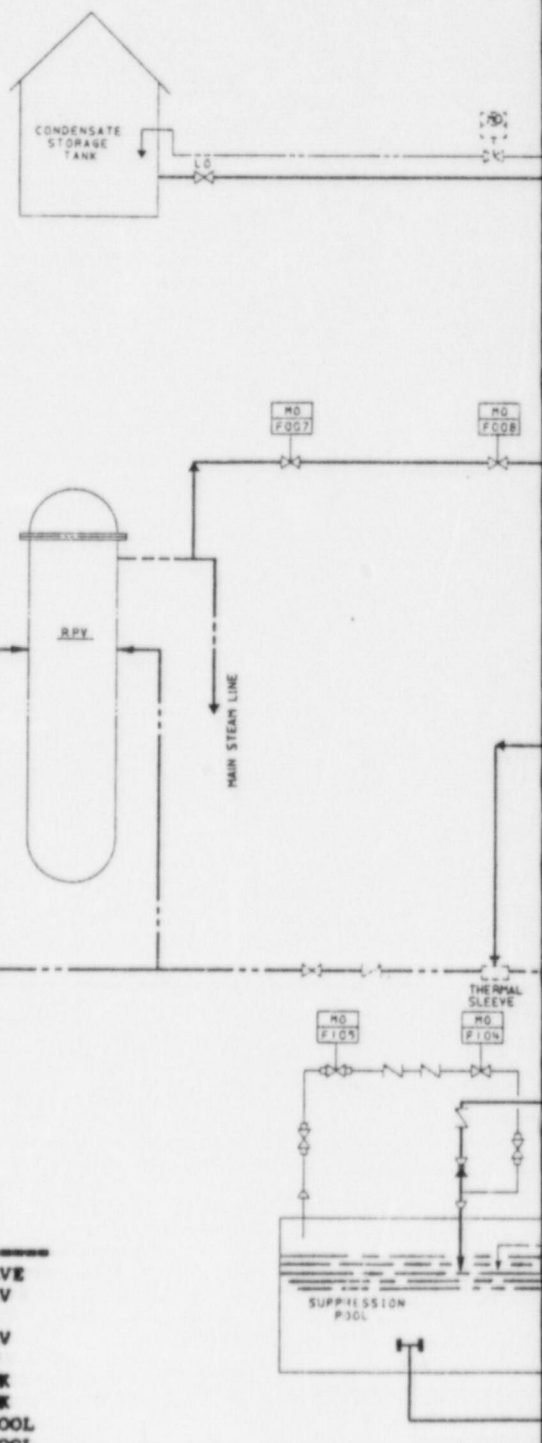
Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	Dwight Wilson	9/19/86
Subject/Title	**Reviewed By**	**Date**
Unit 1 HPCI Motor Operated Valve	[illegible]	9/21/86
Differential Pressure Calculation	Calculation Number SNH-86-015	Sheet 61 of 61

TWO INCH GLOBE VALVE PVEL CALCULATIONS PAGE 2 OF 2

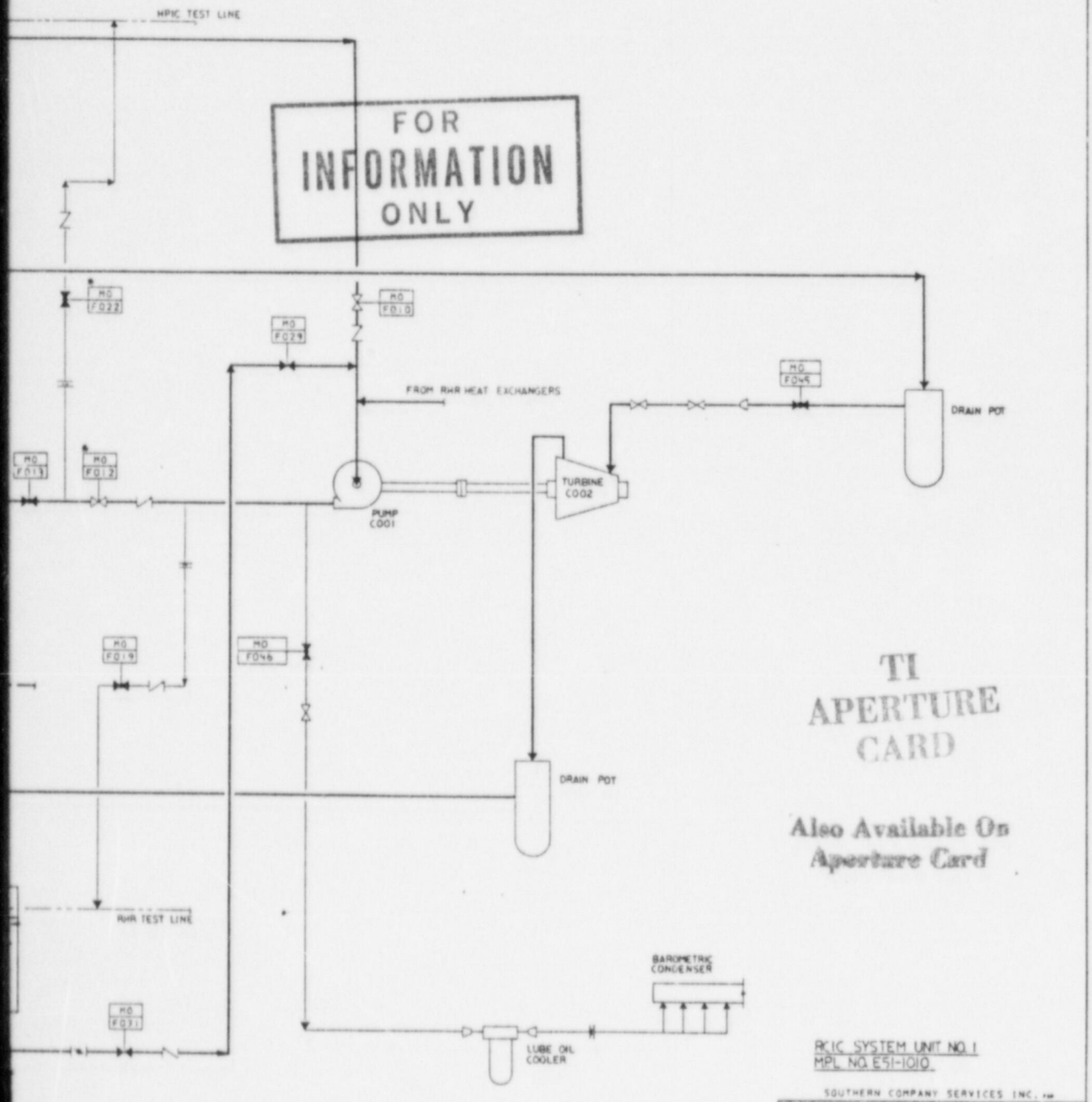
```
H5: [W2] \-
I5: \-
J5: \-
K5: \-
L5: \-
M5: \-
N5: \-
O5: \-
P5: \-
Q5: \-
R5: \-
S5: \-
T5: \-
U5: \-
V5: \-
W5: \-
X5: \-
Y5: \-
Z5: \-
AA5: \-
A6: [W11] '1E41-F059
B6: 1.75
C6: 10
D6: 25
E6: 31.42
F6: 7.601
G6: 7.601
H6: [W2] '|
I6: (2*D6)/$D$28
J6: (2*E6)/$D$28
K6: +$C6*0.5
L6: +$C6*0.5+I6
M6: +$C6*0.5
N6: +$C6*0.5+J6
O6: (+K6*100)/$C6
P6: (+L6*100)/$C6
Q6: (+M6*100)/$C6
R6: (+N6*100)/$C6
S6: +O6*0.8
T6: +P6*0.8
U6: +Q6*0.8
V6: +R6*0.8
W6: (+F6*(T6-S6))/100
X6: (+G6*(V6-U6))/100
Y6: (W6*$D$27*$D$28)/(144*32.2)
Z6: (X6*$D$27*$D$28)/(144*32.2)
AA6: +Y6+Z6

C27: 'DENSITY
D27: 61.996
E27: 'LB/FT3
C28: 'C
D28: 4000
E28: 'FT/SEC
```

ENCLOSURE 2



MPL NUMBER	VALVE DESCRIPTION
1E51-F007	RCIC STEAM INBOARD ISOL VALVE
1E51-F008	RCIC STEAM OUTBOARD ISOL VLV
1E51-F010	PUMP SUCT FRM COND STG TNK
*1E51-F012	RCIC PUMP OUTBOARD DISCH VLV
1E51-F013	RCIC PUMP INBOARD DISCH VLV
1E51-F019	TEST BYPASS TO COND STG TANK
*1E51-F022	TEST BYPASS TO COND STG TANK
1E51-F029	RCIC PMP SUCT VLV FRM SUP POOL
1E51-F031	RCIC PMP SUCT VLV FRM SUP POOL
1E51-F045	TURBINE STEAM SUPPLY VALVE
1E51-F046	COOLING WATER SUPPLY VALVE
1E51-F104	GATE VALVE 1.5 IN MO
1E51-F105	GATE VALVE 2 IN MO



* THESE VALVES HAVE NO SAFETY ACTION ON OPEN/CLOSE AND THEREFORE DO NOT REQUIRE DP TESTING.

RCIC SYSTEM UNIT NO. 1
MPL NO. E51-1010

SOUTHERN COMPANY SERVICES INC. for
Georgia Power Company, Atlanta, Ga.
General Engineering Department

EDWIN I HATCH NUCLEAR PLANT UNIT NO.1
RCIC SYSTEM FLOW DIAGRAM
MOV DIFFERENTIAL PRESSURE STUDY

		M.R.	
		SCALE	DATE
5		NONE	9-19-86
4		DRAWING NUMBER	
3		LOCATION	SHEET NO.
2			
1			

Calculation Cover Sheet

Southern Company Services

	Calculation Number: SNH-86-016
Project: E.I. HATCH NUCLEAR PLANT UNIT 1	Discipline: Mechanical
Objective: Calculate DP for RCIC Motor Operated Valves	SDS Number:

Subject/Title: Unit 1 RCIC Motor Operated Valve Differential Pressure Calculation

Design Engineer's Signature	Date	Last Page Number
Chris Sorensen	9.19.86	53

Contents

Record of Revisions

Rev. No.	Description	Originator Date	Reviewer Date	Proj. Engr. Date
0	APPROVED	9.19.86	9/21/86	9/21/86

Notes

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	Dawn C. Wilson	09/19/86
Subject/Title	Reviewed By	Date
Unit 1 RCIC Motor Operated Valve	W. T. Barr	9/20/86
Differential Pressure Calculation	Calculation Number SNH-86-016	Sheet 1 of 53

INTRODUCTION

The Nuclear Regulatory Commission (NRC) IE Bulletin 85-03 (Motor Operated Valve Common Mode Failure) requested that owners of light water reactors develop and implement a program to ensure that torque switch settings on safety related motor-operated valves on high pressure systems are selected, set and maintained correctly to accomodate the maximum differential pressures expected on these valves during both normal and abnormal events within the design basis. The objective of this calculation is to determine the maximum Differential Pressure across each of the affected Unit 1 RCIC Motor Operated Valves.

00451

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	[signature]	9.19.86
Subject/Title	Reviewed By	Date
Unit 1 RCIC Motor Operated Valve	[signature]	9/21/86
Differential Pressure Calculation	Calculation Number SNH-86-016	Sheet 2 of 53

CRITERIA

1) The criteria, assumptions and formulas given in the General Electric "BWR Owner's Group Report on the Operational Design Basis of Selected Safety-Related Motor-Operated Valves," DRF-E12-00100-75, are assumed to be correct.

ASSUMPTIONS

1) PC is assumed to equal PLOC. The terms are defined as follows:
   * PLOC is the maximum wet well LOCA pressure.
   * PC is the maximum wetwell LOCA pressure which the valve is required to operate against.

2) In the PVEL calculation, it is assumed that the time required for a sound wave to travel to and return from an atmospheric vessel is infinity. Thus, the related term in the PVEL equation is equal to zero.

3) In the PVEL calculation, downstream velocities for lines of equal sizes with differing wall thicknesses are assumed to be equal. The impact upon the downstream pressure increase is small.

4) Disc and Port diameters are assumed to be equal. Equal diameters for disc and port yield higher rate of change therefore higher DV and is therefore more conservative.

5) The Formula for calculating area of the gate valve available for flow is approximated from a known geometric relationship and is off by a small percentage, however, the overall effect is negligible.

6) In the PVEL calculation, it is assumed that where a small line tees into a much larger line (i.e. Larger being two times or greater in diameter) the boundary for the small line ends at the line intersection.

00431

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	C. Sorenson	9.19.86
Subject/Title	Reviewed By	Date
Unit 1 RCIC Motor Operated Valve	W.T. Barr	9/20/86
Differential Pressure Calculation	Calculation Number SNH-86-016	Sheet 3 of 53

SUMMARY OF CONCLUSIONS

The following page is a summary table of the results for each RCIC motor operated valve in the scope of NRC IEB 85-03.

The first column titled "MPL Number" gives the mpl number of the valve.

The second column titled "Valve Description" is the Description of the Valve given in the Equipment Location Index (ELI).

The third column titled "Valve Function" is the function of the valve as stated in the General Electric "BWR Owners' Group Report on the Operational Design Basis of Selected Safety-Related Motor-Operated Valves."

The fourth column titled "Safety Act" gives the safety action of the valve.

The fifth column titled "DP Calculation Formula" gives the formula used to calculate the maximum differential pressure.

The sixth column titled "Maximum DP" gives the safety action for which the maximum DP was calculated. If the formula is the same for both opening and closing, then both are listed.

The seventh column titled " MAX DP " is where the maximum differential pressure occurs, either upstream or downstream.

The eighth column titled "DP (PSID)" is the calculated maximum Differential Pressure in PSID against which the valve must either open or close.

The ninth column indicates if the valve has any safety function.

00441

SUMMARY TABLE 09/21/86

MPL NUMBER	VALVE DESCRIPTION	VALVE FUNCTION	SAFETY ACT	DP CALCULATION FORMULA	MAX DP ON	MAXIMUM DP	DP (PSID)	SAFETY
1E51-F007	RCIC STEAM INBOARD ISOL VALVE	RCIC STEAM LINE ISOLATION VALVE	CLOSE	DP=PRSS	CLOSE	UPSTREAM	1080	YES
1E51-F008	RCIC STEAM OUTBOARD ISOL VLV	RCIC STEAM LINE ISOLATION VALVE	CLOSE	DP=PRSS	CLOSE	UPSTREAM	1080	YES
1E51-F010	PUMP SUCT FRM COND STG TNK	RCIC CST SUCTION ISOLATION VALVE	CLOSE	DP=PELD+PV+PVEL1	CLOSE	UPSTREAM	29.406	YES
1E51-F012	RCIC PUMP OUTBOARD DISCH VLV	RCIC INJECTION VALVE TEST VALVE	NONE	NO SAFETY ACTION	N/A	N/A	N/A	NO
1E51-F013	RCIC PUMP INBOARD DISCH VLV	RCIC INJECTION VALVE	OPEN/CLOSE	DP=PRSS+PEL	OPEN/CLOSE	DOWNSTREAM	1115.612	YES
1E51-F019	TEST BYPASS TO COND STG TANK	RCIC MINIMUM FLOW BYPASS ISOL VALVE	OPEN/CLOSE	DP=PSOH+PELM	OPEN	UPSTREAM	1305.687	YES
1E51-F019	TEST BYPASS TO COND STG TANK	RCIC MINIMUM FLOW BYPASS ISOL VALVE	OPEN/CLOSE	DP=PMF+PELM+PVEL3	CLOSE	UPSTREAM	1307.1232	YES
1E51-F022	TEST BYPASS TO COND STG TANK	RCIC CST TEST RETURN VALVE	NONE	NO SAFETY ACTION	N/A	N/A	N/A	NO
1E51-F029	RCIC PMP SUCT VLV FRM SUP POOL	RCIC SUPP POOL SUCTION ISOL VALVE	OPEN/CLOSE	DP=PRV-PELS	OPEN	DOWNSTREAM	95.367	YES
1E51-F029	RCIC PMP SUCT VLV FRM SUP POOL	RCIC SUPP POOL SUCTION ISOL VALVE	OPEN/CLOSE	DP=PLOC+PLOM1	CLOSE	UPSTREAM	36.1	YES
1E51-F031	RCIC PMP SUCT VLV FRM SUP POOL	RCIC SUPP POOL SUCTION ISOL VALVE	OPEN/CLOSE	DP=PRV-PELS	OPEN	DOWNSTREAM	95.367	YES
1E51-F031	RCIC PMP SUCT VLV FRM SUP POOL	RCIC SUPP POOL SUCTION ISOL VALVE	OPEN/CLOSE	DP=PLOC+PLOM1	CLOSE	UPSTREAM	36.1	YES
1E51-F045	TURBINE STEAM SUPPLY VALVE	RCIC STEAM ADMISSION VALVE	OPEN/CLOSE	DP=PRSS	OPEN/CLOSE	UPSTREAM	1080	YES
1E51-F046	COOLING WATER SUPPLY VALVE	RCIC TURBINE ACCESSORY COOL WTR VALVE	OPEN/CLOSE	DP=PSOI+PELC	OPEN	UPSTREAM	288.179	YES
1E51-F046	COOLING WATER SUPPLY VALVE	RCIC TURBINE ACCESSORY COOL WTR VALVE	OPEN/CLOSE	DP=PLOC+PLOM2+PVEL4	CLOSE	UPSTREAM	37.065	YES
1E51-F104	GATE VALVE 1.5 IN MO	RCIC VACUUM BREAKER LINE ISOL VALVE	CLOSE	DP=PC+PATM	CLOSE	UPSTREAM	30.5	YES
1E51-F105	GATE VALVE 2 IN MO	RCIC VACUUM BREAKER LINE ISOL VALVE	CLOSE	DP=PC+PATM	CLOSE	UPSTREAM	30.5	YES

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	G. Soren	9-19-86
Subject/Title	Reviewed By	Date
Unit 1 RCIC Motor Operated Valve	W. T. Barr	9-19-86
Differential Pressure Calculation	Calculation Number SNH-86-016	Sheet 5 of 53

UNIT 1
RCIC MOV CALCULATIONS
REFERENCES

1). H-11038 REV. 15 P & I DIAGRAM DEMINERALIZED WATER

2). H-16081 REV. 4 FEEDWATER PIPING REACTOR BLDG. El. 130'-0" & ABOVE

3). S-00090 REV. 0 KELLOGG ISOMETRIC

4). S-01467 REV. 5 KELLOGG ISOMETRIC

5). S-01469 REV. 0 KELLOGG ISOMETRIC

6). S-15290 REV. H GENERAL PLAN - CONTAINMENT

7). C-11020 REV. 1 COMPOSITE DRAWING OF MODEL LC RELIEF VALVE

8). UNIT NO. 1 TECHNICAL SPECIFICATIONS REV. 08-15-86

9). A-16237 REV. 12 SETPOINT INDEX

10. G.E. NEDO 24570 REV.2

11. H-16334 REV. 15 RCIC SYSTEM P & ID SHEET 1

12. H-16335 REV. 11 RCIC SYSTEM P & ID SHEET 2

13. SECTION F CRC HANDBOOK OF CHEMISTRY & PHYSICS 57TH EDITION. CONVERSION FACTORS

14. SECTION B CRANE "FLOW OF FLUIDS" - TECHNICAL PAPER No. 410. PIPE DATA & FLOW EQUATIONS

15. BECHTEL RCIC SYSTEM CALCULATIONS IBM VOL. 1 BINDER 1 0045 DATED 11/11/71

16. BWR OWNERS GROUP REPORT ON THE OPERATIONAL DESIGN BASIS OF SELECTED SAFETY RELATED MOTOR OPERATED VALVES, DRF-E12-00100-75, AUGUST 1986.

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	C. Sorensen	9-19-86
Subject/Title	**Reviewed By**	**Date**
Unit 2 RCIC Motor Operated Valve	W. T. Barr	9/20/86
Differential Pressure Calculation	Calculation Number SNH-86-018	Sheet 6 of 53

UNIT 1
RCIC MOV CALCULATIONS
REFERENCES (Cont'd)

17. TELEPHONE CONFIRMATION 09-05-86 BETWEEN CHRIS SORENSEN OF SCS AND GORDON PARKS OF BINGHAM PUMP.

18. S-11551 REV. D 900 lb CAST STEEL GATE VALVE - CRANE

19. S-18627 REV. C 2" 1500 lb CS MOTOR OPERATED GLOBE - VELAN

20. S-00089 REV. 27 KELLOGG ISOMETRIC

21. S-01469 REV. 0 KELLOGG ISOMETRIC

22. S-01451 REV. 0 KELLOGG ISOMETRIC

23. S-01452 REV. 0 KELLOGG ISOMETRIC

24. S-00096 REV. 11 KELLOGG ISOMETRIC

25. S-00092 REV. 0 KELLOGG ISOMETRIC

26. S-15066 REV. B RCIC SYSTEM FLOW DIAGRAM

27. HNP-2 FSAR - TABLE 6.2-5 SHEET 2 NOTE 7

28. TELEPHONE CONFIRMATION R. KUBISCK OF VELAN VALVE CO. WITH JACK ROBYN OF SCS ON 9/11/86

29. BWROG ALTERNATIVE METHOD FOR CALCULATION OF PVEL SEPTEMBER 4, 1986.

30. A-16360 DATA SHEETS

31. ENGINEERING FORMULAS 4TH ED. SEGMENT OF CIRCLE AREA EQUATION.

0071d

DEFINITION OF TERMS 09/18/86

TERM	DEFINITION OF TERM
DP	VALVE MAXIMUM EXPECTED OPERATING DIFFERENTIAL PRESSURE
PSOH	DIFFERENTIAL PRESSURE DEVELOPED BY SYSTEM MAIN PUMPS AT ZERO FLOW RATE. (MAXIMUM NORMAL TURBINE SPEED)
PEL	MINIMUM HYDROSTATIC PRESSURE DIFFERENCE BETWEEN SUCTION AND DISCHARGE DUE TO ELEVATION. (DISCHARGE ELEVATION IS HIGHER THAN SUCTION)
PISO	LOW REACTOR PRESSURE AT WHICH STEAM SUPPLY LINES AUTOMATICALLY ISOLATE FLOW
PELM	MAXIMUM HYDROSTATIC PRESSURE DIFFERENCE BETWEEN SUCTION AND DISCHARGE SOURCE DUE TO ELEVATION
PRSS	REACTOR PRESSURE CORRESPONDING TO THE SPRING SETPOINT OF THE REACTOR SAFETY RELIEF VALVE WITH THE LOWEST NOMINAL SPRING SETPOINT
PELD	HYDROSTATIC PRESSURE DIFFERENCE BETWEEN CST AND SUPPRESSION POOL ASSUMING THE CST TO BE FULL AND THE SUPPRESSION POOL WATER LEVEL AT ITS MAXIMUM ALLOWABLE NORMAL LEVEL
PMF	DIFFERENTIAL PRESSURE DEVELOPED BY THE SYSTEM MAIN PUMPS AT A FLOW RATE EQUAL TO THE REQUIRED MINIMUM BYPASS FLOW RATE. (MAXIMUM NORMAL TURBINE SPEED)
PV	VELOCITY HEAD IN THE SUPPRESSION POOL SUCTION LINE

DEFINITION OF TERMS 09/18/86

TERM	DEFINITION OF TERM
	AT THE LOCATION WHERE THE CST LINE CONNECTS TO IT
PRV	SYSTEM SUCTION RELIEF VALVE ACTUATION SET PRESSURE
PELS	HYDROSTATIC PRESSURE DIFFERENCE BETWEEN THE MINIMUM SUPPRESSION POOL WATER LEVEL AND THE LOCATION OF THE RELIEF VALVE ON THE PUMP SUCTION LINE
PLOC	LOCA WETWELL PRESSURE WHEN THE SYSTEM IS ISOLATED
PLOM	HYDROSTATIC PRESSURE UPSTREAM OF THE VALVE DUE TO MAXIMUM LOCA SUPPRESSION POOL WATER LEVEL
PC	MAXIMUM LOCA WETWELL PRESSURE WHEN SYSTEM IS REQUIRED TO OPERATE (PC IS CONSERVATIVELY TAKEN TO EQUAL PLOC)
PELC	HYDROSTATIC PRESSURE DIFFERENCE BETWEEN CST AND LOCATION OF VALVE WHEN THE CST IS FULL
PSOI	RCIC PUMP DISCHARGE PRESSURE AT ZERO FLOW AND A TURBINE SPEED OF 2000 RPM
PATM	NORMAL ATMOSPHERIC PRESSURE
PVEL	DIFFERENTIAL PRESSURE ASSOCIATED WITH VALVE CLOSURE DUE TO FLUID VELOCITY CHANGES (I.E., WATER HAMMER TYPE PRESSURE INCREASE) INSIDE THE PIPE

DERIVATION OF VALUES 09/19/86

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PSOH	1276.271	TELEPHONE CONFIRMATION - C. SORENSEN OF SCS WITH G. PARKS OF BINGHAM PUMP ON SEPTEMBER 5, 1986.
PEL	35.612	THE ELEVATION FOR THE INJECTION POINT OF DISCHARGE IS GIVEN AS 183' 9 1/2" ON DRAWING H-16081 REV. 4. THE CENTERLINE OF THE SUPPRESSION POOL IS GIVEN AS 103' 6 1/4" AND THE INSIDE DIAMETER IS GIVEN AS 28' 1" ON DRAWING S-15290 REV. H. THE INSIDE BOTTOM ELEVATION OF THE SUPPRESSION POOL IS THE CENTERLINE MINUS 1/2 THE DIAMETER: 103' 6 1/4" - (28' 1")/2 = 89' 5 3/4" THE MINIMUM SUPPRESSION POOL LEVEL IS GIVEN AS 12' 2" IN THE TECHNICAL SPECIFICATIONS SECTION 3.7. THE MINIMUM SUPPRESSION POOL ELEVATION IS THE BOTTOM ELEVATION PLUS THE MINIMUM LEVEL: 89' 5 3/4" + 12' 2" = 101' 7 3/4" THE HYDROSTATIC DIFFERENCE IS THUS: 183' 9 1/2" - 101' 7 3/4" = 82' 1 3/4" = 985.75" H2O AND HYDROSTATIC PRESSURE IS:

DERIVATION OF VALUES 09/19/86

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PEL		985.75" H2O / 27.6807"H2O/PSIG = 35.612 PSIG
PISO	850	A-16237 UNIT 1 REV 12 INSTRUMENT SETPOINT INDEX FOR INSTRUMENTS 1B21-N015 A-D
PELM	29.416	THE MAXIMUM CST LEVEL IS GIVEN AS 169' 6" FOR THE SETPOINT OF 1P21-R200 ON DRAWING H-11038 REV. 15. THE MINIMUM SUPPRESSION POOL LEVEL WAS CALCULATED AS 101' 7 3/4" IN THE CALCULATION FOR PEL ABOVE. THUS THE HYDROSTATIC DIFFERENCE IS: 169' 6" - 101' 7 3/4" = 67' 10 1/4" = 814.25 "H2O HYDROSTATIC PRESSURE IS: 814.25"H2O / 27.6807 "H2O/PSIG = 29.416
PRSS	1080	UNIT 1 TECHNICAL SPECIFICATIONS SECTION 2.2
PELD	29.272	THE MAXIMUM CST LEVEL IS GIVEN AS 169' 6" FOR THE SETPOINT OF 1P21-R200 ON DRAWING H-11038 REV. 15.

DERIVATION OF VALUES 09/19/86

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PELD		THE INSIDE BOTTOM ELEVATION OF THE SUPPRESSION POOL WAS CALCULATED AS 89' 5 3/4" IN THE CALCULATION FOR PEL. THE MAXIMUM SUPPRESSION POOL LEVEL IS GIVEN AS 12' 6" IN THE UNIT 1 TECHNICAL SPECIFICATIONS SECTION 3.7 THE MAXIMUM ELEVATION LEVEL OF THE SUPPRESSION POOL IS: 89' 5 3/4" + 12' 6" = 101' 11 3/4" THUS THE HYDROSTATIC DIFFERENCE IS: 169' 6" - 101' 11 3/4" = 67' 6 1/4" = 810.25 "H2O HYDROSTATIC PRESSURE EQUALS: 810.25 "H20 / 27.6807 "H2O/PSIG = 29.272
PMF	1276.271	TELEPHONE CONFIRMATION - CHRIS SORENSEN OF SCS WITH G. PARKS OF BINGHAM PUMP ON SEPTEMBER 5, 1986.
PV	0.134	THE RCIC SYSTEM RATED FLOW IS GIVEN AS 198,930 lbm/hr IN BECHTEL CALCULATION lBM VOL 01 BINDER 01 0045. THE SIZE OF THE SUCTION LINE IS GIVEN AS 6" SCH 40 ON DWG. S-00090 REV. 0. THE

DERIVATION OF VALUES 09/19/86

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PV		INTERNAL DIAMETER IS GIVEN IN CRANE AS 6.065". 6.065 INCHES / 12 INCHES/FOOT = 0.5054 FEET THE VELOCITY HEAD IS EQUAL TO: ' [{V}**2] / 2 x gc,FROM (CRANE 410 EQ NO. 2-1) ' WHERE gc IS THE GRAVITATIONAL CONSTANT ' gc = 32.2 ft/(sec**2) ' and V = Q/A, FROM (CRANE 410 EQ NO. 3-2) PI = 3.1416 V = (198,930 lbm/hr) x (0.01613 ft**3/lbm) / ' [PI x ({0.5054**2}/4)] x 3600 ' = 4.46 ft/sec VELOCITY HEAD IS: ' [4.46**2] / 2 x 32.2 = 0.309 ft H2O VELOCITY HEAD PRESSURE IS: ' 0.309 FT H2O x 0.432781 PSIG/FT H2O ' = 0.134 PSIG
PRV	100	DWG C-11020 REV. 1 VALVE COMPOSITE DRAWING FOR E51-F018 GIVES THE RELIEF SETTING OF 100 PSIG
PELS	4.633	THE MINIMUM SUPPRESSION POOL ELEVATION WAS DETERMINED TO BE 101' 7 3/4" IN THE CALCULATION FOR PEL.

DERIVATION OF VALUES 09/19/86

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PELS		THE ELEVATION FOR THE SUCTION RELIEF VALVE 1E51-F017 IS GIVEN AS 90'-11 1/2" ON DRAWING S-01467 REV. 5. THUS THE HYDROSTATIC DIFFERENCE IS: 101' 7 3/4" - 90' -11 1/2 " = 10 -8' 1/4" = 128.25 "H2O HYDROSTATIC PRESSURE IS: 128.25 "H2O / 27.6807 "H2O/PSIG = 4.633
PLOC	30.5	NEDO-24570-2 FIG H1 4.1.2-1 PG 12
PLOM1	5.6	THE ACCIDENT SUPPRESSION POOL LEVEL IS GIVEN AS 102' 7 1/2" ON DRAWING S-15290 REV. H. THE ELEVATION FOR THE SUPPRESSION POOL ISOLATION VALVES 1E51-F029 AND F031 ARE GIVEN AS 89' 8 7/8" ON DRAWING S-00090 REV. 0. THUS THE HYDROSTATIC DIFFERENCE IS: 102' 7 1/2" - 89' 8 7/8" = 12' 10 5/8" = 154.625 "H2O THE HYDROSTATIC PRESSURE IS: 154.625 "H2O / 27.6087 "H2O/PSIG = 5.60
PLOM2	6.449	THE ACCIDENT SUPPRESSION POOL LEVEL IS GIVEN

DERIVATION OF VALUES 09/19/86

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PLOM2		AS 102' 7 1/2" ON DRAWING S-15290 REV. H. THE ELEVATION FOR THE TURBINE ACCESSORIES VALVE 1E51-F046 IS GIVEN AS 87' 9" ON DRAWING S-01469 REV. 0. THUS THE HYDROSTATIC DIFFERENCE IS: . . 102' 7 1/2" - 87' 9" = 14' 10 1/2" . = 178.5" H20 THE HYDROSTATIC PRESSURE IS: 178.5 "H2O / 27.6807 "H2O/PSIG = 6.449
PC	30.5	PC=PLOC
PELC	35.44	THE MAXIMUM CST LEVEL IS GIVEN AS 169' 6" PER SETPOINT FOR 1P21-R200 ON DRAWING H-11038 REV. 15. THE ELEVATION FOR THE RCIC TURBINE ACCESSORIES COOLING WATER VALVE 1E51-F046 IS GIVEN AS 87' 9" ON DRAWING S-01469 REV. 0. THUS THE HYDROSTATIC DIFFERENCE IS: 169' 6" - 87' 9" = 81' 9" = 981 "H2O THE HYDROSTATIC PRESSURE IS:

DERIVATION OF VALUES 09/20/86

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PELC		981 "H2O / 27.6807 "H2O/PSIG = 35.440
PSOI	252.739	TELEPHONE CONFIRMATION -C.SORENSEN OF SCS AND G. PARKS OF BINGHAM PUMP ON SEPTEMBER 5, 1986. HEAD AT 2000 RPM AND ZERO FLOW = 583 ft = 6996 in 6996 "H2O/27.6807 "H2O/PSIG = 252.739 PSIG
PATM	0	NORMAL ATMOSPHERIC PRESSURE = 14.696 PSIA. PSIG = PSIA - 14.696 = 0
PVEL1	0	KELLOGG ISOMETRIC DRAWINGS S-00096 REV. 0, S-00092 REV. 0, AND S-00090 REV. 0 SHOW THAT THE UPSTREAM PIPING IS CONNECTED TO THE CONDENSATE STORAGE TANK. IT IS ASSUMED THAT ANY WATER HAMMER EFFECTS IN THE UPSTREAM PIPING WOULD BE DISSIPATED WITHIN THE CST VOLUME, AND PRODUCE NO RESULTANT PRESSURE RISE UPON THE VALVE. THE REFERENCED DRAWINGS ALSO SHOW THAT THE DOWNSTREAM PIPING IS INTERCONNECTED WITH THE SUPPRESSION POOL SUCTION LINE. IT IS ASSUMED THAT THE RCIC PUMP IS OPERATING TO DRAW A SUCTION FROM THE SUPPRESSION POOL WHEN E51-F010 BEGINS TO CLOSE. THEREFORE, NO DOWNSTREAM FLUID

DERIVATION OF VALUES 09/21/86

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PVEL1		DECELERATION WILL RESULT. IT MAY BE CONCLUDED THAT NO INCREASE IN PRESSURE BECAUSE OF WATER HAMMER WILL RESULT. CONSIDERING THE ABOVE FACTS, VALVE 1E51-F010 CAN BE CONSIDERED TO HAVE NO WATER HAMMER PRESSURE INCREASE. THEREFORE PVEL1 = 0.
PVEL2	3.194	SYSTEM VELOCITY FOR 1E51-F013 FLOW RATE = 400 GPM FROM S-15066 REV. B . RCIC FLOW DIAGRAM AREA OF 4" SCH 80 PIPE = 11.50 IN SQ AREA OF 4" SCH 120 PIPE = 10.31 IN SQ . CRANE 410 VELOCITY UPSTREAM = [400 GPM X 0.321]/11.50 IN SQ ,, =11.17 FT/SEC VELOCITY DOWNSTRM = [400 GPM X 0.321]/10.31 IN SQ . =12.45 FT/SEC CLOSURE TIME . TC = 15 SEC FROM DATA SHEET A-16360 VALVE THROAT DIAMETER . VALVE DIAMETER = 3 5/16" . 900 L CAST STEEL GATE VALVE S-11551 REV. D LENGTH UPSTREAM (LU) AND DOWNSTREAM (LD)

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PVEL2		. LU = 102.44 FT
		. KELLOGG ISOMETRIC DWE S-00089 REV. 0.
		. LD = 16.6 FT
		. KELLOGG ISOMETRIC DWG S-00089 REV. 0.
		PVEL2=3.194 FROM COMPUTER PRINTOUT
PVEL3	1.4362	SYSTEM VELOCITY FOR 1E51-F019
		. FLOW RATE = 50 GPM FROM S-15066 REV. B
		. RCIC SYSTEM FLOW DIAGRAM
		AREA OF 2" SCH 80 PIPE = 2.953 IN**2
		. CRANE 410
		VELOCITY = [50 GPM X 0.321]/2.953 IN**2
		. =5.435 FT/SEC
		CLOSURE TIME
		. TC = 10 SEC FROM A-16368 SHT 1
		. PER STD STROKE TIME FROM HNP-2
		. FSAR TABLE 6.2-5 SHT 2 NOTE 7
		VALVE THROAT DIAMETER
		. VALVE DIAMETER = 1 3/4"
		. 1500# CS MOTOR OPERATED GLOBE VALVE
		. S-18627 REV. C.
		LENGTH UPSTREAM (LU) AND DOWNSTREAM (LD)
		. LU = 53.3487 FT

DERIVATION OF VALUES 09/21/86

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PVEL3		. KELLOGG ISOMETRIC DWG S-00089 REV. 0.
		. KELLOGG ISOMETRIC DWG S-01451 REV 0.
		. KELLOGG ISOMETRIC DRAWING S-01452 REV 0
		. LD = 70.1889 FT
		. KELLOGG ISOMETRIC DWG S-01451 REV 0.
		. KELLOGG ISOMETRIC DRAWING S-01452 REV 0.
		PVEL3 = 1.4362 FROM COMPUTER PRINTOUT
PVEL4	0.116	SYSTEM VELOCITY FOR 1E51-F046
		. FLOW RATE = 16 GPM FROM S-15066 REV. 13
		. RCIC SYSTEM FLOW DIAGRAM
		AREA OF 2" SCH 80 PIPE = 2.953 IN**2
		. CRANE 410
		VELOCITY = [16GPM X 0.321]/2.953 IN**2
		. = 1.739 FT/SEC
		CLOSURE TIME
		. TC = 10 SEC FROM A-16368 SHT 1
		. PER STD STROKE TIME HNP-2
		. FSAR TABLE 6.2-5 SHT2 NOTE 7
		VALVE THROAT DIAMETER
		. VALVE DIAMETER = 1 3/4"
		. 1500# CS MOTOR OPERATED GLOBE VALVE
		. FROM S-18627 REV. C
		LENGTH UPSTREAM (LU) AND DOWNSTREAM (LD)

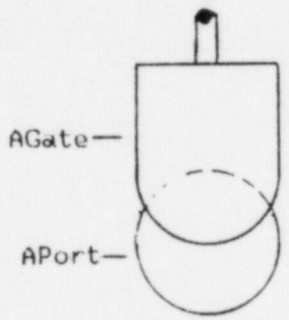
DERIVATION OF VALUES 09/19/86

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PVEL4		. LU = 7 FT
		. KELLOGG ISOMETRIC DWG S-01469 REV 0.
		. LD = 24.218 FT
		. KELLOGG ISOMETRIC DWG S-01469 REV 0.
		PVEL4 = 0.116136 FROM COMPUTER PRINTOUT

RELATIONSHIP OF THE GATE VALVE FLOW AREA TO THE PERCENTAGE OPENING OF A TYPICAL GATE VALVE

It is assumed that the diameter of the gate is equal to the port diameter of the valve since the difference in diameters is insignificantly small.

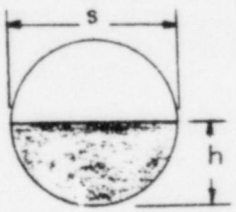
THE FLOW AREA OF THE VALVE MAY BE DETERMINED BY SUBTRACTING THE AREA OF THE GATE OCCLUDING THE TOTAL PORT AREA.



A = Area

AFlow = APort - AGate

THE AREA OF THE PORT IS CALCULATED USING THE CIRCULAR SEGMENT CALCULATION



$ASEG = h/6s\ (3h^2 + 4s^2)$

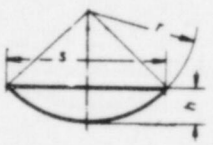
WITH h = RISE = RADIUS
AND s = CHORD = DIAMETER

THE AREA OF THE PORT IS EQUAL TO TWICE ASEG

APORT = 2ASEG = R/6D (3R**2 + 4D**2)

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	C. Sorensen	9.19.86
Subject/Title	Reviewed By	Date
Unit 1 RCIC Motor Operated Valve	D. McNeill	9/21/86
Differential Pressure Calculation	Calculation Number SNH-86-016	Sheet 21 of 53

THE OCCLUDING AREA OF THE GATE IS FOUND BY USING THE AREA OF A CIRCULAR SEGMENT CALCULATION.



$$ASEG = h/6s\ (3h^2 + 4s^2)$$

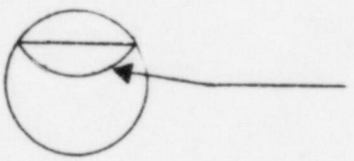
$$r = h/2 + s^2/8h$$

TRANSFORMING THE LATER EQUATION

$$s = (\ 8h\ (r-(h/2)))^{1/2}$$

WHICH COMBINED WITH THE ASEG CALCULATION MAY BE READILY SOLVED.

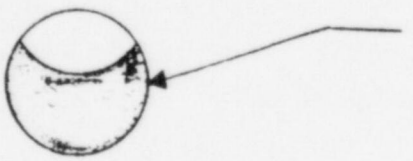
THE AREA OCCLUDED IS EQUAL TO TWICE ASEG.



AGATE = 2 ASEG.

THUS THE AREA OF FLOW THROUGH THE VALVE IS CALCULATED AS:

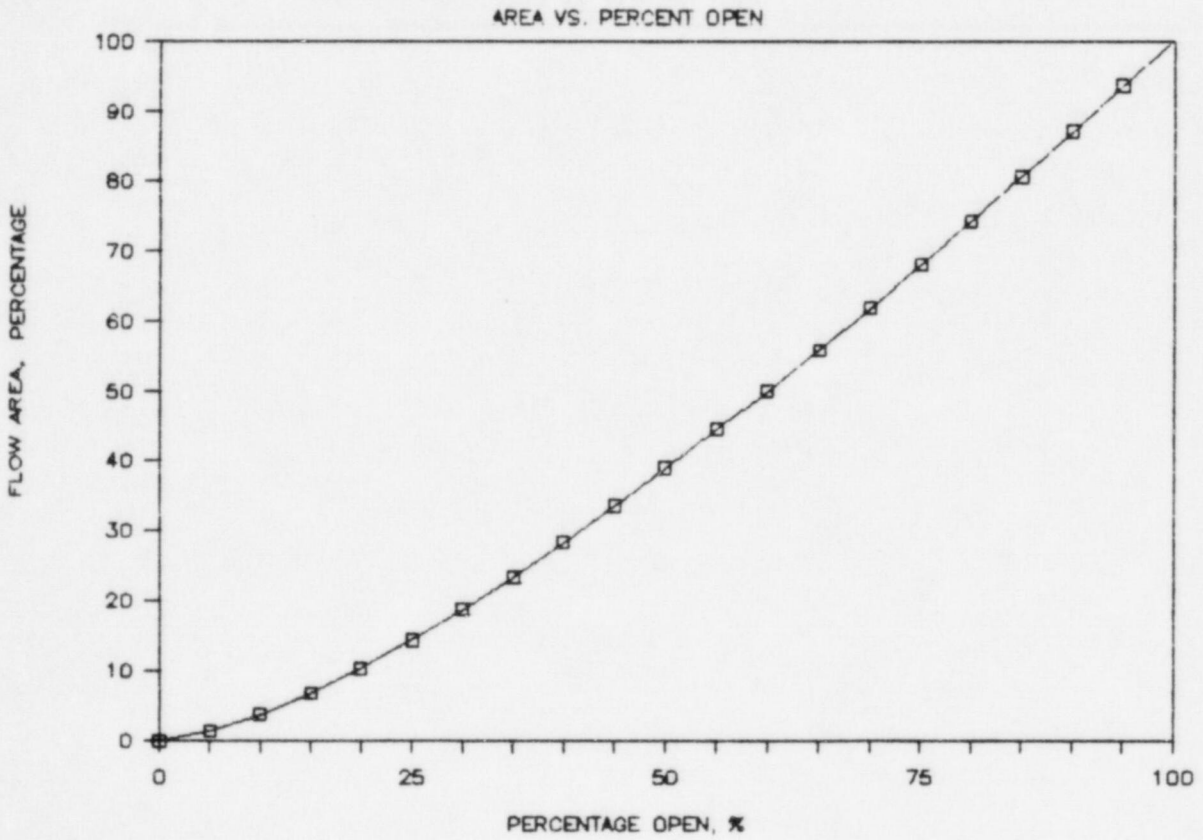
AFlow = APORT - AGATE



AFlow

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	C Lorenan	9.19.86
Subject/Title	Reviewed By	Date
Unit 1 RCIC Motor Operated Valve	G D McFadden	9/21/86
Differential Pressure Calculation	Calculation Number SNH-86-016	Sheet 22 of 53

A GRAPHIC PRESENTATION OF THE TYPICAL FLOW AREA VS. PERCENT VALVE OPENING IS GIVEN AS FOLLOWS.



REFERENCE: ENGINEERING FORMULAS 4th EDITION, PAGE B3.

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	C Foreman	9-19-86
Subject/Title	Reviewed By	Date
Unit 1 RCIC Motor Operated Valve	A. S. Kirk	9-19-86
Differential Pressure Calculation	Calculation Number SNH-86-016	Sheet 23 of 53

NUMERICAL RELATIONSHIP BETWEEN A GRAPHICAL PRESENTATION OF MANUFACTURER'S 2" GLOBE VALVE OPENING VS. MANUFACTURER'S CV DATA

Given a curve of 0-100 % opening (see attached), It is Desired to numerically relate the first 60% of opening to CV.

The First 60% of opening is a linear function thus, the curve may be equated using linear regression of the point-slope form.

$$y - y1 = m(x-x1)$$

Using the points (0,0) and (50,40)

$$40-0 = m(50-0)$$

Solving for m

$$m = 40/50 = 0.8$$

The equation of a line is given as:

$$y = mx$$

Hence, the equation relating cv with percent opening is:

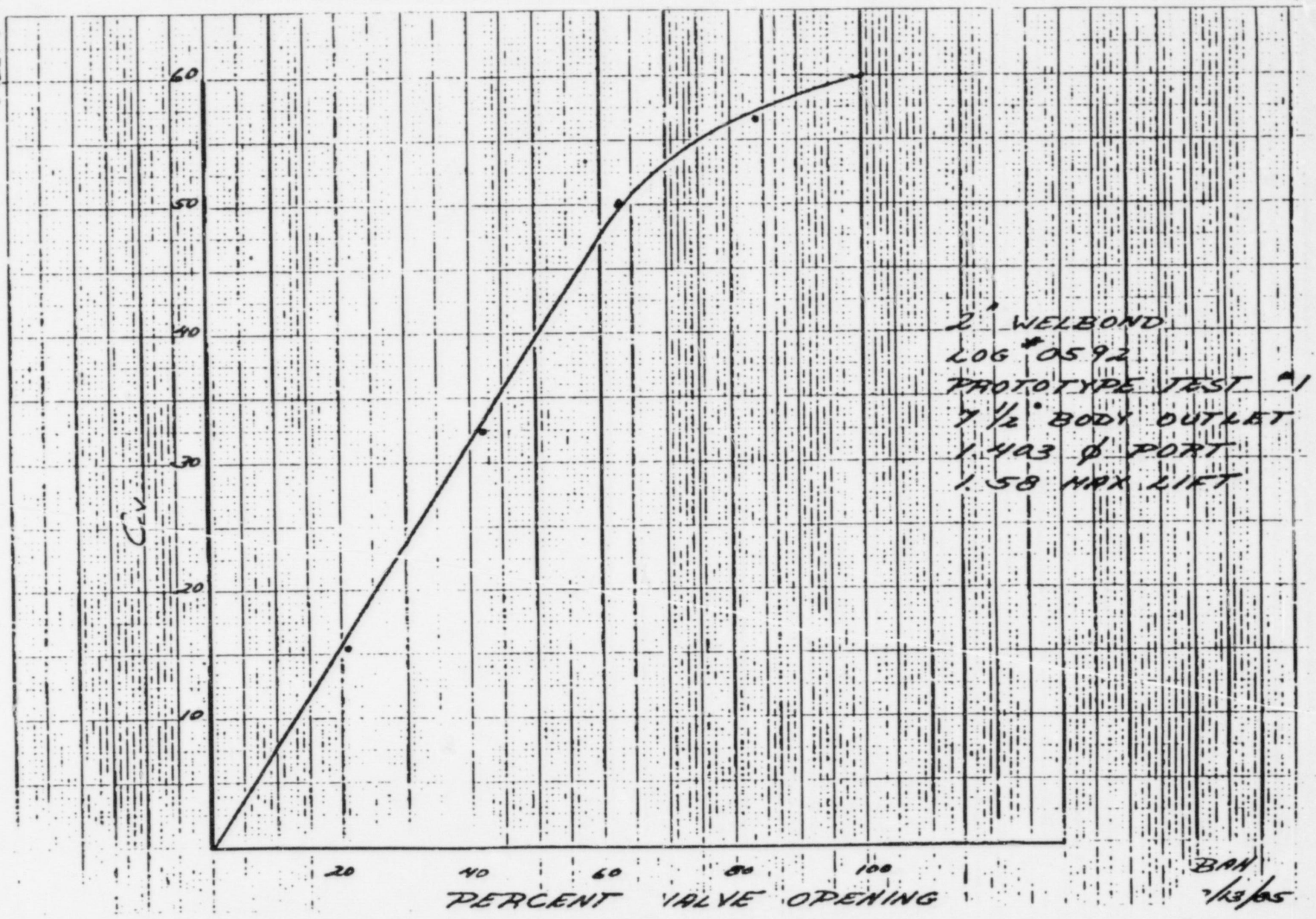
$$CV = 0.8 \text{ (percentage opening)}$$

FOR ALL OPENINGS LESS THAN 60%.

Reference: THE ENGINEER'S COMPANION 1966 PG. 13.

00481

SHEET 24 of 53



Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	G Lorenz	9-19-86
Subject/Title	**Reviewed By**	**Date**
Unit 1 RCIC Motor Operated Valve	A.S. Kirk	9-20-86
Differential Pressure Calculation	Calculation Number SNH-86-016	Sheet 25 of 53

DETERMINE THE PRESSURE INCREASE DUE TO THE RAPID DECELERATION OF FLUID CAUSED BY THE MOVEMENT OF A PROCESS GATE OR GLOBE VALVE

ASSUMPTIONS

1) Valve openings result in no waterhammer effects. The differential pressure across a valve during opening is decreased by an increase in fluid velocity. The maximum actuator loading takes place before the valve lift occurs.

2) Steam valve closure results in only minor or no waterhammer effect. The compressible nature of the fluid medium coupled with maximum anticipated velocity changes make the pressure addition insignificant.

3) Area of flow through a gate valve is a direct and linear relation to system velocity.

4) The percentage of valve opening is a direct relation to opening time.

5) It is assumed that flowing pressure does not drop below the fluids vapor pressure.

The pressure increase due to sudden deceleration of fluid may be expressed as:

$$PVEL = P1 + P2$$

Where P1 is the upstream pressure change, and P2 is the downstream pressure change.

The respective valves for P1 and P2 may be calculated as follows:

$$P_1, P_2 = \frac{\rho C \Delta VMAX}{144\ g}$$

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	C. Loren	9-19-86
Subject/Title	**Reviewed By**	**Date**
Unit 1 RCIC Motor Operated Valve	A. S. Kirk	9-20-86
Differential Pressure Calculation	Calculation Number SNH-86-016	Sheet 26 of 53

Incremental time is Defined As:

$$\Delta t = t2 - t1 = \frac{2L}{c}$$

Where the term 2L/C is the time require for a pressure wave to travel down a pipe's flow length and rebound to it's source valve.

Knowing the equation of the curve, the maximum ΔV for (ie; greatest slope) is calculated and entered into the pressure equations.

The procedure is once again performed for the down stream side of the valve and added as follows to produce PVEL.

$$PVEL = P1 + P2$$

Reference: BWROG REPORT APP. B

0082d

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	C Lorenz	9.19.86
Subject/Title	Reviewed By	Date
Unit 1 RCIC Motor Operated Valve	A.S. Kirk	9-20-86
Differential Pressure Calculation	Calculation Number SNH-86-016	Sheet 27 of 53

Where: ρ is the fluid density

C is the speed of sound through the fluid

Δ VMAX is the maximum system fluid differential velocity

144 is a conversion factor

and g is the Gravatational Constant

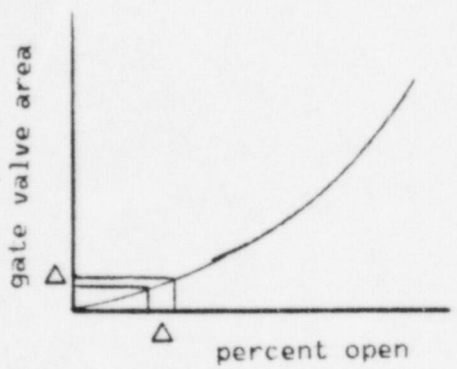
The fluid ΔV is assumed to be a direct relation to flow area, as shown in the gate valve area - percent open curves, and is a direct relation to Cv, as shown on the globe valve Cv - percent open curves.

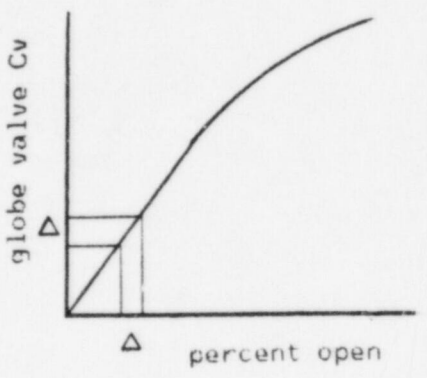
The valve Δt is a direct relation to Δ percentage open.

Therefore:

$$\frac{\Delta A}{\Delta \% \text{ Open}} \approx \frac{\Delta Cv}{\Delta \% \text{ Open}} \approx \frac{\Delta V}{\Delta t}$$

Having plotted a velocity relation against a time relation the region of highest differential velocity is examined.





Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	C Lorenan	9.19.86
Subject/Title	Reviewed By	Date
Unit 1 RCIC Motor Operated Valve	A.S. Kirk	9-20-86
Differential Pressure Calculation	Calculation Number SNH-86-016	Sheet 28 of 53

Incremental time is Defined As:

$$\Delta t = t2 - t1 = \frac{2L}{c}$$

Where the term 2L/C is the time require for a pressure wave to travel down a pipe's flow length and rebound to it's source valve.

Knowing the equation of the curve, the maximum ΔV for Δt (ie; greatest slope) is calculated and entered into the pressure equations.

The procedure is once again performed for the down stream side of the valve and added as follows to produce PVEL

$$PVEL = P1 + P2$$

Reference: BWROG REPORT APP. B

0082d

GATE VALVE PVEL CALCULATION

MPL NUMBER	1E51-F013
VALVE DIAMETER (INCHES)	3.3125
CLOSING TIME (SECONDS)	15
UPSTREAM PIPE LENGTH (FT)	102.44
DOWNSTREAM PIPE LENGTH (FT)	16.6
UPSTREAM SYSTEM VEL (FT/SEC)	11.17
DOWNSTREAM SYSTEM VEL (FT/SEC)	12.46
delta TIME UPSTREAM (SECONDS)	0.05122
delta TIME DWNSTREAM (SECONDS)	0.0083
TIME UPSTREAM 1 (SECONDS)	14.94878
TIME UPSTREAM 2 (SECONDS)	15
TIME DOWNSTREAM 1 (SECONDS)	14.9917
TIME DOWNSTREAM 2 (SECONDS)	15
RISE UPSTREAM 1	1.6505945
RISE UPSTREAM 2	1.65625
RISE DOWNSTREAM 1	1.6553335
RISE DOWNSTREAM 2	1.65625
CHORD UPSTREAM 1	3.3124807
CHORD UPSTREAM 2	3.3125
CHORD DOWNSTREAM 1	3.3124995
CHORD DOWNSTREAM 2	3.3125
MAX AREA (IN SQ)	8.6866862
AREA FLOW UPSTREAM 1	0.0390158
AREA FLOW UPSTREAM 2	0
AREA FLOW DOWNSTREAM 1	0.0063242
AREA FLOW DOWNSTREAM 2	0
a/Au1	0.0045273
a/Au2	0
a/Ad1	0.0007338
a/Ad2	0
VELOCITY UPSTREAM 1 (FT/SEC)	0.0505699
VELOCITY UPSTREAM 2 (FT/SEC)	0
VELOCITY DOWNSTREAM 1 (FT/SEC)	0.0091437
VELOCITY DOWNSTREAM 2 (FT/SEC)	0
delta VEL UPSTREAM (FT/SEC)	0.0505699
delta VEL DOWNSTREAM (FT/SEC)	0.0091437
Pvu UPSTREAM PRESSURE (PSIG)	2.7045639
Pvd DOWNSTREAM PRESSURE (PSIG)	0.4890182

Pvel (PSIG) 3.1935821

TWO INCH GLOBE VALVE PVEL CALCULATIONS

MPL NUMBER	1E51-F019
VALVE DIAMETER (INCHES)	1.75
CLOSING TIME (SECONDS)	10
UPSTREAM PIPE LENGTH (FT)	53.349
DOWNSTREAM PIPE LENGTH (FT)	70.1889
UPSTREAM SYSTEM VEL (FT/SEC)	5.435
DOWNSTREAM SYSTEM VEL (FT/SEC)	5.435
delta TIME UPSTREAM (SECONDS)	0.0266745
delta TIME DWNSTREAM (SECONDS)	0.0350944
TIME UPSTREAM 1 (SECONDS)	5
TIME UPSTREAM 2 (SECONDS)	5.0266745
TIME DOWNSTREAM 1 (SECONDS)	5
TIME DOWNSTREAM 2 (SECONDS)	5.0350944
% OPEN UPSTREAM 1	50
% OPEN UPSTREAM 2	50.266745
% OPEN DOWNSTREAM 1	50
% OPEN DOWNSTREAM 2	50.350944
% CV UPSTREAM 1	40
% CV UPSTREAM 2	40.213396
% CV DOWNSTREAM 1	40
% CV DOWNSTREAM 2	40.280756
delta VEL UPSTREAM (FT/SEC)	0.0115981
delta VEL DOWNSTREAM (FT/SEC)	0.0152591
Pvu UPSTREAM (PSIG)	0.6202848
Pvd DOWNSTREAM (PSIG)	0.816081

Pvel (PSIG) 1.4363658

TWO INCH GLOBE VALVE PVEL CALCULATIONS

MPL NUMBER	1E51-F046
VALVE DIAMETER (INCHES)	1.75
CLOSING TIME (SECONDS)	10
UPSTREAM PIPE LENGTH (FT)	7
DOWNSTREAM PIPE LENGTH (FT)	24.218
UPSTREAM SYSTEM VEL (FT/SEC)	1.739
DOWNSTREAM SYSTEM VEL (FT/SEC)	1.739
delta TIME UPSTREAM (SECONDS)	0.0035
delta TIME DWNSTREAM (SECONDS)	0.012109
TIME UPSTREAM 1 (SECONDS)	5
TIME UPSTREAM 2 (SECONDS)	5.0035
TIME DOWNSTREAM 1 (SECONDS)	5
TIME DOWNSTREAM 2 (SECONDS)	5.012109
% OPEN UPSTREAM 1	50
% OPEN UPSTREAM 2	50.035
% OPEN DOWNSTREAM 1	50
% OPEN DOWNSTREAM 2	50.12109
% CV UPSTREAM 1	40
% CV UPSTREAM 2	40.028
% CV DOWNSTREAM 1	40
% CV DOWNSTREAM 2	40.096872
delta VEL UPSTREAM (FT/SEC)	0.0004869
delta VEL DOWNSTREAM (FT/SEC)	0.0016846
Pvu UPSTREAM (PSIG)	0.0260413
Pvd DOWNSTREAM (PSIG)	0.0900955

Pvel (PSIG) 0.1161368

DIFFERENTIAL PRESSURE CALCULATION 09/18/86

MPL NUMBER	1E51-F007
VALVE DESCRIPTION	RCIC STEAM INBOARD ISOL VALVE
VALVE FUNCTION	RCIC STEAM LINE ISOLATION VALVE
SAFETY FUNCTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PRSS
MAX DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ON OPEN/CLOSE	CLOSE
MAXIMUM DP ON OPEN/CLOSE	CLOSE

VALUES USED: (PSIG)

PRSS = 1080

DP (PSID) 1080

DIFFERENTIAL PRESSURE CALCULATION 09/18/86

MPL NUMBER	1E51-F008
VALVE DESCRIPTION	RCIC STEAM OUTBOARD ISOL VLV
VALVE FUNCTION	RCIC STEAM LINE ISOLATION VALVE
SAFETY FUNCTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PRSS
MAX DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ON OPEN/CLOSE	CLOSE
MAXIMUM DP ON OPEN/CLOSE	CLOSE

VALUES USED: (PSIG)

PRSS = 1080

DP (PSID) 1080

DIFFERENTIAL PRESSURE CALCULATION 09/18/86

MPL NUMBER	1E51-F010
VALVE DESCRIPTION	PUMP SUCT FRM COND STG TNK
VALVE FUNCTION	RCIC CST SUCTION ISOLATION VALVE
SAFETY FUNCTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PELD+PV+PVEL1
MAX DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ON OPEN/CLOSE	CLOSE
MAXIMUM DP ON OPEN/CLOSE	CLOSE

VALUES USED: (PSIG)

PELD	= 29.272
PV	= 0.134
PVEL1	= 0

DP (PSID) 29.406

DIFFERENTIAL PRESSURE CALCULATION 09/18/86

MPL NUMBER	1E51-F012
VALVE DESCRIPTION	RCIC PUMP OUTBOARD DISCH VLV
VALVE FUNCTION	RCIC INJECTION VALVE TEST VALVE
SAFETY FUNCTION (YES/NO)	NO
DP CALCULATION FORMULA	NO SAFETY ACTION
MAX DP UPSTREAM/DOWNSTREAM	N/A
SAFETY ON OPEN/CLOSE	NONE
MAXIMUM DP ON OPEN/CLOSE	N/A
VALUES USED: (PSIG)	
DP (PSID)	N/A

DIFFERENTIAL PRESSURE CALCULATION 09/18/86

MPL NUMBER	1E51-F013
VALVE DESCRIPTION	RCIC PUMP INBOARD DISCH VLV
VALVE FUNCTION	RCIC INJECTION VALVE
SAFETY FUNCTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PRSS+PEL (b)
MAX DP UPSTREAM/DOWNSTREAM	DOWNSTREAM
SAFETY ON OPEN/CLOSE	OPEN/CLOSE
MAXIMUM DP ON OPEN/CLOSE	OPEN/CLOSE

VALUES USED: (PSIG)

PRSS = 1080
PEL = 35.612

DP (PSID) 1115.612

DIFFERENTIAL PRESSURE CALCULATION 09/18/86

MPL NUMBER	1E51-FØ19
VALVE DESCRIPTION	TEST BYPASS TO COND STG TANK
VALVE FUNCTION	RCIC MINIMUM FLOW BYPASS ISOL VALVE
SAFETY FUNCTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PSOH+PELM
MAX DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ON OPEN/CLOSE	OPEN/CLOSE
MAXIMUM DP ON OPEN/CLOSE	OPEN

VALUES USED: (PSIG)

PSOH = 1276.271
PELM = 29.416

DP (PSID) 1305.687

DIFFERENTIAL PRESSURE CALCULATION 09/21/86

MPL NUMBER	1E51-FØ19
VALVE DESCRIPTION	TEST BYPASS TO COND STG TANK
VALVE FUNCTION	RCIC MINIMUM FLOW BYPASS ISOL VALVE
SAFETY FUNCTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PMF+PELM+PVEL3
MAX DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ON OPEN/CLOSE	OPEN/CLOSE
MAXIMUM DP ON OPEN/CLOSE	CLOSE

VALUES USED: (PSIG)

PMF	= 1276.271
PELM	= 29.416
PVEL3	= 1.4362

DP (PSID) 1307.1232

DIFFERENTIAL PRESSURE CALCULATION 09/18/86

MPL NUMBER	1E51-F022
VALVE DESCRIPTION	TEST BYPASS TO COND STG TANK
VALVE FUNCTION	RCIC CST TEST RETURN VALVE
SAFETY FUNCTION (YES/NO)	NO
DP CALCULATION FORMULA	NO SAFETY ACTION
MAX DP UPSTREAM/DOWNSTREAM	N/A
SAFETY ON OPEN/CLOSE	NONE
MAXIMUM DP ON OPEN/CLOSE	N/A
VALUES USED: (PSIG)	
	=
DP (PSID)	N/A

DIFFERENTIAL PRESSURE CALCULATION 09/18/86

MPL NUMBER	1E51-F029
VALVE DESCRIPTION	RCIC PMP SUCT VLV FRM SUP POOL
VALVE FUNCTION	RCIC SUPP POOL SUCTION ISOL VALVE
SAFETY FUNCTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PLOC+PLOM1 (c)
MAX DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ON OPEN/CLOSE	OPEN/CLOSE
MAXIMUM DP ON OPEN/CLOSE	CLOSE

VALUES USED: (PSIG)

PLOC	= 30.5
PLOM1	= 5.6

DP (PSID) 36.1

DIFFERENTIAL PRESSURE CALCULATION 09/18/86

MPL NUMBER	1E51-F029
VALVE DESCRIPTION	RCIC PMP SUCT VLV FRM SUP POOL
VALVE FUNCTION	RCIC SUPP POOL SUCTION ISOL VALVE
SAFETY FUNCTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PRV-PELS
MAX DP UPSTREAM/DOWNSTREAM	DOWNSTREAM
SAFETY ON OPEN/CLOSE	OPEN/CLOSE
MAXIMUM DP ON OPEN/CLOSE	OPEN

VALUES USED: (PSIG)

PRV	= 100
PELS	= 4.633

DP (PSID) 95.367

DIFFERENTIAL PRESSURE CALCULATION 09/18/86

MPL NUMBER	1E51-F031
VALVE DESCRIPTION	RCIC PMP SUCT VLV FRM SUP POOL
VALVE FUNCTION	RCIC SUPP POOL SUCTION ISOL VALVE
SAFETY FUNCTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PRV-PELS
MAX DP UPSTREAM/DOWNSTREAM	DOWNSTREAM
SAFETY ON OPEN/CLOSE	OPEN/CLOSE
MAXIMUM DP ON OPEN/CLOSE	OPEN

VALUES USED: (PSIG)

PRV = 100
PELS = 4.633

DP (PSID) 95.367

DIFFERENTIAL PRESSURE CALCULATION 09/18/86

MPL NUMBER	1E51-F031
VALVE DESCRIPTION	RCIC PMP SUCT VLV FRM SUP POOL
VALVE FUNCTION	RCIC SUPP POOL SUCTION ISOL VALVE
SAFETY FUNCTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PLOC+PLOM1 (c)
MAX DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ON OPEN/CLOSE	OPEN/CLOSE
MAXIMUM DP ON OPEN/CLOSE	CLOSE

VALUES USED: (PSIG)

PLOC	= 30.5
PLOM1	= 5.6

DP (PSID) 36.1

DIFFERENTIAL PRESSURE CALCULATION 09/18/86

MPL NUMBER	1E51-F045
VALVE DESCRIPTION	TURBINE STEAM SUPPLY VALVE
VALVE FUNCTION	RCIC STEAM ADMISSION VALVE
SAFETY FUNCTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PRSS
MAX DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ON OPEN/CLOSE	OPEN/CLOSE
MAXIMUM DP ON OPEN/CLOSE	OPEN/CLOSE

VALUES USED: (PSIG)

PRSS = 1080

DP (PSID) 1080

DIFFERENTIAL PRESSURE CALCULATION 09/18/86

MPL NUMBER	1E51-F046
VALVE DESCRIPTION	COOLING WATER SUPPLY VALVE
VALVE FUNCTION	RCIC TURBINE ACCESSORY COOL WTR VALVE
SAFETY FUNCTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PLOC+PLOM2+PVEL4
MAX DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ON OPEN/CLOSE	OPEN/CLOSE
MAXIMUM DP ON OPEN/CLOSE	CLOSE

VALUES USED: (PSIG)

PLOC	= 30.5
PLOM2	= 6.449
PVEL4	= 0.116136

DP (PSID) 37.065136

DIFFERENTIAL PRESSURE CALCULATION 09/18/86

MPL NUMBER	1E51-FØ46
VALVE DESCRIPTION	COOLING WATER SUPPLY VALVE
VALVE FUNCTION	RCIC TURBINE ACCESSORY COOL WTR VALVE
SAFETY FUNCTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PSOI+PELC
MAX DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ON OPEN/CLOSE	OPEN/CLOSE
MAXIMUM DP ON OPEN/CLOSE	OPEN

VALUES USED: (PSIG)

PSOI = 252.739
PELC = 35.44

DP (PSID) 288.179

DIFFERENTIAL PRESSURE CALCULATION 09/18/86

MPL NUMBER	1E51-F104
VALVE DESCRIPTION	GATE VALVE 1.5 IN MO
VALVE FUNCTION	RCIC VACUUM BREAKER LINE ISOL VALVE
SAFETY FUNCTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PC+PATM
MAX DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ON OPEN/CLOSE	CLOSE
MAXIMUM DP ON OPEN/CLOSE	CLOSE

VALUES USED: (PSIG)

PC = 30.5
PATM = 0

DP (PSID) 30.5

DIFFERENTIAL PRESSURE CALCULATION 09/18/86

MPL NUMBER	1E51-F105
VALVE DESCRIPTION	GATE VALVE 2 IN MO
VALVE FUNCTION	RCIC VACUUM BREAKER LINE ISOL VALVE
SAFETY FUNCTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PC+PATM
MAX DP UPSTREAM/DOWNSTREAM	UPSTREAM
SAFETY ON OPEN/CLOSE	CLOSE
MAXIMUM DP ON OPEN/CLOSE	CLOSE

VALUES USED: (PSIG)

PC = 30.5
PATM = 0

DP (PSID) 30.5

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	Dawn C. Wilson	09/19/86
Subject/Title	Reviewed By	Date
Unit 1 RCIC Motor Operated Valve	[illegible]	9/21/86
Differential Pressure Calculation	Calculation Number SNH-86-016	Sheet 49 of 53

TWO INCH GLOBE VALVE PVEL CALCULATIONS PAGE 1 OF 2

```
A3: [W11] ^MPL
B3: ^VALVE
C3: ^CLOSING
D3: ^UPSTR
E3: ^DNSTR
F3: 'UPSTRSYS
G3: 'DNSTRSYS
I3: ^dT UP
J3: ^dTDN
K3: ^TIMEu1
L3: ^TIMEu2
M3: ^TIMEd1
N3: ^TIMEd2
O3: ^% OPEN
P3: ^% OPEN
Q3: ^% OPEN
R3: ^% OPEN
S3: ^% CV
T3: ^% CV
U3: ^% CV
V3: ^% CV
W3: ^dVu
X3: ^dVd
Y3: ^Pvu
Z3: ^Pvd
AA3: ^Pvel
A4: [W11] ^NUMBER
B4: ^DIA, "
C4: ^T, SECS
D4: ^PIPE L'
E4: ^PIPE L'
F4: ^VEL FPS
G4: ^VEL FPS
O4: ^UPSTR1
P4: ^UPSTR2
Q4: ^DNSTR1
R4: ^DNSTR2
S4: ^UPSTR1
T4: ^UPSTR2
U4: ^DNSTR1
V4: ^DNSTR2
A5: [W11] \-
B5: \-
C5: \-
D5: \-
E5: \-
F5: \-
G5: \-
```

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 1	Dawn C. Wilson	09/19/86
Subject/Title	Reviewed By	Date
Unit 1 RCIC Motor Operated Valve	[illegible]	9/21/86
Differential Pressure Calculation	Calculation Number SNH-86-016	Sheet 50 of 53

TWO INCH GLOBE VALVE PVEL CALCULATIONS PAGE 2 OF 2

```
H5: [W2] \-
I5: \-
J5: \-
K5: \-
L5: \-
M5: \-
N5: \-
O5: \-
P5: \-
Q5: \-
R5: \-
S5: \-
T5: \-
U5: \-
V5: \-
W5: \-
X5: \-
Y5: \-
Z5: \-
AA5: \-
A6: [W11] '1E41-FØ59
B6: 1.75
C6: 1Ø
D6: 25
E6: 31.42
F6: 7.6Ø1
G6: 7.6Ø1
H6: [W2] '|
I6: (2*D6)/$D$28
J6: (2*E6)/$D$28
K6: +$C6*Ø.5
L6: +$C6*Ø.5+I6
M6: +$C6*Ø.5
N6: +$C6*Ø.5+J6
O6: (+K6*1ØØ)/$C6
P6: (+L6*1ØØ)/$C6
Q6: (+M6*1ØØ)/$C6
R6: (+N6*1ØØ)/$C6
S6: +O6*Ø.8
T6: +P6*Ø.8
U6: +Q6*Ø.8
V6: +R6*Ø.8
W6: (+F6*(T6-S6))/1ØØ
X6: (+G6*(V6-U6))/1ØØ
Y6: (W6*$D$27*$D$28)/(144*32.2)
Z6: (X6*$D$27*$D$28)/(144*32.2)
AA6: +Y6+Z6

C27: 'DENSITY
D27: 61.996
E27: 'LB/FT3
C28: 'C
D28: 4ØØØ
E28: 'FT/SEC
```

GATE VALVE PVEL CALCULATIONS


```
A3: [W11] ^MPL
B3: ^VALVE
C3: ^CLOSING
D3: ^UPSTR
E3: ^DNSTR
F3: 'UPSTRSYS
G3: 'DNSTRSYS
I3: ^dT UP
J3: ^dTDN
K3: ^TIMEu1
L3: ^TIMEu2
M3: ^TIMEd1
N3: ^TIMEd2
O3: ^RISEu1
P3: ^RISEu2
Q3: ^RISEd1
R3: ^RISEd2
S3: ^CHORDu1
T3: ^CHORDu2
U3: ^CHORDd1
V3: ^CHORDd2
W3: 'MAX AREA
X3: ^Aflu1
Y3: ^Aflu2
Z3: ^Afld1
AA3: ^Afld2
AB3: ^a/Au1
AC3: ^a/Au2
AD3: ^a/Ad1
AE3: ^a/Ad2
AF3: ^Vu1
AG3: ^Vu2
AH3: ^Vd1
AI3: ^Vd2
AJ3: ^dVu
AK3: ^dVd
AL3: ^Pvu
AM3: ^Pvd
AN3: ^Pvel
A4: [W11] ^NUMBER
B4: ^DIA, "
C4: ^T, SECS
D4: ^PIPE L'
E4: ^PIPE L'
F4: ^VEL FPS
G4: ^VEL FPS
W4: 'FLOW
A5: [W11] \-
```

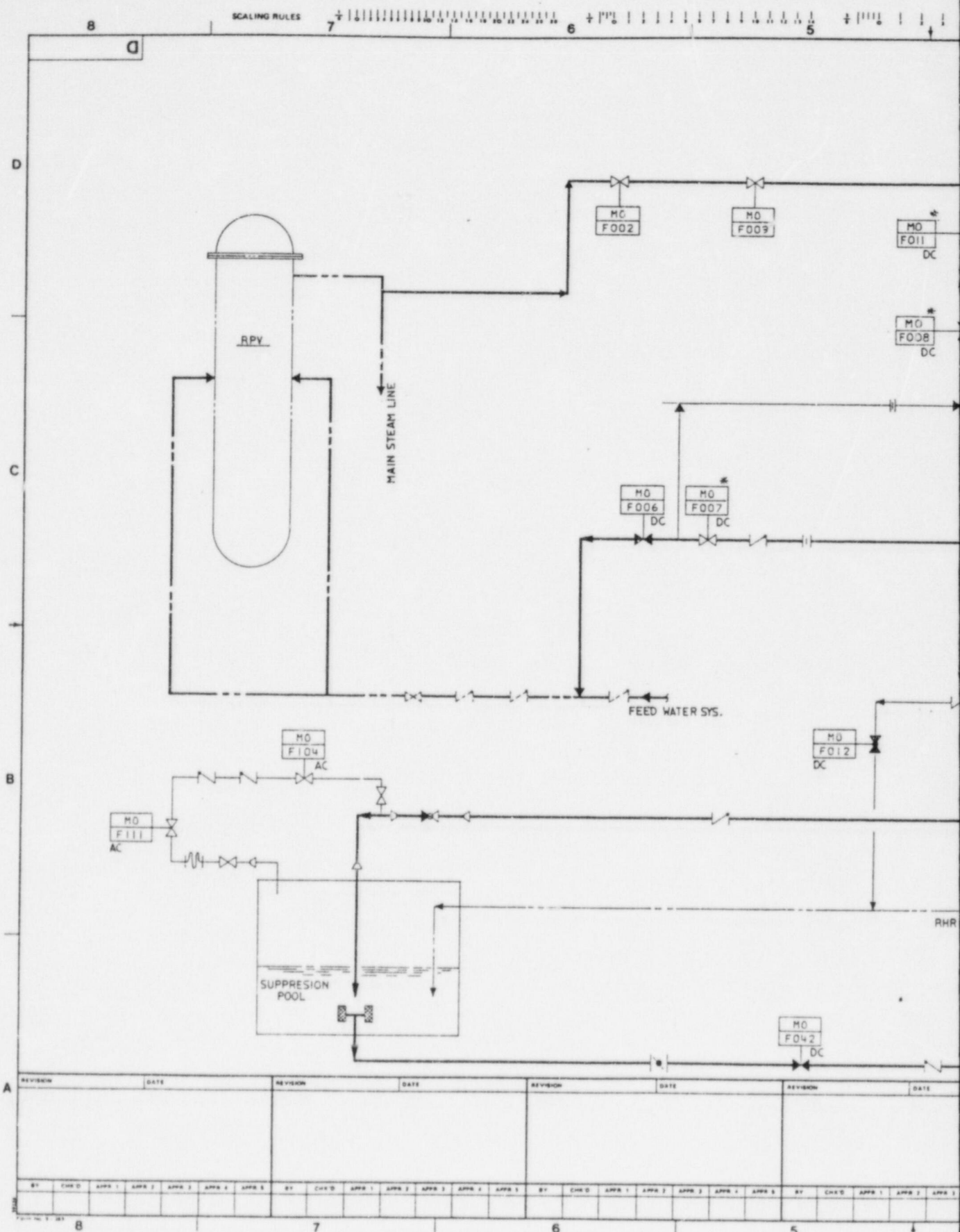
GATE VALVE PVEL CALCULATIONS

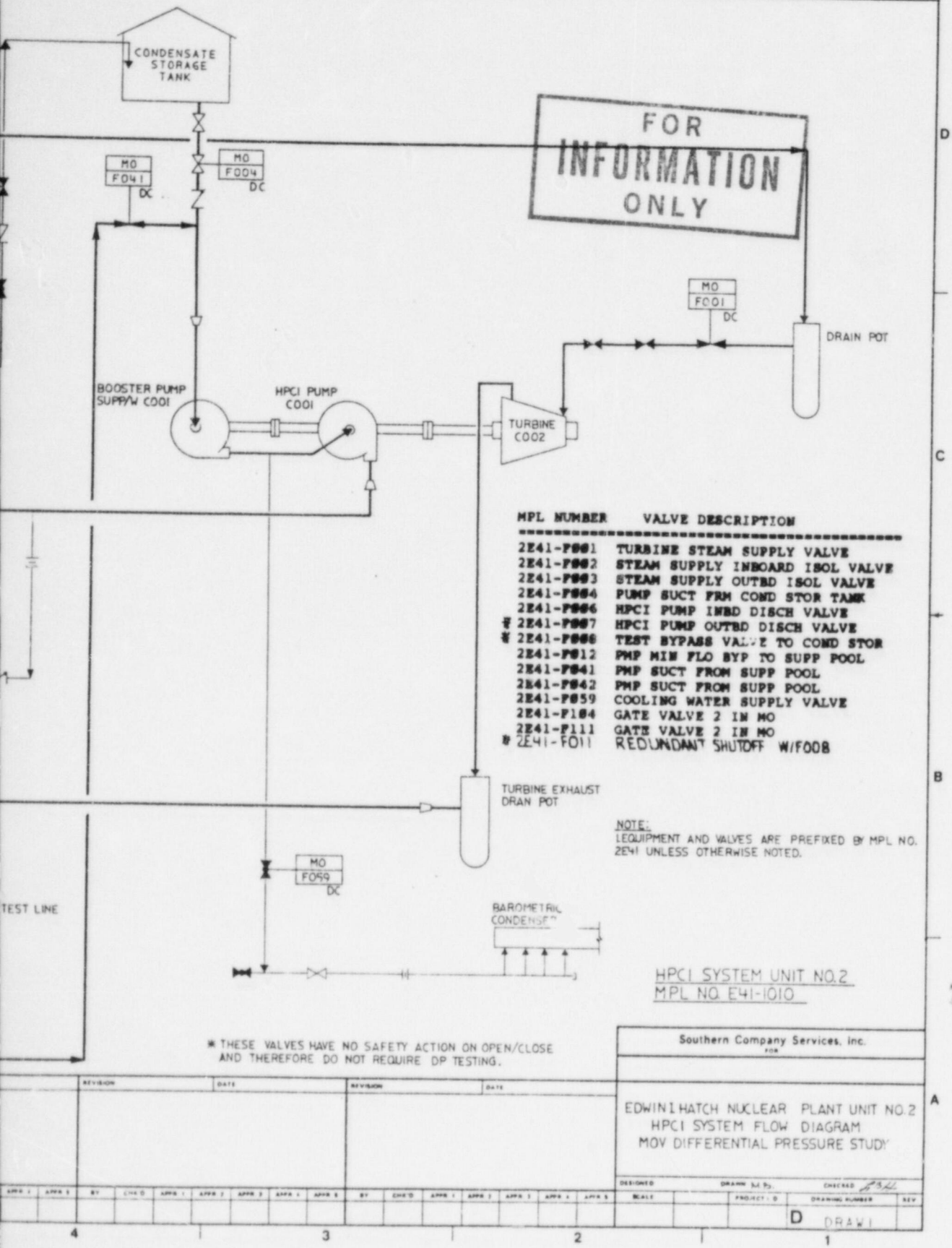

```
B5: \-
C5: \-
D5: \-
E5: \-
F5: \-
G5: \-
H5: [W2] \-
I5: \-
J5: \-
K5: \-
L5: \-
M5: \-
N5: \-
O5: \-
P5: \-
Q5: \-
R5: \-
S5: \-
T5: \-
U5: \-
V5: \-
W5: \-
X5: \-
Y5: \-
Z5: \-
AA5: \-
AB5: \-
AC5: \-
AD5: \-
AE5: \-
AF5: \-
AG5: \-
AH5: \-
AI5: \-
AJ5: \-
AK5: \-
AL5: \-
AM5: \-
AN5: \-
A6: [W11] '1E51-FØ13
B6: 3+5/16
C6: 15
D6: 99.9
E6: 16.6
F6: 11.62
G6: 12.46
H6: [W2] '|
I6: (2*D6)/$D$29
```

GATE VALVE PVEL CALCULATIONS


```
J6: (2*E6)/$D$29
K6: ($D$30*$C6)-I6
L6: +$D$30*$C6
M6: ($D$30*$C6)-J6
N6: +$D$30*$C6
O6: (K6/$C6)*($B6/2)
P6: (L6/$C6)*($B6/2)
Q6: (M6/$C6)*($B6/2)
R6: (N6/$C6)*($B6/2)
S6: @SQRT(8*O6*(($B6/2)-(O6/2)))
T6: @SQRT(8*P6*(($B6/2)-(P6/2)))
U6: @SQRT(8*Q6*(($B6/2)-(Q6/2)))
V6: @SQRT(8*R6*(($B6/2)-(R6/2)))
W6: 2*((1/12)*(((3*B6*B6)/4)+(4*B6*B6)))
X6: (F6) (W6)-(2*((O6/(6*S6))*((3*O6*O6)+(4*S6*S6))))
Y6: (F6) (W6)-(2*((P6/(6*T6))*((3*P6*P6)+(4*T6*T6))))
Z6: (F6) ($W6)-2*((Q6/(6*U6))*((3*Q6*Q6)+(4*U6*U6)))
AA6: (F6) ($W6)-2*((R6/(6*V6))*((3*R6*R6)+(4*V6*V6)))
AB6: (F6) +X6/((@PI*$B6*$B6)/4)
AC6: (F6) +Y6/((@PI*$B6*$B6)/4)
AD6: (F6) +Z6/((@PI*$B6*$B6)/4)
AE6: (F6) +AA6/((@PI*$B6*$B6)/4)
AF6: (F6) +AB6*$F6
AG6: (F6) +AC6*$F6
AH6: (F6) +AD6*$G6
AI6: (F6) +AE6*$G6
AJ6: (F6) +AF6-AG6
AK6: (F6) +AH6-AI6
AL6: (F6) (AJ6*$D$28*$D$29)/(144*32.2)
AM6: (F6) (AK6*$D$28*$D$29)/(144*32.2)
AN6: (F6) +AL6+AM6
C28: 'DENSITY
D28: 61.996
E28: 'LB/FT3
C29: 'C
D29: 4000
E29: 'FT/SEC
C30: 'FUDGE FAC
D30: 1
E30: 'DIMLESS
```

ENCLOSURE 3


SCALING RULES
8
7
6
5
D
C
B
A
RPV
MAIN STEAM LINE
MO F002
MO F009
MO F011
DC
MO F008
DC
MO F006
DC
MO F007
DC
FEED WATER SYS.
MO F104
AC
MO F111
AC
MO F012
DC
RHR
SUPPRESION POOL
MO F042
DC
REVISION
DATE
BY
CHK'D
APPR 1
APPR 2
APPR 3
APPR 4
APPR 5



FOR INFORMATION ONLY

MPL NUMBER	VALVE DESCRIPTION
2E41-F001	TURBINE STEAM SUPPLY VALVE
2E41-F002	STEAM SUPPLY INBOARD ISOL VALVE
2E41-F003	STEAM SUPPLY OUTBD ISOL VALVE
2E41-F004	PUMP SUCT FRM COND STOR TANK
2E41-F006	HPCI PUMP INBD DISCH VALVE
* 2E41-F007	HPCI PUMP OUTBD DISCH VALVE
* 2E41-F008	TEST BYPASS VALVE TO COND STOR
2E41-F012	PMP MIN FLO BYP TO SUPP POOL
2E41-F041	PMP SUCT FROM SUPP POOL
2E41-F042	PMP SUCT FROM SUPP POOL
2E41-F059	COOLING WATER SUPPLY VALVE
2E41-F104	GATE VALVE 2 IN MO
2E41-F111	GATE VALVE 2 IN MO
* 2E41-F011	REDUNDANT SHUTOFF W/F008

NOTE:
EQUIPMENT AND VALVES ARE PREFIXED BY MPL NO. 2E41 UNLESS OTHERWISE NOTED.

HPCI SYSTEM UNIT NO.2
MPL NO. E41-1010

* THESE VALVES HAVE NO SAFETY ACTION ON OPEN/CLOSE AND THEREFORE DO NOT REQUIRE DP TESTING.

Southern Company Services, Inc.

EDWIN I HATCH NUCLEAR PLANT UNIT NO.2
HPCI SYSTEM FLOW DIAGRAM
MOV DIFFERENTIAL PRESSURE STUDY

REVISION	DATE	REVISION	DATE

DESIGNED | DRAWN | CHECKED | SCALE | PROJECT | DRAWING NUMBER | REV

D DRAW I

8610090442-03

Calculation Cover Sheet

Southern Company Services

	Calculation Number: SNH-86-017
Project: E.I. HATCH NUCLEAR PLANT UNIT 2	Discipline: Mechanical
Objective: Calculate DP for HPCI Motor Operated Valves	SDS Number:

Subject/Title: Unit 2 HPCI Motor Operated Valve Differential Pressure Calculation

Design Engineer's Signature	Date	Last Page Number
L B Hudson	9-20-86	59

Contents

Record of Revisions

Rev. No.	Description	Originator Date	Reviewer Date	Proj. Engr. Date
0	APPROVED	LBH 9-20-86	WMD 9/21/86	[illegible] 9/21/86

Notes

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	Dawn C. Wilson	09/19/86
Subject/Title: Unit 2 HPCI Motor Operated Valve	Reviewed By: W.T. Barr	Date: 9/21/86
Differential Pressure Calculation	Calculation Number: SNH-86-017	Sheet: 1 of 59

INTRODUCTION

The Nuclear Regulatory Commission (NRC) IE Bulletin 85-03 (Motor Operated Valve Common Mode Failure) requested that owners of light water reactors develop and implement a program to ensure that torque switch settings on safety related motor-operated valves on high pressure systems are selected, set and maintained correctly to accomodate the maximum differential pressures expected on these valves during both normal and abnormal events within the design basis. The objective of this calculation is to determine the maximum Differential Pressure across each of the affected Unit 2 HPCI Motor Operated Valves.

00451

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	GB Harkins	9-20-96
Subject/Title Unit 2 HPCI Motor Operated Valve	Reviewed By AD McKenzie	Date 9/21/96
Differential Pressure Calculation	Calculation Number SNH-86-017	Sheet 2 of 59

CRITERIA

1) The criteria, assumptions and formulas given in the General Electric "BWR Owner's Group Report on the Operational Design Basis of Selected Safety-Related Motor-Operated Valves," DRF-E12-00100-75, are assumed to be correct.

ASSUMPTIONS

1) PC is assumed to equal PLOC. The terms are defined as follows:
   * PLOC is the maximum wet well LOCA pressure.
   * PC is the maximum wetwell LOCA pressure which the valve is required to operate against.

2) In the PVEL calculation, it is assumed that the time required for a sound wave to travel to and return from an atmospheric vessel is infinity. Thus, the related term in the PVEL equation is equal to zero.

3) Disc and Port diameters are assumed to be equal. Equal diameters for disc and port yield higher rate of change therefore higher DV and is therefore more conservative.

4) The Formula for calculating area of the gate valve available for flow is approximated from a known geometric relationship and is off by a small percentage, however, the overall effect is negligible.

5) In the PVEL calculation, it is assumed that where a small line tees into a much larger line (i.e. Larger being two times or greater in diameter) the boundary for the small line ends at the line intersection.

00431

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	G B Hatcher	9-20-86
Subject/Title: Unit 2 HPCI Motor Operated Valve	Reviewed By: W. T. Barr	Date: 9/20/86
Differential Pressure Calculation	Calculation Number: SNH-86-017	Sheet: 3 of 54

UNIT 2
HPCI MOV CALCULATIONS
REFERENCES

1.	A-26497 REV. 12	INSTRUMENT SETPOINT INDEX
2.	A-26503 REV. N/A	SHT. 1, 2, 16 AND 30 MOV DATA SHEETS
3.	H-26020 REV. 17	HPCI SYSTEM P & ID SHEET 1
4.	H-26021 REV. 14	HPCI SYSTEM P & ID SHEET 2
5.	H-26289 REV. 4	FEEDWATER PIPING DRYWELL ELEV. 130' & ABOVE
6.	S-25176 REV. 0	PROCESS DIAGRAM HPCI SYSTEM
7.	S-25701 REV. E	BYRON JACKSON PUMP MANUAL, PUMP CURVE T-33713-1
8.	S-25711 REV. 0	4" PRESS SEAL GLOBE VALVE, VELAN
9.	S-26835 REV. E	KELLOGG ISOMETRIC DWG. 2E41-1
10.	S-26837 REV. M	KELLOGG ISOMETRIC DWG. 2E41-2
11.	S-26839 REV. G	KELLOGG ISOMETRIC DWG. 2E41-3
12.	S-26841 REV. N	KELLOGG ISOMETRIC DWG. 2E41-4
13.	S-26843 REV. M	KELLOGG ISOMETRIC DWG. 2E41-5
14.	S-26845 REV. J	KELLOGG ISOMETRIC DWG. 2E41-6
15.	S-26847 REV. L	KELLOGG ISOMETRIC DWG. 2E41-7
16.	S-27026 REV. B	16" 150LB OSY GATE VALVE, POWELL 1523WE
17.	S-27131 REV. F	14" 900LB OSY GATE VALVE, POWELL 19023WE
18.	S-27294 REV. F	MODEL LCT-20 SERIES RELIEF VALVE
19.	S-27535 REV. 0	GENERAL PLAN DRYWELL AND TORUS LAYOUT
20.	S-28978 REV. N	KELLOGG ISOMETRIC DWG. 2B21-3
21.	S-28980 REV. M	KELLOGG ISOMETRIC DWG. 2B21-4
22.	S-29112 REV. H	KELLOGG ISOMETRIC DWG 2B21-5
23.	S-36017 REV. 0	KELLOGG ISOMETRIC DWG. 2E41-F6

UNIT 2
HPCI MOV CALCULATIONS
REFERENCES CONT'D

24. S-36034 REV. A KELLOGG ISOMETRIC DWG. 2E41-F23

25. S-36035 REV. 0 KELLOGG ISOMETRIC DWG. 2E41-F24

26. S-36036 REV. 0 KELLOGG ISOMETRIC DWG. 2E41-F25

27. S-36037 REV. 0 KELLOGG ISOMETRIC DWG. 2E41-F26

28. S-36038 REV. A KELLOGG ISOMETRIC DWG. 2E41-F27

29. S-36040 REV. A KELLOGG ISOMETRIC DWG. 2E41-F28

30. S-43166 REV. 0 4" PRESS SEAL GLOBE VALVE, VELAN

31. SX-24013 REV. 0 YARWAY WELBOND VALVE FIG. 5515B

32. SX-22585 REV. D KELLOGG ISOMETRIC DWG. 2E41-17

33. SX-24226 REV. C KELLOGG ISOMETRIC DWG. 2E41-20

34. UNIT NO. 2 TECHNICAL SPECIFICATIONS AMENDMENT 62

36. UNIT 2 FSAR TABLE 6.2-5 SHT. 2 NOTE 7

37. BWR OWNERS GROUP REPORT ON THE OPERATIONAL DESIGN BASIS OF SELECTED SAFETY RELATED MOTOR OPERATED VALVES, DRF-E12-00100-75, AUGUST 1986.

38. NEDO DOCUMENT 24569 REV. 2 FIGURE H2 4.1.2-1

39. CRANE TECHNICAL PAPER NO. 410, 18TH PRINTING

40. ENGINEERS COMPANION 1966 PAGE 13

41. TELECOPY TO JACK ROBYN OF SCS FROM PAUL COUTINHO OF VELAN ON 9-18-86

42. TELECOPY TO JACK ROBYN OF SCS FROM DAN ~~HARASEN~~HORASOWYCH OF YARWAY ON 9-11-86

43. TELEPHONE CONFIRMATION FROM BRAD HARKINS OF SCS TO DENNIS SCHERER OF POWELL ON 9-11-86

44. ENGINEERING FORMULAS 4TH EDITION, PAGE B3

0072D

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	E B Harkins	9-20-86
Subject/Title: Unit 2 HPCI Motor Operated Valve	Reviewed By: W. T. Barr	Date: 9/20/86
Differential Pressure Calculation	Calculation Number: SNH-86-017	Sheet: 5 of 59

SUMMARY OF CONCLUSIONS

The following page is a summary table of the results for each HPCI Motor Operated Valve in the Scope of NRC IEB 85-03.

The first column titled "MPL Number" gives the MPL number of the valve.

The second column titled "Valve Description" is the description of the valve given in the equipment location index (ELI).

The third column titled "Valve Function" is the function of the valve as stated in the General Electric "BWR Owners' Group Report on the Operational Design Basis of Selected Safety-Related Motor-Operated Valves."

The fourth column titled "Safety" indicates if the valve has any safety-related action.

The fifth column titled "DP Calculation Formula" gives the formula used to calculate the maximum differential pressure.

The sixth column titled "Maximum DP" indicates whether the maximum DP occurs upstream or downstream of the valve.

The seventh column titled " Max DP ON " indicates whether the maximum DP is calculated for opening or closing.

The eighth column titled "DP (PSID)" gives the calculated maximum DP in psid.

The ninth column titled "Safety On" gives the safety action of the valve.

00471

DESIGN CALCULATIONS — SOUTHERN COMPANY SERVICES

E.I. HATCH NUCLEAR PLANT UNIT 2 — PREPARED BY: [signature] — DATE 09/21/86

UNIT 2 HPCI MOTOR OPERATED VALVE — REVIEWED BY: [signature] — DATE 09/21/86

DIFFERENTIAL PRESSURE CALCULATION — CALCULATION NUMBER SNH-86-017 — SHEET 6 OF 59.

SUMMARY TABLE 09/21/86

MPL NUMBER	VALVE DESCRIPTION	VALVE FUNCTION	SAFETY	DP CALCULATION FORMULA	MAXIMUM DP	MAXIMUM DP	DP (PSID)	SAFETY
2E41-F001	TURBINE STEAM SUPPLY VALVE	HPCI TURBINE STEAM ADMISSION VALVE	OPEN	DP=PRSS	OPEN	UPSTREAM	1090	YES
2E41-F002	STEAM SUPPLY INBOARD ISOL VALVE	HPCI STEAM LINE ISOLATION VALVE	CLOSE	DP=PRSS	CLOSE	UPSTREAM	1090	YES
2E41-F003	STEAM SUPPLY OUTBD ISOL VALVE	HPCI STEAM LINE ISOLATION VALVE	CLOSE	DP=PRSS	CLOSE	UPSTREAM	1090	YES
2E41-F004	PUMP SUCT FRM COND STOR TANK	HPCI CST SUCTION VALVE	CLOSE	DP=PELD+PV+PVEL1	CLOSE	UPSTREAM	29.814	YES
2E41-F006	HPCI PUMP INBD DISCH VALVE	HPCI INJECTION/ISOLATION VALVE	OPEN/CLOSE	DP=PSDH-PISO-PEL	OPEN	UPSTREAM	1379.03	YES
2E41-F006	HPCI PUMP INBD DISCH VALVE	HPCI INJECTION/ISOLATION VALVE	OPEN/CLOSE	DP=PSDH-PISO-PEL+PVEL2	CLOSE	UPSTREAM	1387.193	YES
2E41-F007	HPCI PUMP OUTBD DISCH VALVE	HPCI INJECTION VALVE TEST VALVE	NONE	NO SAFETY ACTION	N/A	N/A	N/A	NO
2E41-F008	TEST BYPASS VALVE TO COND STOR	HPCI CST TEST RETURN VALVE	NONE	NO SAFETY ACTION	N/A	N/A	N/A	NO
2E41-F011	REDUNDANT SHUTOFF W/F008	HPCI CST TEST RETURN VALVE	NONE	NO SAFETY ACTION	N/A	N/A	N/A	NO
2E41-F012	PMP MIN FLO BYP TO SUPP POOL	HPCI PUMP MIN FLO BYP ISOL VALVE	OPEN/CLOSE	DP=PSDH+PELM	OPEN	UPSTREAM	2269.58	YES
2E41-F012	PMP MIN FLO BYP TO SUPP POOL	HPCI PUMP MIN FLO BYP ISOL VALVE	OPEN/CLOSE	DP=PMF+PELM+PVEL3	CLOSE	UPSTREAM	2270.605	YES
2E41-F041	PMP SUCT FROM SUPP POOL	HPCI SUPP POOL SUCT ISOL VALVE	OPEN/CLOSE	DP=PRV-PELS	OPEN	DOWNSTREAM	97.12	YES
2E41-F041	PMP SUCT FROM SUPP POOL	HPCI SUPP POOL SUCT ISOL VALVE	OPEN/CLOSE	DP=PLOC+PLOM1	CLOSE	UPSTREAM	37.06	YES
2E41-F042	PMP SUCT FROM SUPP POOL	HPCI SUPP POOL SUCT ISOL VALVE	OPEN/CLOSE	DP=PRV-PELS	OPEN	DOWNSTREAM	97.12	YES
2E41-F042	PMP SUCT FROM SUPP POOL	HPCI SUPP POOL SUCT ISOL VALVE	OPEN/CLOSE	DP=PLOC+PLOM1	CLOSE	UPSTREAM	37.06	YES
2E41-F059	COOLING WATER SUPPLY VALVE	HPCI TURBINE ACCES COOLING WTR VLV	OPEN/CLOSE	DP=PC+PLOM2	OPEN	UPSTREAM	37.01	YES
2E41-F059	COOLING WATER SUPPLY VALVE	HPCI TURBINE ACCES COOLING WTR VLV	OPEN/CLOSE	DP=PC+PLOM2+PVEL4	CLOSE	UPSTREAM	37.947	YES
2E41-F104	GATE VALVE 2 IN MO	HPCI VAC BREAKER LINE ISOL VALVE	CLOSE	DP=PC+PATM	CLOSE	UPSTREAM	31.6	YES
2E41-F111	GATE VALVE 2 IN MO	HPCI VAC BREAKER LINE ISOL VALVE	CLOSE	DP=PC+PATM	CLOSE	UPSTREAM	31.6	YES

DEFINITION OF TERMS 09/19/86

TERM	DEFINITION OF TERM
DP	VALVE MAXIMUM EXPECTED OPERATING DIFFERENTIAL PRESSURE
PSOH	DIFFERENTIAL PRESSURE DEVELOPED BY SYSTEM MAIN PUMPS AT ZERO FLOW RATE. FOR STEAM TURBINE DRIVEN PUMPS, USE MAXIMUM NORMAL TURBINE SPEED
PEL	MINIMUM HYDROSTATIC PRESSURE DIFFERENCE BETWEEN SUCTION AND DISCHARGE DUE TO ELEVATION. (DISCHARGE ELEVATION IS HIGHER THAN SUCTION)
PISO	LOW REACTOR PRESSURE AT WHICH STEAM SUPPLY LINES AUTOMATICALLY ISOLATE
PELM	MAXIMUM HYDROSTATIC PRESSURE DIFFERENCE BETWEEN SUCTION AND DISCHARGE SOURCE DUE TO ELEVATION
PRSS	REACTOR PRESSURE CORRESPONDING TO THE SPRING SETPOINT OF THE REACTOR SAFETY RELIEF VALVE WITH THE LOWEST NOMINAL SPRING SETPOINT
PELD	HYDROSTATIC PRESSURE DIFFERENCE BETWEEN CST AND SUPPRESSION POOL ASSUMING THE CST TO BE FULL AND THE SUPPRESSION POOL WATER LEVEL AT ITS MAXIMUM ALLOWABLE NORMAL LEVEL
PMF	DIFFERENTIAL PRESSURE DEVELOPED BY THE SYSTEM MAIN PUMPS AT A FLOW RATE EQUAL TO THE REQUIRED MINIMUM BYPASS FLOW RATE. FOR STEAM DRIVEN PUMPS USE MAXIMUM NORMAL TURBINE SPEED
PV	VELOCITY HEAD IN THE SUPPRESSION POOL SUCTION LINE

DEFINITION OF TERMS 09/19/86

TERM	DEFINITION OF TERM
	AT THE LOCATION WHERE THE CST LINE CONNECTS TO IT
PRV	SYSTEM SUCTION RELIEF VALVE ACTUATION SET PRESSURE
PELS	HYDROSTATIC PRESSURE DIFFERENCE BETWEEN THE MINIMUM SUPPRESSION POOL WATER LEVEL AND THE LOCATION OF THE RELIEF VALVE ON THE PUMP SUCTION LINE
PLOC	LOCA WETWELL PRESSURE WHEN THE SYSTEM IS ISOLATED
PLOM	HYDROSTATIC PRESSURE UPSTREAM OF THE VALVE DUE TO MAXIMUM LOCA SUPPRESSION POOL WATER LEVEL
PC	MAXIMUM LOCA WETWELL PRESSURE WHEN SYSTEM IS REQUIRED TO OPERATE
PATM	ATMOSPHERIC PRESSURE
PVEL	DIFFERENTIAL PRESSURE ASSOCIATED WITH VALVE CLOSURE DUE TO FLUID VELOCITY CHANGES (I.E., WATER HAMMER TYPE PRESSURE INCREASE) INSIDE THE PIPE

DERIVATION OF VALUES 09/19/86

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PSOH	2240	FROM S-25701 REV. E, BYRON JACKSON PUMP MANUAL, PUMP CURVE T-33713-1 @ A TURBINE SPEED OF 4000 RPM.
PEL	5.97	THE ELEVATION OF THE FEEDWATER PIPING NOZZLE AT THE REACTOR IS GIVEN AS 183' 9 1/2" IN H-26298 REV. 4. THE MAXIMUM WATER LEVEL IN THE CST IS GIVEN AS 170' 0" IN A-26497 REV. 12. FOR 2P21-N002. THUS THE DIFFERENCE IN ELEVATION IS: 183' 9 1/2" - 170' 0" = 7' 9 1/2" = 13.79 FT H20. AND THE HYDROSTATIC PRESSURE IS: 13.79 FT H20 X 0.432781 PSIG/FT H20=5.97 PSIG
PISO	855	FROM A-26497 REV.12 INSTRUMENT SETPOINT INDEX. USE THE MSL ISOLATION SETPOINT AS GIVEN FOR INSTRUMENTS 2B21-N015 A-D.
PELM	29.58	THE CST IS AT ITS MAXIMUM WATER LEVEL AND THE SUPPRESSION POOL IS AT ITS MINIMUM WATER LEVEL WHEN THE MINIMUM FLOW BYPASS VALVE IS REQUIRED

DERIVATION OF VALUES 09/20/86

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PELM		TO OPERATE. THE MAXIMUM WATER LEVEL IN THE CST IS GIVEN AS 170' 0" IN A-26497 REV. 12 FOR INSTRUMENT 2P21-N002. THE MINIMUM WATER LEVEL IN THE SUPPRESSION POOL IS GIVEN AS 12' 2" IN THE UNIT 2 TECHNICAL SPECIFICATION SECTION 3.6.2.1 AMENDMENT NO. 62. THE INSIDE BOTTOM ELEVATION OF THE SUPPRESSION POOL IS GIVEN AS 89' 5 3/4", DERIVED FROM 103' 6 1/4" - 14' 1/2 ", IN S-27535 REV. 0. THE ELEVATION OF THE SUPPRESSION POOL AT MINIMUM WATER LEVEL IS THE INSIDE BOTTOM ELEVATION PLUS THE MINIMUM WATER LEVEL: 89' 5 3/4" + 12' 2" = 101' 7 3/4" THE HEAD DIFFERENCE IS THEN: 170' 0" - 101' 7 3/4" = 68' 4 1/4" = 68.35 FT H20 THUS THE HYDROSTATIC PRESSURE IS: 68.35 FT H20 X 0.432781 PSIG/FT H20 =29.58 PSIG

DERIVATION OF VALUES 09/20/86

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PRSS	1090	FROM UNIT 2 TECHNICAL SPECIFICATION SECTION 3.4.2.1 AMENDMENT NO. 62.
PELD	29.44	THE MAXIMUM WATER LEVEL IN THE CST IS GIVEN AS 170' 0" IN A-26497 REV. 12 FOR INSTRUMENT 2P21-N002. THE MAXIMUM WATER LEVEL IN THE SUPPRESSION POOL IS 12' 6" GIVEN IN UNIT 2 TECHNICAL SPECIFICATION SECTION 3.6.2.1 AMENDMENT NO. 62. THE INSIDE BOTTOM ELEVATION OF THE SUPPRESSION POOL IS 89' 5 3/4", DERIVED FROM 103' 6 1/4" - 14' 1/2", IN S-27535 REV. 0. THE ELEVATION OF THE SUPPRESSION POOL MAXIMUM WATER LEVEL IS THE INSIDE BOTTOM ELEVATION PLUS THE MAXIMUM WATER LEVEL: 89' 5 3/4" + 12' 6" = 101' 11 3/4" THE HEAD DIFFERENCE IS THEN: 170' 0" - 101' 11 3/4" = 68' 0 1/4" = 68.02 FT H20 THUS THE HYDROSTATIC PRESSURE IS: 68.02 FT X 0.432781 PSI/FT H20 = 29.44 PSIG
PMF	2235	FROM S-25701 REV.E,BYRON JACKSON PUMP MANUAL, PUMP CURVE T-33713-1 AT A MINIMUM FLOW

DERIVATION OF VALUES 09/20/86

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PMF		BYPASS RATE OF 450 GPM, S-25176 REV. 0 PROCESS DIAGRAM HPCI SYSTEM, AND A TURBINE SPEED OF 4000 RPM.
PV	0.374	THE HPCI SYSTEM RATED FLOW IS GIVEN AS 4250 GPM IN THE UNIT 2 TECHNICAL SPECIFICATION SECTION 4.5.1 AMENDMENT NO. 62. THE INSIDE DIAMETER OF THE SUPPRESSION POOL SUCTION LINE IS 15.250 GIVEN IN H-26020 REV. 17, UNIT 2 PIPE SPECIFICATION AND THE CRANE TECHNICAL PAPER NO. 410, 18TH PRINTING. THE VELOCITY HEAD IS EQUAL TO: (V)**2/2*gc FROM CRANE TP NO 410, WHERE: gc IS GRAVITATIONAL CONSTANT = 32.2 FT/(SEC)**2 PI = 3.1416 V = Q/A V = (4250*0.13368)*(144/60)/ . [PI (15.250)**2/4] . = 7.46 FT/SEC THUS THE VELOCITY HEAD IS: (7.46)**2/2(32.2) = 0.865 FT H20

DERIVATION OF VALUES 09/20/86

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PV		AND VELOCITY HEAD PRESSURE IS: Ø.865 FT H2Ø X Ø.432781 PSIG/FT H2Ø = Ø.374 PSIG
PRV	1ØØ	FROM S-27294 REV. F MODEL LCT-2Ø SERIES RELIEF VALVE.
PELS	2.88	THE MINIMUM SUPPRESSION POOL ELEVATION WAS DETERMINED TO BE 1Ø1' 7 3/4" IN THE CALCULATION FOR PELM ABOVE. THE ELEVATION FOR THE SUCTION RELIEF VALVE 2E41-FØ2Ø IS GIVEN AS 95' Ø" IN S-36Ø17 REV. Ø. THUS THE HYDROSTATIC HEAD IS: 1Ø1' 7 3/4" - 95' Ø" = 6' 7 3/4" = 6.65 FT H2Ø AND THE HYDROSTATIC PRESSURE IS: 6.65 FT. X Ø.432781 PSIG/FT H2Ø = 2.88 PSIG
PLOC	31.6	PLOC=PC. THE ECCS OPERATION MAY REQUIRE THE CLOSURE OF THE SUPPRESSION POOL ISOLATION VALVES TO PROVIDE PRIMARY CONTAINMENT ISOLATION FOR EXTREME LOCA

DERIVATION OF VALUES 09/20/86

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PLOC		CONDITIONS FOLLOWING UTILIZATION OF THE WETWELL INVENTORY.
PLOM1	5.46	THE MAXIMUM LOCA SUPPRESSION POOL WATER LEVEL IS 102' 7 1/2" GIVEN IN S-27535 REV. 0. THE CENTERLINE ELEVATION OF VALVES 2E41-F041 AND 2E41-F042 IS 90' 0" FROM S-26835 REV. E. THE HEAD DIFFERENCE IS: 102' 7 1/2" - 90' 0" = 12' 7 1/2" = 12.625 FT H20. THUS THE HYDROSTATIC PRESSURE IS: 12.625 FT H20 X 0.432781 PSIG/FT H20 = 5.46 PSIG
PLOM2	5.41	THE MAXIMUM LOCA SUPPRESSION POOL WATER LEVEL IS 102' 7 1/2" GIVEN IN S-27535 REV. 0. THE CENTERLINE ELEVATION OF VALVE 2E41-F059 IS 90' 1 1/2" FROM S-36034 REV. A. THE HEAD DIFFERENCE IS: 102' 7 1/2" - 90' 1 1/2" = 12' 6" = 12.5 FT H20 THUS THE HYDROSTATIC PRESSURE IS: 12.5 FT H20 X 0.432781 PSIG/FT H20

DERIVATION OF VALUES 09/21/86

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PLOM2		= 5.41 PSIG
PC	31.6	FROM NEDO DOC. 24569 REV. 2 FIGURE H2 4.1.2-1.
PATM	Ø	NORMAL ATMOSPHERIC PRESSURE = 14.6976 PSIA PSIG = PSIA - 14.696 = Ø
PVEL1	Ø	KELLOGG ISOMETRIC DRAWINGS S-26835 REV. E, S-26837 REV. M, SX-22585 REV. D, AND SX-24226 REV. C SHOW THAT THE UPSTREAM PIPING IS CONNECTED TO THE CONDENSATE STORAGE TANK. IT IS ASSUMED THAT ANY WATER HAMMER EFFECTS IN THE UPSTREAM PIPING WOULD BE DISSIPATED WITHIN THE CST VOLUME AND PRODUCE NO RESULTANT PRESSURE RISE ON THE VALVE. THE REFERENCED DRAWINGS ALSO SHOW THAT THE DOWNSTREAM PIPING IS INTERCONNECTED WITH THE SUPPRESSION POOL SUCTION LINE. IT IS ASSUMED THE HPCI PUMP IS OPERATING TO DRAW A SUCTION FROM THE SUPPRESSION POOL WHEN 2E41-FØØ4 BEGINS TO CLOSE. THEREFORE NO DOWNSTREAM FLUID DECELERATION WILL RESULT. IT MAY BE CONCLUDED THAT NO INCREASE IN PRESSURE

DERIVATION OF VALUES 09/21/86

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PVEL1		RESULTS BECAUSE OF WATER HAMMER. CONSIDERING THE ABOVE FACTS VALVE 2E41-F004 CAN BE CONSIDERED TO HAVE NO WATER HAMMER PRESSURE INCREASE.
PVEL2	8.163	DIFFERENTIAL PRESSURE ACROSS THE VALVE DUE TO WATER HAMMER FOR 2E41-F006: THE VALUE FOR PVEL2 IS CALCULATED BY COMPUTER. A DERIVATION FOR PVEL AND THE GATE VALVE AREA VS PERCENT OPEN CURVE USED IN THE CALCULATION ARE FOUND ATTACHED. THE FOLLOWING DATA IS USED IN THE CALCULATION TO DERIVE PVEL2: . SYSTEM VELOCITY UPSTREAM (Vsu) AND SYSTEM VELOCITY DOWNSTREAM (Vsd), WHERE: . FLOWRATE = 4250 GPM FROM S-25176 REV. 0. . AREA OF 14" SCH 80 PIPE = 122.72 IN SQ . AREA OF 14" SCH 100 PIPE = 115.49 IN SQ . FROM CRANE TECHNICAL PAPER No. 410. THEN: . Vsu=(4250 GPM x 0.321) / 122.72 IN SQ . = 11.12 FT/SEC . Vsd=(4250 GPM x 0.321) / 115.49 IN SQ . = 11.81 FT/SEC

DERIVATION OF VALUES 09/21/86

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PVEL2		CLOSURE TIME = 20 SEC FROM A-26503 SH 2 VALVE THROAT DIAMETER . DIAM VALVE = 11.25" PER TELEPHONE CONFIRMATION . FROM BRAD HARKINS OF SCS TO DENNIS . SCHERER OF POWELL ON 09/11/86 LENGTH UPSTREAM (LU) AND DOWNSTREAM (LD) . LU = 252.36 FT FROM S-26839 REV. G, . S-26841 REV. N AND S-26843 REV. M . LD = 152.35 FT FROM S-26843 REV. M, S-29112 . REV. H, S-28980 REV. M AND S-28978 REV. N PVEL2 = 8.163 FROM COMPUTER PRINTOUT.
PVEL3	6.025	DIFFERENTIAL PRESSURE ACROSS THE VALVE DUE TO WATER HAMMER FOR 2E41-F012: THE VALUE FOR PVEL3 IS CALCULATED BY COMPUTER. A DERIVATION DOR PVEL AND THE GLOBE VALVE CV VS PERCENT OPEN CURVE USED IN THE CALCULATION ARE FOUND ATTACHED. THE FOLLOWING DATA IS USED IN THE CALCULATION TO DERIVE PVEL3: . SYSTEM VELOCITY UPSTREAM (Vsu) AND SYSTEM VELOCITY DOWNSTREAM (Vsd) WHERE: . FLOWRATE = 450 GPM FROM S-25176 REV. 0 . AREA IF 4" SCH 80 PIPE = 11.5 IN SQ

DERIVATION OF VALUES 09/21/86

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PVEL3		. AREA OF 4" SCH 40 PIPE = 12.73 IN SQ . FROM CRANE TECHNICAL PAPER No. 410 THEN: Vsu=(450 GPM x 0.321) / 11.5 IN SQ . = 12.561 FT/SEC Vsd=(450 GPM x 0.321) / 12.73 IN SQ . = 11.347 FT/SEC CLOSURE TIME = 10 SEC FROM A-26503 SH 30 VALVE THROAT DIAMETER . DIAM VALVE = 2.5" PER TELECOPY TO JACK . ROBYN OF SCS FROM PAUL COUTINHO OF VELAN . ON 9/18/86. LENGTH UPSTREAM (LU) AND LENGTH DOWNSTREAM (LD) . LU = 59.86 FT FROM S-26845 REV. J . AND S-26839 REV. G . LD = 49.59 FT FROM S-26845 REV. J . AND S-26847 REV. L . FOR LD IT IS ASSUMED THAT THE WATER HAMMER . BOUNDARY ENDS AT THE TIE IN TO THE . RHR TEST LINE. PVEL3 = 6.025 FROM COMPUTER PRINTOUT
PVEL4	0.937	DIFERENTIAL PRESSURE ACROSS THE VALVE DUE TO WATER HAMMER FOR 2E41-F059.

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PVEL4		THE VALUE FOR PVEL4 IS CALCULATED BY COMPUTER. A DERIVATION FOR PVEL AND THE GLOBE VALVE CV VS PERCENT OPEN CURVE USED IN THE CALCULATION ARE FOUND ATTACHED. THE FOLLOWING DATA IS USED IN THE CALCULATION TO DERIVE PVEL4: . SYSTEM VELOCITY UPSTREAM (Vsu) AND SYSTEM VELOCITY DOWNSTREAM (Vsd) WHERE: . FLOWRATE = 70 GPM FROM S-25176 REV. 0 . AREA OF 2" SCH 80 PIPE = 2.953 IN SQ . FROM CRANE TECHNICAL PAPER No. 410 THEN . Vsu=(70 gpm X 0.321) / 2.953 IN SQ . = 7.601 FT/SEC . Vsd=Vsu CLOSURE TIME = 10 SEC FROM A-26503 SH 1 . PER STD. STROKE TIME HNP2 . FSAR TABLE 6.2-5 SH 2 NOTE 7 VALVE THROAT DIAMETER . DIAM VALVE = 1.403" PER TELECOPY TO JACK . ROBYN OF SCS FROM DAN HARASENGCH OF . YARWAY ON 9/11/86. LENGTH UPSTREAM (LU) AND LENGTH DOWNSTREAM (LD) . LU = 16.23 FT FROM S-36034 REV. A

DERIVATION OF VALUES 09/21/86

TERM	PRESSURE (PSIG)	DERIVATION OF VALUE
PVEL4		. LD = 41.39 FT FROM S-36034 REV. A, S-36035 REV. 0, S-36036 REV. 0, S-36037 REV. 0, S-36038 REV. A, AND S-36040 REV. A.
		PVEL4 = 0.937 FROM COMPUTER PRINTOUT

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	R B Hooker	9-19-86
Subject/Title: Unit 2 HPCI Motor Operated Valve	Reviewed By: A. S. Kirk	Date: 9-20-86
Differential Pressure Calculation	Calculation Number: SNH-86-017	Sheet: 21 of 59

DETERMINE THE PRESSURE INCREASE DUE TO THE RAPID DECELERATION OF FLUID CAUSED BY THE MOVEMENT OF A PROCESS GATE OR GLOBE VALVE

ASSUMPTIONS

1) Valve openings result in no waterhammer effects. The differential pressure across a valve during opening is decreased by an increase in fluid velocity. The maximum actuator loading takes place before the valve lift occurs.

2) Steam valve closure results in only minor or no waterhammer effect. The compressible nature of the fluid medium coupled with maximum anticipated velocity changes make the pressure addition insignificant.

3) Area of flow through a gate valve is a direct and linear relation to system velocity.

4) The percentage of valve opening is a direct relation to opening time.

5) It is assumed that flowing pressure does not drop below the fluids vapor pressure.

The pressure increase due to sudden deceleration of fluid may be expressed as:

$$PVEL = P1 + P2$$

Where P1 is the upstream pressure change, and P2 is the downstream pressure change.

The respective valves for P1 and P2 may be calculated as follows:

$$P_1, P_2 = \frac{\rho C \Delta VMAX}{144\ g}$$

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	T B Hudson	9-19-86
Subject/Title: Unit 2 HPCI Motor Operated Valve	Reviewed By: A S Kirk	Date: 9-20-86
Differential Pressure Calculation	Calculation Number: SNH-86-017	Sheet: 22 of 59

Where: ρ is the fluid density

C is the speed of sound through the fluid

Δ VMAX is the maximum system fluid differential velocity

144 is a conversion factor

and g is the Gravatational Constant

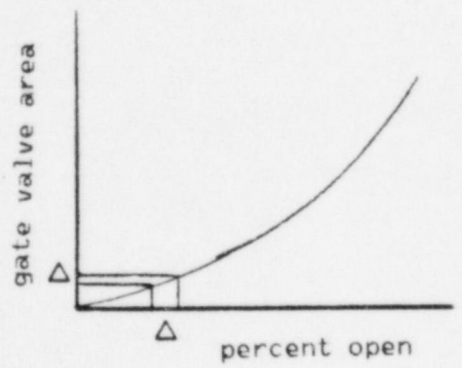
The fluid ΔV is assumed to be a direct relation to flow area, as shown in the gate valve area - percent open curves, and is a direct relation to Cv, as shown on the globe valve Cv - percent open curves.

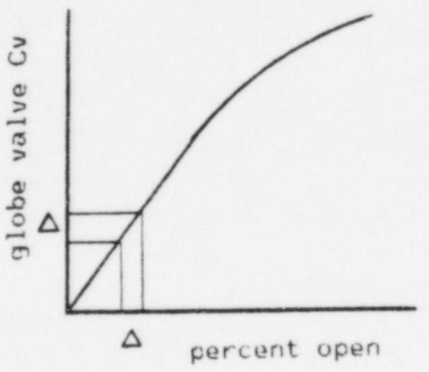
The valve Δt is a direct relation to Δ percentage open.

Therefore:

$$\frac{\Delta A}{\Delta \% \text{ Open}} \approx \frac{\Delta Cv}{\Delta \% \text{ Open}} \approx \frac{\Delta V}{\Delta t}$$

Having plotted a velocity relation against a time relation the region of highest differential velocity is examined.





Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	LB Hudson	9-19-86
Subject/Title: Unit 2 HPCI Motor Operated Valve	Reviewed By: A.S. Kish	Date: 9-20-86
Differential Pressure Calculation	Calculation Number: SNH-86-017	Sheet: 23 of 59

Incremental time is Defined As:

$$\Delta t = t2 - t1 = \frac{2L}{c}$$

Where the term 2L/C is the time require for a pressure wave to travel down a pipe's flow length and rebound to it's source valve.

Knowing the equation of the curve, the maximum ΔV for Δt (ie; greatest slope) is calculated and entered into the pressure equations.

The procedure is once again performed for the down stream side of the valve and added as follows to produce PVEL

$$PVEL = P1 + P2$$

Reference: BWROG REPORT APP. B

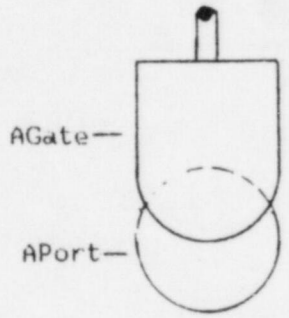
0082d

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2		9-19-86
Subject/Title: Unit 2 HPCI Motor Operated Valve	Reviewed By: GD McGlothlin	Date: 9/21/86
Differential Pressure Calculation	Calculation Number: SNH-86-017	Sheet: 24 of 59

RELATIONSHIP OF THE GATE VALVE FLOW AREA TO THE PERCENTAGE OPENING OF A TYPICAL GATE VALVE

It is assumed that the diameter of the gate is equal to the port diameter of the valve since the difference in diameters is insignificantly small.

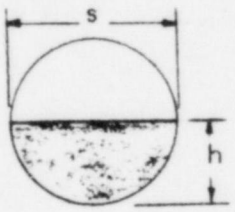
THE FLOW AREA OF THE VALVE MAY BE DETERMINED BY SUBTRACTING THE AREA OF THE GATE OCCLUDING THE TOTAL PORT AREA.



A = Area

AFlow = APort - AGate

THE AREA OF THE PORT IS CALCULATED USING THE CIRCULAR SEGMENT CALCULATION



$ASEG = h/6s\ (3h^2 + 4s^2)$

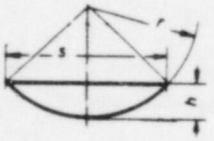
WITH h = RISE = RADIUS
AND s = CHORD = DIAMETER

THE AREA OF THE PORT IS EQUAL TO TWICE ASEG

APORT = 2ASEG = R/6D (3R**2 + 4D**2)

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	C Morgan	9.19.86
Subject/Title: Unit 2 HPCI Motor Operated Valve	Reviewed By: GD McPhail	Date: 9/21/86
Differential Pressure Calculation	Calculation Number: SNH-86-017	Sheet: 25 of 59

THE OCCLUDING AREA OF THE GATE IS FOUND BY USING THE AREA OF A CIRCULAR SEGMENT CALCULATION.



$$ASEG = h/6s\ (3h^2 + 4s^2)$$

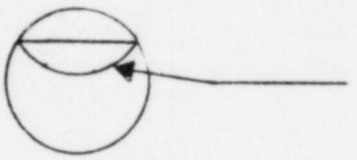
$$r = h/2 + s^2/8h$$

TRANSFORMING THE LATER EQUATION

$$s = (\ 8h\ (r-(h/2)))^{1/2}$$

WHICH COMBINED WITH THE ASEG CALCULATION MAY BE READILY SOLVED.

THE AREA OCCLUDED IS EQUAL TO TWICE ASEG.



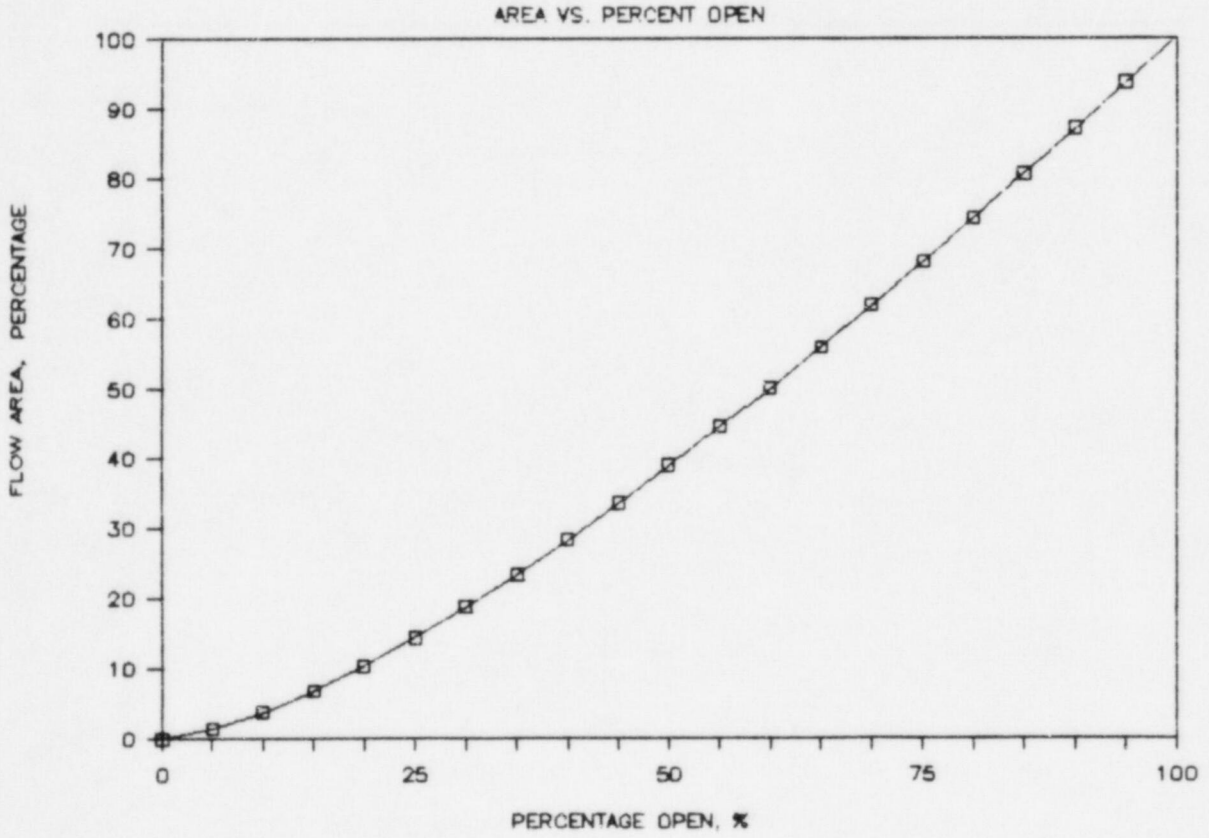
AGATE = 2 ASEG.

THUS THE AREA OF FLOW THROUGH THE VALVE IS CALCULATED AS:

AFlow = APORT - AGATE

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	C Sorensen	9·19·86
Subject/Title: Unit 2 HPCI Motor Operated Valve	Reviewed By: GD McNab	Date: 9/21/86
Differential Pressure Calculation	Calculation Number: SNH-86-017	Sheet: 26 of 59

A GRAPHIC PRESENTATION OF THE TYPICAL FLOW AREA VS. PERCENT VALVE OPENING IS GIVEN AS FOLLOWS.



REFERENCE: ENGINEERING FORMULAS 4th EDITION, PAGE B3.

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	C Lorenzo	9-19-86
Subject/Title: Unit 2 HPCI Motor Operated Valve	Reviewed By: A.S. Kirk	Date: 9-19-86
Differential Pressure Calculation	Calculation Number: SNH-86-017	Sheet: 27 of 59

NUMERICAL RELATIONSHIP BETWEEN A GRAPHICAL PRESENTATION OF MANUFACTURER'S 2" GLOBE VALVE OPENING VS. MANUFACTURER'S CV DATA

Given a curve of 0-100 % opening (see attached), It is Desired to numerically relate the first 60% of opening to CV.

The First 60% of opening is a linear function thus, the curve may be equated using linear regression of the point-slope form.

$$y - y1 = m(x-x1)$$

Using the points (0,0) and (50,40)

$$40-0 = m(50-0)$$

Solving for m

$$m = 40/50 = 0.8$$

The equation of a line is given as:

$$y = mx$$

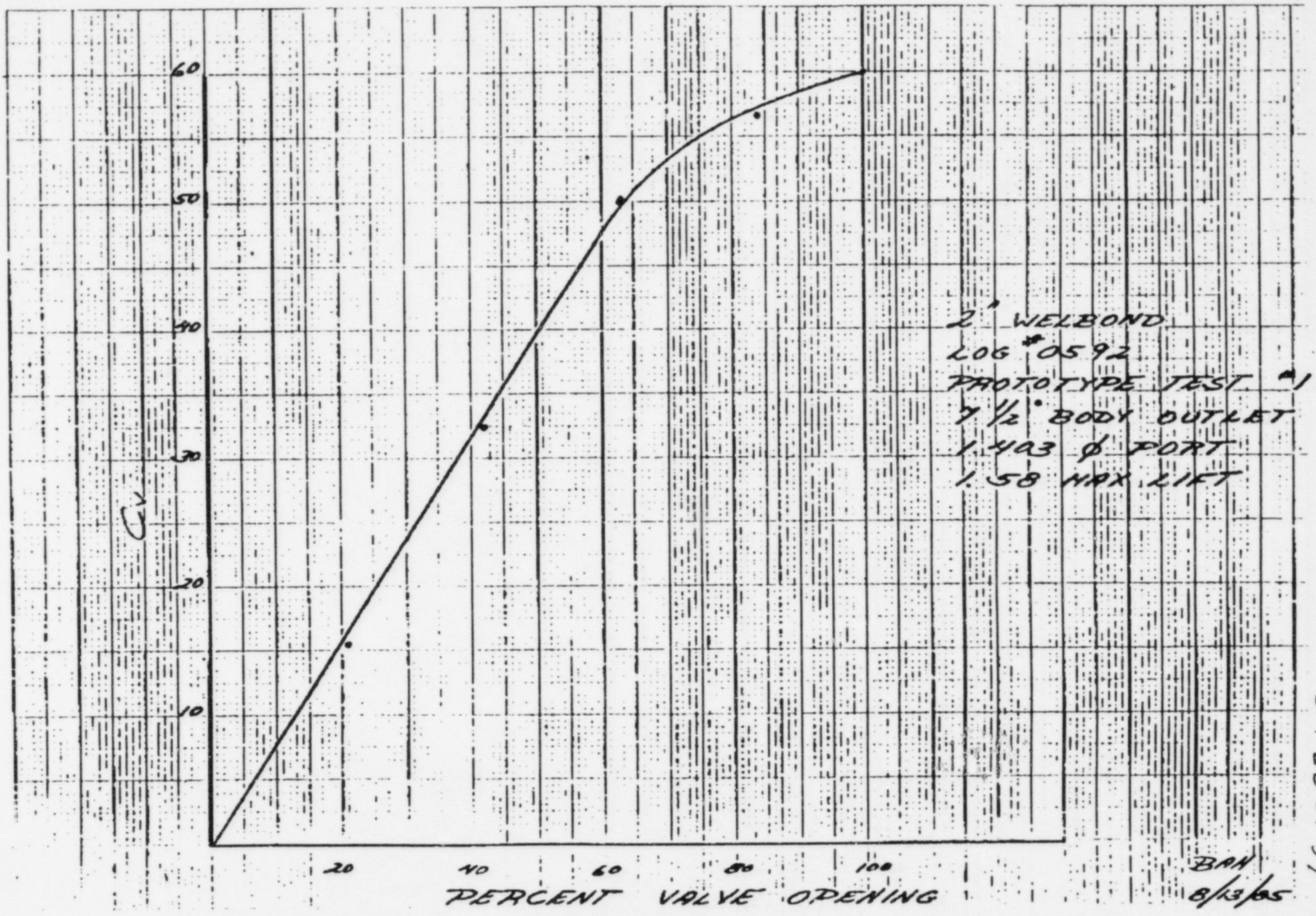
Hence, the equation relating cv with percent opening is:

$$CV = 0.8 \text{ (percentage opening)}$$

FOR ALL OPENINGS LESS THAN 60%.

Reference: THE ENGINEER'S COMPANION 1966 PG. 13.

00481


60
50
40
30
20
10
Cv
20
40
60
80
100
PERCENT VALVE OPENING
2" WELBOND
LOG #0592
PROTOTYPE TEST #1
3 1/2" BODY OUTLET
1.493 Ø PORT
1.58 MAX. LIFT
BAH
8/13/85

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	F B Hayden	9-19-86
Subject/Title: Unit 2 HPCI Motor Operated Valve	Reviewed By: A. S. Kirk	Date: 9-19-86
Differential Pressure Calculation	Calculation Number: SNH-86-017	Sheet: 29 of 59

NUMERICAL RELATIONSHIP BETWEEN A GRAPHICAL PRESENTATION OF MANUFACTURER'S 4" GLOBE VALVE OPENING VS. MANUFACTURER'S CV DATA

Given a curve of 0-100 % opening (see attached), It is Desired to numerically relate the first 45% of opening to CV.

The First 45% of opening is a linear function thus, the curve may be equated using linear regression of the point-slope form.

$$y - y1 = m(x-x1)$$

Using the points (10,15) and (30,49)

$$49-15 = m(30-10)$$

Solving for m

$$m = 34/20 = 1.7$$

The equation of a line is given as:

$$y = mx$$

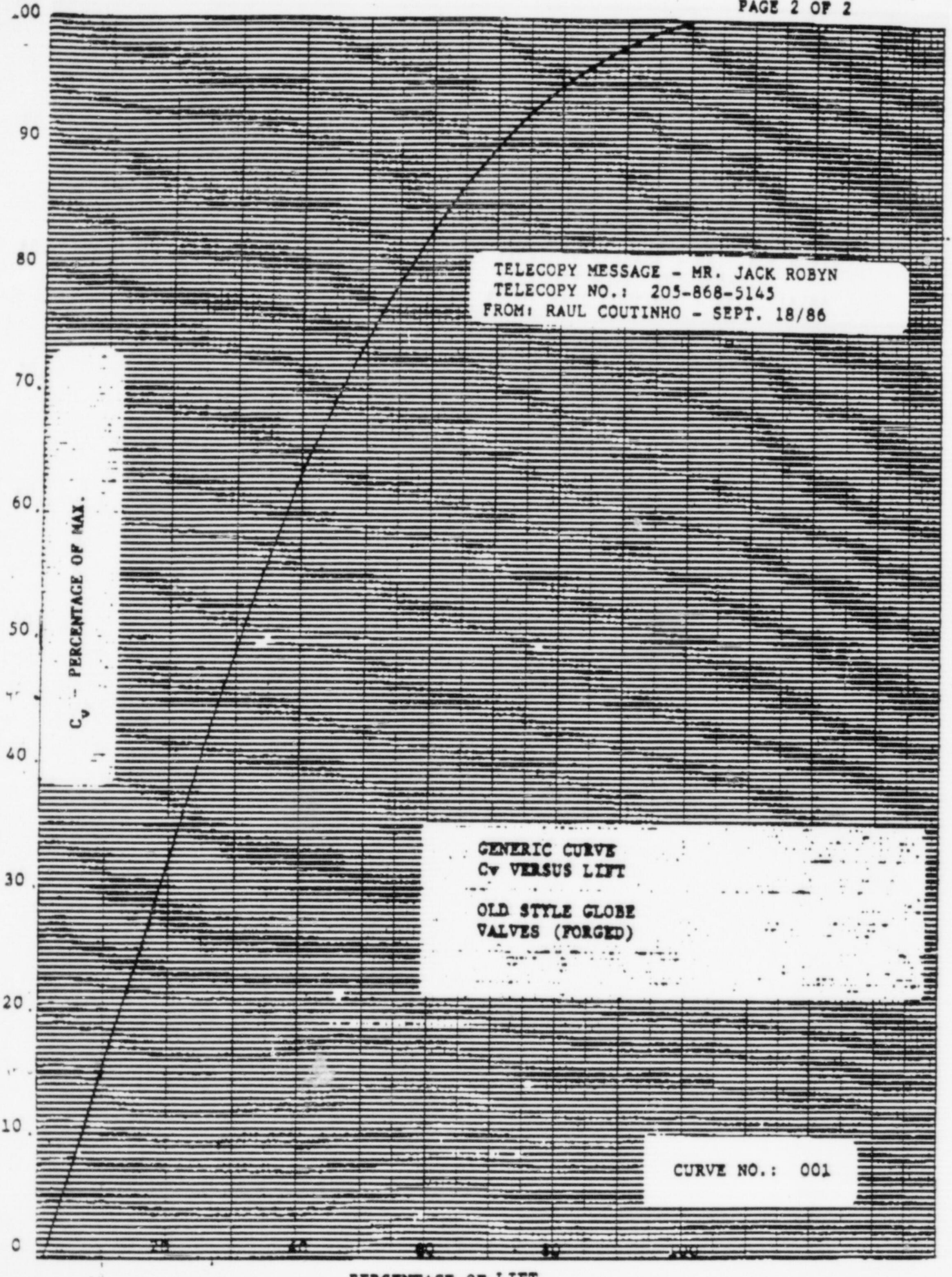
Hence, the equation relating cv with percent opening is:

$$CV = 1.7 \text{ (percentage opening)}$$

FOR ALL OPENINGS LESS THAN 49%.

Reference: THE ENGINEER'S COMPANION 1966 PG. 13.

00481


.00
90
80
70
60
50
40
30
20
10
0
C_v - PERCENTAGE OF MAX.
TELECOPY MESSAGE - MR. JACK ROBYN
TELECOPY NO.: 205-868-5145
FROM: RAUL COUTINHO - SEPT. 18/86
GENERIC CURVE
Cv VERSUS LIFT
OLD STYLE GLOBE
VALVES (FORGED)
CURVE NO.: 001
PERCENTAGE OF LIFT

GATE VALVE PVEL CALCULATION

MPL NUMBER	2E41-F006
VALVE DIAMETER (INCHES)	11.25
CLOSING TIME (SECONDS)	20
UPSTREAM PIPE LENGTH (FT)	252.36
DOWNSTREAM PIPE LENGTH (FT)	152.35
UPSTREAM SYSTEM VEL (FT/SEC)	11.12
DOWNSTREAM SYSTEM VEL (FT/SEC)	11.81
delta TIME UPSTREAM (SECONDS)	0.12618
delta TIME DWNSTREAM (SECONDS)	0.076175
TIME UPSTREAM 1 (SECONDS)	19.87382
TIME UPSTREAM 2 (SECONDS)	20
TIME DOWNSTREAM 1 (SECONDS)	19.923825
TIME DOWNSTREAM 2 (SECONDS)	20
RISE UPSTREAM 1	5.5895119
RISE UPSTREAM 2	5.625
RISE DOWNSTREAM 1	5.6035758
RISE DOWNSTREAM 2	5.625
CHORD UPSTREAM 1	11.249776
CHORD UPSTREAM 2	11.25
CHORD DOWNSTREAM 1	11.249918
CHORD DOWNSTREAM 2	11.25
MAX AREA (IN SQ)	100.19531
AREA FLOW UPSTREAM 1	0.8312275
AREA FLOW UPSTREAM 2	0
AREA FLOW DOWNSTREAM 1	0.5019387
AREA FLOW DOWNSTREAM 2	0
a/Au1	0.0083623
a/Au2	0
a/Ad1	0.0050496
a/Ad2	0
VELOCITY UPSTREAM 1 (FT/SEC)	0.0929886
VELOCITY UPSTREAM 2 (FT/SEC)	0
VELOCITY DOWNSTREAM 1 (FT/SEC)	0.0596356
VELOCITY DOWNSTREAM 2 (FT/SEC)	0
delta VEL UPSTREAM (FT/SEC)	0.0929886
delta VEL DOWNSTREAM (FT/SEC)	0.0596356
Pvu UPSTREAM PRESSURE (PSIG)	4.97319
Pvd DOWNSTREAM PRESSURE (PSIG)	3.1894146

Pvel (PSIG) 8.1626046

FOUR INCH GLOBE VALVE PVEL CALCULATIONS

MPL NUMBER	2E41-F012
VALVE DIAMETER (INCHES)	2.5
CLOSING TIME (SECONDS)	10
UPSTREAM PIPE LENGTH (FT)	59.86
DOWNSTREAM PIPE LENGTH (FT)	49.59
UPSTREAM SYSTEM VEL (FT/SEC)	12.561
DOWNSTREAM SYSTEM VEL (FT/SEC)	11.347
delta TIME UPSTREAM (SECONDS)	0.02993
delta TIME DWNSTREAM (SECONDS)	0.024795
TIME UPSTREAM 1 (SECONDS)	5
TIME UPSTREAM 2 (SECONDS)	5.02993
TIME DOWNSTREAM 1 (SECONDS)	5
TIME DOWNSTREAM 2 (SECONDS)	5.024795
% OPEN UPSTREAM 1	50
% OPEN UPSTREAM 2	50.2993
% OPEN DOWNSTREAM 1	50
% OPEN DOWNSTREAM 2	50.24795
% CV UPSTREAM 1	85.7
% CV UPSTREAM 2	86.213
% CV DOWNSTREAM 1	85.7
% CV DOWNSTREAM 2	86.124986
delta VEL UPSTREAM (FT/SEC)	0.064438
delta VEL DOWNSTREAM (FT/SEC)	0.0482232
Pvu UPSTREAM (PSIG)	3.4462521
Pvd DOWNSTREAM (PSIG)	2.579059

Pvel3 (PSIG) 6.0253112

TWO INCH GLOBE VALVE PVEL CALCULATIONS

MPL NUMBER	2E41-F059
VALVE DIAMETER (INCHES)	1.403
CLOSING TIME (SECONDS)	10
UPSTREAM PIPE LENGTH (FT)	16.23
DOWNSTREAM PIPE LENGTH (FT)	41.39
UPSTREAM SYSTEM VEL (FT/SEC)	7.601
DOWNSTREAM SYSTEM VEL (FT/SEC)	7.601
delta TIME UPSTREAM (SECONDS)	0.008115
delta TIME DWNSTREAM (SECONDS)	0.020695
TIME UPSTREAM 1 (SECONDS)	5
TIME UPSTREAM 2 (SECONDS)	5.008115
TIME DOWNSTREAM 1 (SECONDS)	5
TIME DOWNSTREAM 2 (SECONDS)	5.020695
% OPEN UPSTREAM 1	50
% OPEN UPSTREAM 2	50.08115
% OPEN DOWNSTREAM 1	50
% OPEN DOWNSTREAM 2	50.20695
% CV UPSTREAM 1	40
% CV UPSTREAM 2	40.06492
% CV DOWNSTREAM 1	40
% CV DOWNSTREAM 2	40.16556
delta VEL UPSTREAM (FT/SEC)	0.0049346
delta VEL DOWNSTREAM (FT/SEC)	0.0125842
Pvu UPSTREAM (PSIG)	0.2639092
Pvd DOWNSTREAM (PSIG)	0.6730254

Pvel4(PSIG) 0.9369346

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	2E41-F001
VALVE DESCRIPTION	TURBINE STEAM SUPPLY VALVE
VALVE FUNCTION	HPCI TURBINE STEAM ADMISSION VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PRSS
MAXIMUM DP UPSTREAM/DOWNSTREAM	OPEN
SAFETY ON OPEN/CLOSE	OPEN
MAXIMUM DP ON OPEN OR CLOSE	UPSTREAM

VALUES

PRSS = 1090

DP (PSID) 1090

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	2E41-F002
VALVE DESCRIPTION	STEAM SUPPLY INBOARD ISOL VALVE
VALVE FUNCTION	HPCI STEAM LINE ISOLATION VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PRSS
MAXIMUM DP UPSTREAM/DOWNSTREAM	CLOSE
SAFETY ON OPEN/CLOSE	CLOSE
MAXIMUM DP ON OPEN OR CLOSE	UPSTREAM

VALUES

PRSS = 1090

DP (PSID) 1090

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	2E41-F003
VALVE DESCRIPTION	STEAM SUPPLY OUTBD ISOL VALVE
VALVE FUNCTION	HPCI STEAM LINE ISOLATION VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PRSS
MAXIMUM DP UPSTREAM/DOWNSTREAM	CLOSE
SAFETY ON OPEN/CLOSE	CLOSE
MAXIMUM DP ON OPEN OR CLOSE	UPSTREAM

VALUES

PRSS = 1090

DP (PSID) 1090

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	2E41-F004
VALVE DESCRIPTION	PUMP SUCT FRM COND STOR TANK
VALVE FUNCTION	HPCI CST SUCTION VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PELD+PV+PVEL1
MAXIMUM DP UPSTREAM/DOWNSTREAM	CLOSE
SAFETY ON OPEN/CLOSE	CLOSE
MAXIMUM DP ON OPEN OR CLOSE	UPSTREAM

VALUES

PELD	= 29.44
PV	= 0.374
PVEL1	= 0

DP (PSID) 29.814

DIFFERENTIAL PRESSURE CALCULATION 09/21/86

MPL NUMBER	2E41-F006
VALVE DESCRIPTION	HPCI PUMP INBD DISCH VALVE
VALVE FUNCTION	HPCI INJECTION/ISOLATION VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PSOH-PISO-PEL+PVEL2
MAXIMUM DP UPSTREAM/DOWNSTREAM	CLOSE
SAFETY ON OPEN/CLOSE	OPEN/CLOSE
MAXIMUM DP ON OPEN OR CLOSE	UPSTREAM

VALUES

PSOH	= 2240
PISO	= 855
PEL	= 5.97
PVEL2	= 8.163

DP (PSID) 1387.193

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	2E41-F006
VALVE DESCRIPTION	HPCI PUMP INBD DISCH VALVE
VALVE FUNCTION	HPCI INJECTION/ISOLATION VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PSOH-PISO-PEL
MAXIMUM DP UPSTREAM/DOWNSTREAM	OPEN
SAFETY ON OPEN/CLOSE	OPEN/CLOSE
MAXIMUM DP ON OPEN OR CLOSE	UPSTREAM

VALUES

PSOH	= 2240
PISO	= 855
PEL	= 5.97

DP (PSID) 1379.03

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	2E41-F007
VALVE DESCRIPTION	HPCI PUMP OUTBD DISCH VALVE
VALVE FUNCTION	HPCI INJECTION VALVE TEST VALVE
SAFETY ACTION (YES/NO)	NO
DP CALCULATION FORMULA	NO SAFETY ACTION
MAXIMUM DP UPSTREAM/DOWNSTREAM	N/A
SAFETY ON OPEN/CLOSE	NONE
MAXIMUM DP ON OPEN OR CLOSE	N/A
VALUES	

DP (PSID) N/A

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	2E41-F008
VALVE DESCRIPTION	TEST BYPASS VALVE TO COND STOR
VALVE FUNCTION	HPCI CST TEST RETURN VALVE
SAFETY ACTION (YES/NO)	NO
DP CALCULATION FORMULA	NO SAFETY ACTION
MAXIMUM DP UPSTREAM/DOWNSTREAM	N/A
SAFETY ON OPEN/CLOSE	NONE
MAXIMUM DP ON OPEN OR CLOSE	N/A

VALUES

DP (PSID) N/A

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	2E41-F011
VALVE DESCRIPTION	REDUNDANT SHUTOFF W/F008
VALVE FUNCTION	HPCI CST TEST RETURN VALVE
SAFETY ACTION (YES/NO)	NO
DP CALCULATION FORMULA	NO SAFETY ACTION
MAXIMUM DP UPSTREAM/DOWNSTREAM	N/A
SAFETY ON OPEN/CLOSE	NONE
MAXIMUM DP ON OPEN OR CLOSE	N/A

VALUES

DP (PSID)	N/A

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	2E41-F012
VALVE DESCRIPTION	PMP MIN FLO BYP TO SUPP POOL
VALVE FUNCTION	HPCI PUMP MIN FLO BYP ISOL VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PMF+PELM+PVEL3
MAXIMUM DP UPSTREAM/DOWNSTREAM	CLOSE
SAFETY ON OPEN/CLOSE	OPEN/CLOSE
MAXIMUM DP ON OPEN OR CLOSE	UPSTREAM

VALUES

PMF = 2235

PELM = 29.58

PVEL3 = 6.025

DP (PSID) 2270.605

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	2E41-F012
VALVE DESCRIPTION	PMP MIN FLO BYP TO SUPP POOL
VALVE FUNCTION	HPCI PUMP MIN FLO BYP ISOL VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PSOH+PELM
MAXIMUM DP UPSTREAM/DOWNSTREAM	OPEN
SAFETY ON OPEN/CLOSE	OPEN/CLOSE
MAXIMUM DP ON OPEN OR CLOSE	UPSTREAM

VALUES

PSOH = 2240

PELM = 29.58

DP (PSID) 2269.58

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	2E41-F041
VALVE DESCRIPTION	PMP SUCT FROM SUPP POOL
VALVE FUNCTION	HPCI SUPP POOL SUCT ISOL VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PRV-PELS
MAXIMUM DP UPSTREAM/DOWNSTREAM	OPEN
SAFETY ON OPEN/CLOSE	OPEN/CLOSE
MAXIMUM DP ON OPEN OR CLOSE	DOWNSTREAM

VALUES

PRV = 100

PELS = 2.88

DP (PSID) 97.12

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	2E41-F041
VALVE DESCRIPTION	PMP SUCT FROM SUPP POOL
VALVE FUNCTION	HPCI SUPP POOL SUCT ISOL VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PLOC+PLOM1
MAXIMUM DP UPSTREAM/DOWNSTREAM	CLOSE
SAFETY ON OPEN/CLOSE	OPEN/CLOSE
MAXIMUM DP ON OPEN OR CLOSE	UPSTREAM

VALUES

PLOC = 31.6

PLOM1 = 5.46

DP (PSID) 37.06

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	2E41-F042
VALVE DESCRIPTION	PMP SUCT FROM SUPP POOL
VALVE FUNCTION	HPCI SUPP POOL SUCT ISOL VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PRV-PELS
MAXIMUM DP UPSTREAM/DOWNSTREAM	OPEN
SAFETY ON OPEN/CLOSE	OPEN/CLOSE
MAXIMUM DP ON OPEN OR CLOSE	DOWNSTREAM

VALUES

PRV = 100

PELS = 2.88

DP (PSID) 97.12

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	2E41-F042
VALVE DESCRIPTION	PMP SUCT FROM SUPP POOL
VALVE FUNCTION	HPCI SUPP POOL SUCT ISOL VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PLOC+PLOM1
MAXIMUM DP UPSTREAM/DOWNSTREAM	CLOSE
SAFETY ON OPEN/CLOSE	OPEN/CLOSE
MAXIMUM DP ON OPEN OR CLOSE	UPSTREAM

VALUES

PLOC = 31.6

PLOM1 = 5.46

DP (PSID) 37.06

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	2E41-F059
VALVE DESCRIPTION	COOLING WATER SUPPLY VALVE
VALVE FUNCTION	HPCI TURBINE ACCES COOLING WTR VLV
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PC+PLOM2
MAXIMUM DP UPSTREAM/DOWNSTREAM	OPEN
SAFETY ON OPEN/CLOSE	OPEN/CLOSE
MAXIMUM DP ON OPEN OR CLOSE	UPSTREAM

VALUES

PC = 31.6

PLOM2 = 5.41

DP (PSID) 37.01

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	2E41-F059
VALVE DESCRIPTION	COOLING WATER SUPPLY VALVE
VALVE FUNCTION	HPCI TURBINE ACCES COOLING WTR VLV
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PC+PLOM2+PVEL4
MAXIMUM DP UPSTREAM/DOWNSTREAM	CLOSE
SAFETY ON OPEN/CLOSE	OPEN/CLOSE
MAXIMUM DP ON OPEN OR CLOSE	UPSTREAM

VALUES

PC	= 31.6
PLOM2	= 5.41
PVEL4	= 0.937

DP (PSID) 37.947

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	2E41-F104
VALVE DESCRIPTION	GATE VALVE 2 IN MO
VALVE FUNCTION	HPCI VAC BREAKER LINE ISOL VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PC+PATM
MAXIMUM DP UPSTREAM/DOWNSTREAM	CLOSE
SAFETY ON OPEN/CLOSE	CLOSE
MAXIMUM DP ON OPEN OR CLOSE	UPSTREAM

VALUES

PC = 31.6

PATM = 0

DP (PSID) 31.6

DIFFERENTIAL PRESSURE CALCULATION 09/19/86

MPL NUMBER	2E41-F111
VALVE DESCRIPTION	GATE VALVE 2 IN MO
VALVE FUNCTION	HPCI VAC BREAKER LINE ISOL VALVE
SAFETY ACTION (YES/NO)	YES
DP CALCULATION FORMULA	DP=PC+PATM
MAXIMUM DP UPSTREAM/DOWNSTREAM	CLOSE
SAFETY ON OPEN/CLOSE	CLOSE
MAXIMUM DP ON OPEN OR CLOSE	UPSTREAM

VALUES

PC = 31.6

PATM = Ø

DP (PSID) 31.6

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	Dawn C. Wilson	09/19/86
Subject/Title: Unit 2 HPCI Motor Operated Valve	Reviewed By: A D McPhatter	Date: 9/21/86
Differential Pressure Calculation	Calculation Number: SNH-86-017	Sheet: 53 of 59

GATE VALVE PVEL CALCULATIONS PAGE 1 OF 3

```
A3: [W11] ^MPL
B3: ^VALVE
C3: ^CLOSING
D3: ^UPSTR
E3: ^DNSTR
F3: 'UPSTRSYS
G3: 'DNSTRSYS
I3: ^dT UP
J3: ^dTDN
K3: ^TIMEu1
L3: ^TIMEu2
M3: ^TIMEd1
N3: ^TIMEd2
O3: ^RISEu1
P3: ^RISEu2
Q3: ^RISEd1
R3: ^RISEd2
S3: ^CHORDu1
T3: ^CHORDu2
U3: ^CHORDd1
V3: ^CHORDd2
W3: 'MAX AREA
X3: ^Aflu1
Y3: ^Aflu2
Z3: ^Afld1
AA3: ^Afld2
AB3: ^a/Au1
AC3: ^a/Au2
AD3: ^a/Ad1
AE3: ^a/Ad2
AF3: ^Vu1
AG3: ^Vu2
AH3: ^Vd1
AI3: ^Vd2
AJ3: ^dVu
AK3: ^dVd
AL3: ^Pvu
AM3: ^Pvd
AN3: ^Pvel
A4: [W11] ^NUMBER
B4: ^DIA, "
C4: ^T, SECS
D4: ^PIPE L'
E4: ^PIPE L'
F4: ^VEL FPS
G4: ^VEL FPS
W4: 'FLOW
A5: [W11] \-
```

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	Dawn C. Wilson	09/19/86
Subject/Title: Unit 2 HPCI Motor Operated Valve	Reviewed By: A D McFarlin	Date: 9/21/86
Differential Pressure Calculation	Calculation Number: SNH-86-017	Sheet: 54 of 59

GATE VALVE PVEL CALCULATIONS

B5: \-
C5: \-
D5: \-
E5: \-
F5: \-
G5: \-
H5: [W2] \-
I5: \-
J5: \-
K5: \-
L5: \-
M5: \-
N5: \-
O5: \-
P5: \-
Q5: \-
R5: \-
S5: \-
T5: \-
U5: \-
V5: \-
W5: \-
X5: \-
Y5: \-
Z5: \-
AA5: \-
AB5: \-
AC5: \-
AD5: \-
AE5: \-
AF5: \-
AG5: \-
AH5: \-
AI5: \-
AJ5: \-
AK5: \-
AL5: \-
AM5: \-
AN5: \-
A6: [W11] '1E51-FØ13
B6: 3+5/16
C6: 15
D6: 99.9
E6: 16.6
F6: 11.62
G6: 12.46
H6: [W2] '|
I6: (2*D6)/$D$29

GATE VALVE PVEL CALCULATIONS


```
J6: (2*E6)/$D$29
K6: ($D$30*$C6)-I6
L6: +$D$30*$C6
M6: ($D$30*$C6)-J6
N6: +$D$30*$C6
O6: (K6/$C6)*($B6/2)
P6: (L6/$C6)*($B6/2)
Q6: (M6/$C6)*($B6/2)
R6: (N6/$C6)*($B6/2)
S6: @SQRT(8*O6*(($B6/2)-(O6/2)))
T6: @SQRT(8*P6*(($B6/2)-(P6/2)))
U6: @SQRT(8*Q6*(($B6/2)-(Q6/2)))
V6: @SQRT(8*R6*(($B6/2)-(R6/2)))
W6: 2*((1/12)*(((3*B6*B6)/4)+(4*B6*B6)))
X6: (F6) (W6)-(2*((O6/(6*S6))*((3*O6*O6)+(4*S6*S6))))
Y6: (F6) (W6)-(2*((P6/(6*T6))*((3*P6*P6)+(4*T6*T6))))
Z6: (F6) ($W6)-2*((Q6/(6*U6))*((3*Q6*Q6)+(4*U6*U6)))
AA6: (F6) ($W6)-2*((R6/(6*V6))*((3*R6*R6)+(4*V6*V6)))
AB6: (F6) +X6/((@PI*$B6*$B6)/4)
AC6: (F6) +Y6/((@PI*$B6*$B6)/4)
AD6: (F6) +Z6/((@PI*$B6*$B6)/4)
AE6: (F6) +AA6/((@PI*$B6*$B6)/4)
AF6: (F6) +AB6*$F6
AG6: (F6) +AC6*$F6
AH6: (F6) +AD6*$G6
AI6: (F6) +AE6*$G6
AJ6: (F6) +AF6-AG6
AK6: (F6) +AH6-AI6
AL6: (F6) (AJ6*$D$28*$D$29)/(144*32.2)
AM6: (F6) (AK6*$D$28*$D$29)/(144*32.2)
AN6: (F6) +AL6+AM6
C28: 'DENSITY
D28: 61.996
E28: 'LB/FT3
C29: 'C
D29: 4000
E29: 'FT/SEC
C30: 'FUDGE FAC
D30: 1
E30: 'DIMLESS
```

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	Dawn C. Wilson	09/19/86
Subject/Title: Unit 2 HPCI Motor Operated Valve	Reviewed By: A D McRae	Date: 9/21/86
Differential Pressure Calculation	Calculation Number: SNH-86-017	Sheet: 56 of 59

FOUR INCH GLOBE VALVE PVEL CALCULATIONS PAGE 1 OF 2

A3: [W11] ^MPL
B3: ^VALVE
C3: ^CLOSING
D3: ^UPSTR
E3: ^DNSTR
F3: 'UPSTRSYS
G3: 'DNSTRSYS
I3: ^dT UP
J3: ^dTDN
K3: ^TIMEu1
L3: ^TIMEu2
M3: ^TIMEd1
N3: ^TIMEd2
O3: ^% OPEN
P3: ^% OPEN
Q3: ^% OPEN
R3: ^% OPEN
S3: ^% CV
T3: ^% CV
U3: ^% CV
V3: ^% CV
W3: ^dVu
X3: ^dVd
Y3: ^Pvu
Z3: ^Pvd
AA3: ^Pvel
A4: [W11] ^NUMBER
B4: ^DIA, "
C4: ^T, SECS
D4: ^PIPE L'
E4: ^PIPE L'
F4: ^VEL FPS
G4: ^VEL FPS
O4: ^UPSTR1
P4: ^UPSTR2
Q4: ^DNSTR1
R4: ^DNSTR2
S4: ^UPSTR1
T4: ^UPSTR2
U4: ^DNSTR1
V4: ^DNSTR2
A5: [W11] \-
B5: \-
C5: \-
D5: \-
E5: \-
F5: \-
G5: \-

FOUR INCH GLOBE VALVE PVEL CALCULATIONS PAGE 2 OF 2

```
H5: [W2] \-
I5: \-
J5: \-
K5: \-
L5: \-
M5: \-
N5: \-
O5: \-
P5: \-
Q5: \-
R5: \-
S5: \-
T5: \-
U5: \-
V5: \-
W5: \-
X5: \-
Y5: \-
Z5: \-
AA5: \-
A6: [W11] '1E41-F012
B6: 2.5
C6: 10
D6: 61.05
E6: 38.958
F6: 12.561
G6: 11.347
H6: [W2] '|
I6: (2*D6)/$D$24
J6: (2*E6)/$D$24
K6: +$C6*0.5
L6: +$C6*0.5+I6
M6: +$C6*0.5
N6: +$C6*0.5+J6
O6: (+K6*100)/$C6
P6: (+L6*100)/$C6
Q6: (+M6*100)/$C6
R6: (+N6*100)/$C6
S6: +O6*1.714
T6: +P6*1.714
U6: +Q6*1.714
V6: +R6*1.714
W6: (+F6*(T6-S6))/100
X6: (+G6*(V6-U6))/100
Y6: (W6*$D$23*$D$24)/(144*32.2)
Z6: (X6*$D$23*$D$24)/(144*32.2)
AA6: +Y6+Z6

C23: 'DENSITY
D23: 61.996
E23: 'LB/FT3
C24: 'C
D24: 4000
E24: 'FT/SEC
```

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	Dawn C. Wilson	09/19/86
Subject/Title: Unit 2 HPCI Motor Operated Valve	Reviewed By: R D McRae	Date: 9/21/86
Differential Pressure Calculation	Calculation Number: SNH-86-017	Sheet: 58 of 59

TWO INCH GLOBE VALVE PVEL CALCULATIONS PAGE 1 OF 2

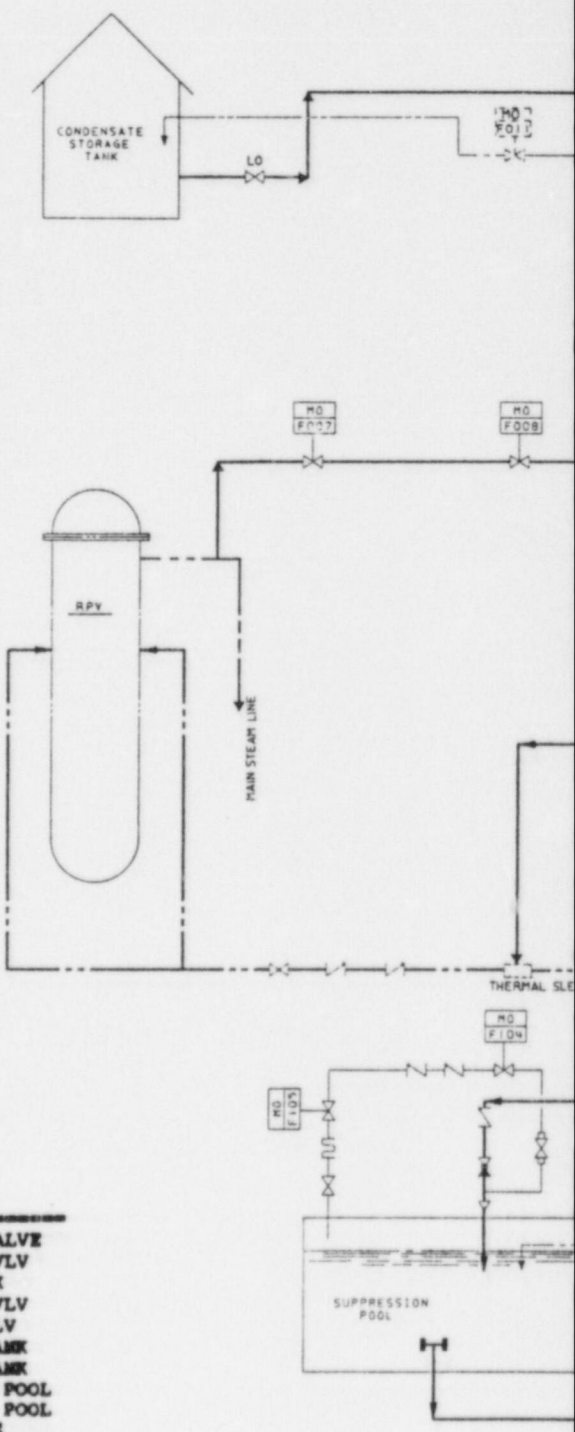
```
A3: [W11] ^MPL
B3: ^VALVE
C3: ^CLOSING
D3: ^UPSTR
E3: ^DNSTR
F3: 'UPSTRSYS
G3: 'DNSTRSYS
I3: ^dT UP
J3: ^dTDN
K3: ^TIMEu1
L3: ^TIMEu2
M3: ^TIMEd1
N3: ^TIMEd2
O3: ^% OPEN
P3: ^% OPEN
Q3: ^% OPEN
R3: ^% OPEN
S3: ^% CV
T3: ^% CV
U3: ^% CV
V3: ^% CV
W3: ^dVu
X3: ^dVd
Y3: ^Pvu
Z3: ^Pvd
AA3: ^Pvel
A4: [W11] ^NUMBER
B4: ^DIA, "
C4: ^T, SECS
D4: ^PIPE L'
E4: ^PIPE L'
F4: ^VEL FPS
G4: ^VEL FPS
O4: ^UPSTR1
P4: ^UPSTR2
Q4: ^DNSTR1
R4: ^DNSTR2
S4: ^UPSTR1
T4: ^UPSTR2
U4: ^DNSTR1
V4: ^DNSTR2
A5: [W11] \-
B5: \-
C5: \-
D5: \-
E5: \-
F5: \-
G5: \-
```

TWO INCH GLOBE VALVE PVEL CALCULATIONS PAGE 2 OF 2

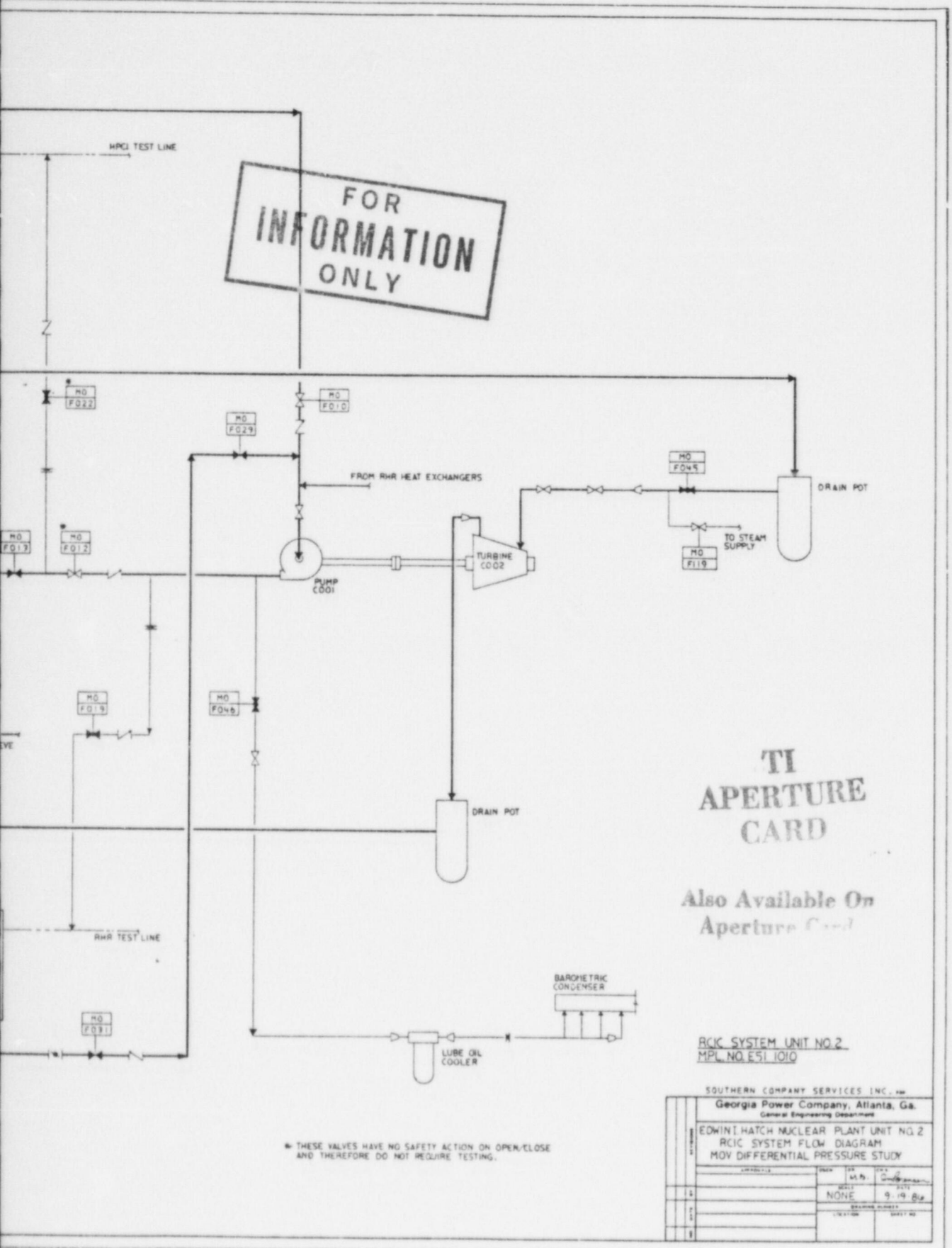
```
H5: [W2] \-
I5: \-
J5: \-
K5: \-
L5: \-
M5: \-
N5: \-
O5: \-
P5: \-
Q5: \-
R5: \-
S5: \-
T5: \-
U5: \-
V5: \-
W5: \-
X5: \-
Y5: \-
Z5: \-
AA5: \-
A6: [W11] '1E41-F059
B6: 1.75
C6: 10
D6: 25
E6: 31.42
F6: 7.601
G6: 7.601
H6: [W2] '|
I6: (2*D6)/$D$28
J6: (2*E6)/$D$28
K6: +$C6*0.5
L6: +$C6*0.5+I6
M6: +$C6*0.5
N6: +$C6*0.5+J6
O6: (+K6*100)/$C6
P6: (+L6*100)/$C6
Q6: (+M6*100)/$C6
R6: (+N6*100)/$C6
S6: +O6*0.8
T6: +P6*0.8
U6: +Q6*0.8
V6: +R6*0.8
W6: (+F6*(T6-S6))/100
X6: (+G6*(V6-U6))/100
Y6: (W6*$D$27*$D$28)/(144*32.2)
Z6: (X6*$D$27*$D$28)/(144*32.2)
AA6: +Y6+Z6

C27: 'DENSITY
D27: 61.996
E27: 'LB/FT3
C28: 'C
D28: 4000
E28: 'FT/SEC
```

ENCLOSURE 4



MPL NUMBER	VALVE DESCRIPTION
2E51-F007	RCIC STEAM INBOARD ISOL VALVE
2E51-F008	RCIC STEAM OUTBOARD ISOL VLV
2E51-F010	PUMP SUCT FRM COND STG TNK
*2E51-F012	RCIC PUMP OUTBOARD DISCH VLV
2E51-F013	RCIC PUMP INBOARD DISCH VLV
2E51-F019	TEST BYPASS TO COND STG TANK
*2E51-F022	TEST BYPASS TO COND STG TANK
2E51-F029	RCIC PMP SUCT VLV FRM SUP POOL
2E51-F031	RCIC PMP SUCT VLV FRM SUP POOL
2E51-F045	TURBINE STEAM SUPPLY VALVE
2E51-F046	COOLING WATER SUPPLY VALVE
2E51-F104	GATE VALVE 1.5 IN MO
2E51-F105	GATE VALVE 2 IN MO
2E51-F119	RCIC STEAM ADMISSION BYPASS VAL



* THESE VALVES HAVE NO SAFETY ACTION ON OPEN/CLOSE AND THEREFORE DO NOT REQUIRE TESTING.

8610090442-04

Calculation Cover Sheet

Southern Company Services

	Calculation Number: SNH-86-018
Project: E.I. HATCH NUCLEAR PLANT UNIT 2	Discipline: Mechanical
Objective: Calculate DP for RCIC Motor Operated Valves	SDS Number:
Subject/Title: Unit 2 RCIC Motor Operated Valve Differential Pressure Calculation	

Design Engineer's Signature	Date	Last Page Number
Chris Sorensen	9.19.86	52

Contents

Record of Revisions

Rev. No.	Description	Originator Date	Reviewer Date	Proj. Engr. Date
0	APPROVED	9.19.86	9/21/86	9/21/86

Notes

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	Dawn C Wilson	09/19/86
Subject/Title	Reviewed By	Date
Unit 2 RCIC Motor Operated Valve	W. T. Burn	9/20/86
Differential Pressure Calculation	Calculation Number SNH-86-018	Sheet 1 of 52

INTRODUCTION

The Nuclear Regulatory Commission (NRC) IE Bulletin 85-03 (Motor Operated Valve Common Mode Failure) requested that owners of light water reactors develop and implement a program to ensure that torque switch settings on safety related motor-operated valves on high pressure systems are selected, set and maintained correctly to accomodate the maximum differential pressures expected on these valves during both normal and abnormal events within the design basis. The objective of this calculation is to determine the maximum Differential Pressure across each of the affected Unit 2 RCIC Motor Operated Valves.

00451

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	[signature]	9·19·86
Subject/Title	Reviewed By	Date
Unit 2 RCIC Motor Operated Valve	[signature]	9/21/86
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CRITERIA

1) The criteria, assumptions and formulas given in the General Electric "BWR Owner's Group Report on the Operational Design Basis of Selected Safety-Related Motor-Operated Valves," DRF-E12-00100-75, are assumed to be correct.

ASSUMPTIONS

1) PC is assumed to equal PLOC. The terms are defined as follows:
   * PLOC is the maximum wet well LOCA pressure.
   * PC is the maximum wetwell LOCA pressure which the valve is required to operate against.

2) In the PVEL calculation, it is assumed that the time required for a sound wave to travel to and return from an atmospheric vessel is infinity. Thus, the related term in the PVEL equation is equal to zero.

3) In the PVEL calculation, downstream velocities for lines of equal sizes with differing wall thicknesses are assumed to be equal. The impact upon the downstream pressure increase is small.

4) Disc and Port diameters are assumed to be equal. Equal diameters for disc and port yield higher rate of change therefore higher DV and is therefore more conservative.

5) The Formula for calculating area of the gate valve available for flow is approximated from a known geometric relationship and is off by a small percentage, however, the overall effect is negligible.

6) In the PVEL calculation, it is assumed that where a small line tees into a much larger line (i.e. Larger being two times or greater in diameter) the boundary for the small line ends at the line intersection.

00431

Project	Prepared By	Date
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Subject/Title	Reviewed By	Date
Unit 2 RCIC Motor Operated Valve	W. T. Barr	9/20/86
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SUMMARY OF CONCLUSIONS

The following page is a summary table of the results for each RCIC Motor Operated Valve in the Scope of NRC IEB 85-03.

The first column titled "MPL Number" gives the MPL number of the valve.

The second column titled "Valve Description" is the description of the valve given in the equipment location index (ELI).

The third column titled "Valve Function" is the function of the valve as stated in the General Electric "BWR Owners' Group Report on the Operational Design Basis of Selected Safety-Related Motor-Operated Valves."

The fourth column titled "Safety" indicates if the valve has any safety-related action.

The fifth column titled "DP Calculation Formula" gives the formula used to calculate the maximum differential pressure.

The sixth column titled "Maximum DP" indicates whether the maximum DP occurs upstream or downstream of the valve.

The seventh column titled " Max DP ON " indicates whether the maximum DP is calculated for opening or closing.

The eighth column titled "DP (PSID)" gives the calculated maximum DP in psid.

The ninth column titled "Safety On" gives the safety action of the valve.

00471

DESIGN CALCULATIONS — SOUTHERN COMPANY SERVICES

E.I. HATCH NUCLEAR PLANT UNIT 2 — PREPARED BY: C Loren — DATE 09/21/86

UNIT 2 RCIC MOTOR OPERATED VALVE — REVIEWED BY: G B Harbin — DATE 09/21/86

DIFFERENTIAL PRESSURE CALCULATION — CALCULATION NUMBER SNH-86-018 — SHEET 4 OF 52.

SUMMARY TABLE 09/21/86

MPL NUMBER	VALVE DESCRIPTION	VALVE FUNCTION	SAFETY	DP CALCULATION FORMULA	MAXIMUM DP	MAXIMUM DP	DP (PSID)	SAFETY
2E51-F007	RCIC STEAM INBOARD ISOL VALVE	RCIC STEAM LINE ISOLATION VALVE	CLOSE	DP=PRSS	CLOSE	UPSTREAM	1090	YES
2E51-F008	RCIC STEAM OUTBOARD ISOL VLV	RCIC STEAM LINE ISOLATION VALVE	CLOSE	DP=PRSS	CLOSE	UPSTREAM	1090	YES
2E51-F010	PUMP SUCT FRM COND STG TNK	RCIC CST SUCTION ISOLATION VALVE	CLOSE	DP=PELD+PV+PVEL1	CLOSE	UPSTREAM	29.6217	YES
2E51-F012	RCIC PUMP OUTBOARD DISCH VLV	RCIC INJECTION VALVE TEST VALVE	NONE	NO SAFETY ACTION	N/A	N/A	N/A	NO
2E51-F013	RCIC PUMP INBOARD DISCH VLV	RCIC INJECTION VALVE	OPEN/CLOSE	DP=PRSS+PEL	OPEN/CLOSE	DOWNSTREAM	1125.612	YES
2E51-F019	TEST BYPASS TO COND STG TANK	RCIC MINIMUM FLOW BYPASS ISOL VALVE	OPEN/CLOSE	DP=PSOH+PELM	OPEN	UPSTREAM	1330.173	YES
2E51-F019	TEST BYPASS TO COND STG TANK	RCIC MINIMUM FLOW BYPASS ISOL VALVE	OPEN/CLOSE	DP=PMF+PELM+PVEL3	CLOSE	UPSTREAM	1333.883641	YES
2E51-F022	TEST BYPASS TO COND STG TANK	RCIC CST TEST RETURN VALVE	NONE	NO SAFETY ACTION	N/A	N/A	N/A	NO
2E51-F029	RCIC PMP SUCT VLV FRM SUP POOL	RCIC SUPP POOL SUCTION ISOL VALVE	OPEN/CLOSE	DP=PRV-PELS	OPEN	DOWNSTREAM	95.6	YES
2E51-F029	RCIC PMP SUCT VLV FRM SUP POOL	RCIC SUPP POOL SUCTION ISOL VALVE	OPEN/CLOSE	DP=PLOC+PLOM1	CLOSE	UPSTREAM	37.317	YES
2E51-F031	RCIC PMP SUCT VLV FRM SUP POOL	RCIC SUPP POOL SUCTION ISOL VALVE	OPEN/CLOSE	DP=PRV-PELS	OPEN	DOWNSTREAM	95.6	YES
2E51-F031	RCIC PMP SUCT VLV FRM SUP POOL	RCIC SUPP POOL SUCTION ISOL VALVE	OPEN/CLOSE	DP=PLOC+PLOM1	CLOSE	UPSTREAM	37.317	YES
2E51-F045	TURBINE STEAM SUPPLY VALVE	RCIC STEAM ADMISSION VALVE	OPEN/CLOSE	DP=PRSS	OPEN/CLOSE	UPSTREAM	1090	YES
2E51-F046	COOLING WATER SUPPLY VALVE	RCIC TURBINE ACCESSORY COOL WTR VALVE	OPEN/CLOSE	DP=PSOI+PELC	OPEN	UPSTREAM	291.974	YES
2E51-F046	COOLING WATER SUPPLY VALVE	RCIC TURBINE ACCESSORY COOL WTR VALVE	OPEN/CLOSE	DP=PLOC+PLOM2+PVEL4	CLOSE	UPSTREAM	37.381729	YES
2E51-F104	GATE VALVE 1.5 IN MO	RCIC VACUUM BREAKER LINE ISOL VALVE	CLOSE	DP=PC+PATM	CLOSE	UPSTREAM	31.6	YES
2E51-F105	GATE VALVE 2 IN MO	RCIC VACUUM BREAKER LINE ISOL VALVE	CLOSE	DP=PC+PATM	CLOSE	UPSTREAM	31.6	YES
2E51-F119	LSTB VALVE	RCIC STEAM ADMISSION BYPASS VALVE	CLOSE	DP=PRSS	CLOSE	UPSTREAM	1090	YES

Project	Prepared By	Date
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Subject/Title	Reviewed By	Date
Unit 2 RCIC Motor Operated Valve	W. T. Barr	9/20/86
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UNIT 2
RCIC MOV CALCULATIONS
REFERENCES

1. H-26281 REV. 5 RCIC SYSTEM BAROMETRIC CONDENSER PIPING PLANS & SECTIONS

2. H-26298 REV. 4 FEEDWATER PIPING -DRYWELL ELEVATION 130'-0" AND ABOVE

3. H-26844 REV. H RCIC SYSTEM SUCTION FROM TORUS, RHR HEAT EXCHANGE AND CONDENSATE STORAGE TANK.

4. H-27535 REV. A GENERAL PLAN - CONTAINMENT

5. UNIT NO. 2 TECHNICAL SPECIFICATIONS REV. 05-25-86

6. A-26497 REV. 12 INSTRUMENT SETPOINT INDEX

7. G.E. NEDO - 24569 REV. 2

8. H-26023 REV. 15 RCIC SYSTEM P & ID SHEET 1

9. H-26024 REV. 13 RCIC SYSTEM P & ID SHEET 2

10. SECTION F CRC HANDBOOK OF CHEMISTRY & PHYSICS 57TH EDITION - CONVERSION FACTORS

11. SECTION B CRANE " FLOW OF FLUIDS " TECHNICAL PAPER NO. 410 - PIPE DATA

12. BWR OWNERS GROUP REPORT ON THE OPERATIONAL DESIGN BASIS OF SELECTED SAFETY RELATED MOTOR OPERATED VALVES, DRF-E12-00100-75, AUGUST 1986.

13. TELEPHONE CONFIRMATION 09-05-86 BETWEEN CHRIS SORENSEN OF SCS AND GORDON PARKS OF BINGHAM PUMP.

14. S-2[5]171 REV. A RCIC FLOW DIAGRAM

15. A-26503 DATA SHEET

16. TELEPHONE CONFIRMATION D. SCHERER OF POWELL VALVE AND B. HARKINS OF SCS ON 9-11-86

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	[signature]	9.19.86
Subject/Title	Reviewed By	Date
Unit 2 RCIC Motor Operated Valve	[signature]	9/20/86
Differential Pressure Calculation	Calculation Number SNH-86-018	Sheet 6 of 52

UNIT 2
RCIC MOV CALCULATIONS
REFERENCES CONT'D

17. S-27083 REV. J KELLOGG ISOMETRIC

18. S-27085 REV. J KELLOGG ISOMETRIC

19. S-27087 REV. J KELLOGG ISOMETRIC

20. S-36100 REV. A KELLOGG ISOMETRIC

21. S-36095 REV. A KELLOGG ISOMETRIC

22. S-36096 REV. A KELLOGG ISOMETRIC

23. S-36097 REV. A KELLOGG ISOMETRIC

24. S-36098 REV. A KELLOGG ISOMETRIC

25. TELECOPY FROM D HORASOWYCH OF YARWAY TO JACK ROBYN OF SCS ON 9-11-86

26. HNP-2-FSAR TABLE 6.2-5 SHT 21 NOTE 7

27. S-28657 REV. 2 6" 150LB OSY GATE VALVE POWELL 1523 WE

28. S-2[illegible]82 (85) REV. H YARWAY FIG. 5515B WELBOND VALVE

29. BM-26509 REV. 5 BILL OF MATERIALS

30. BM-26502 REV. 4 BILL OF MATERIALS

31. S-27294 REV. F VALVE COMPOSITE DRAWING

32. S-36136 REV. A KELLOGG ISOMETRIC DRAWING

0073d

UNIT 2 RCIC TERM DEFINITIONS 09/19/86

TERM	DEFINITION OF TERM
DP	VALVE MAXIMUM EXPECTED OPERATING DIFFERENTIAL PRESSURE
PSOH	DIFFERENTIAL PRESSURE DEVELOPED BY SYSTEM MAIN PUMPS AT ZERO FLOW RATE. (MAXIMUM NORMAL TURBINE SPEED)
PEL	MINIMUM HYDROSTATIC PRESSURE DIFFERENCE BETWEEN SUCTION AND DISCHARGE DUE TO ELEVATION. (DISCHARGE ELEVATION IS HIGHER THAN SUCTION)
PISO	LOW REACTOR PRESSURE AT WHICH STEAM SUPPLY LINES AUTOMATICALLY ISOLATE
PELM	MAXIMUM HYDROSTATIC PRESSURE DIFFERENCE BETWEEN SUCTION AND DISCHARGE SOURCE DUE TO ELEVATION
PRSS	REACTOR PRESSURE CORRESPONDING TO THE SPRING SETPOINT OF THE REACTOR SAFETY RELIEF VALVE WITH THE LOWEST NOMINAL SPRING SETPOINT
PELD	HYDROSTATIC PRESSURE DIFFERENCE BETWEEN CST AND SUPPRESSION POOL ASSUMING THE CST TO BE FULL AND THE SUPPRESSION POOL WATER LEVEL AT ITS MAXIMUM ALLOWABLE NORMAL LEVEL
PMF	DIFFERENTIAL PRESSURE DEVELOPED BY THE SYSTEM MAIN PUMPS AT A FLOW RATE EQUAL TO THE REQUIRED MINIMUM BYPASS FLOW RATE. (MAXIMUM NORMAL TURBINE SPEED)
PV	VELOCITY HEAD IN THE SUPPRESSION POOL SUCTION LINE

UNIT 2 RCIC TERM DEFINITIONS 09/19/86

TERM	DEFINITION OF TERM
	AT THE LOCATION WHERE THE CST LINE CONNECTS TO IT
PRV	SYSTEM SUCTION RELIEF VALVE ACTUATION SET PRESSURE
PELS	HYDROSTATIC PRESSURE DIFFERENCE BETWEEN THE MINIMUM SUPPRESSION POOL WATER LEVEL AND THE LOCATION OF THE RELIEF VALVE ON THE PUMP SUCTION LINE
PLOC	LOCA WETWELL PRESSURE WHEN THE SYSTEM IS ISOLATED
PLOM	HYDROSTATIC PRESSURE UPSTREAM OF THE VALVE DUE TO MAXIMUM LOCA SUPPRESSION POOL WATER LEVEL
PC	MAXIMUM LOCA WETWELL PRESSURE WHEN SYSTEM IS REQUIRED TO OPERATE
PELC	HYDROSTATIC PRESSURE DIFFERENCE BETWEEN CST AND LOCATION OF VALVE WHEN THE CST IS FULL
PSOI	RCIC PUMP DISCHARGE PRESSURE AT ZERO FLOW AND A TURBINE SPEED OF 2000 RPM
PATM	ATMOSPHERIC PRESSURE
PVEL	DIFFERENTIAL PRESSURE ASSOCIATED WITH VALVE CLOSURE DUE TO FLUID VELOCITY CHANGES (I.E., WATER HAMMER TYPE PRESSURE INCREASE) INSIDE THE PIPE

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PSOH	1300.54	TELEPHONE CONFIRMATION -C.SORENSEN/G.PARKS ON SEPTEMBER 5, 1986
PEL	35.612	THE ELEVATION FOR THE INJECTION POINT OF DISCHARGE IS GIVEN AS 183' 9 1/2" ON DRAWING H-26298 REV.4. THE CENTERLINE OF THE SUPPRESSION POOL IS GIVEN AS 103' 6 1/4" AND THE INSIDE DIAMETER IS GIVEN AS 28' 1" ON DRAWING S-27535 REV. A. THE INSIDE BOTTOM ELEVATION OF THE SUPPRESSION POOL IS THE CENTERLINE MINUS 1/2 THE DIAMETER: 103' 6 1/4" - (28' 1") /2 = 89' 5 3/4" THE MINIMUM SUPPRESSION POOL LEVEL IS GIVEN AS 12' 2" IN THE TECHNICAL SPECIFICATIONS SECTION 3.6.2.1 THE MINIMUM SUPPRESSION POOL ELEVATION IS THE BOTTOM ELEVATION PLUS THE MINIMUM LEVEL: 89' 5 3/4" + 12' 2" = 101' 7 3/4" THE HYDROSTATIC DIFFERENCE IS THUS: 183' 9 1/2" - 101' 7 3/4" = 82' 1 3/4" = 985.75" 720 AND HYDROSTATIC PRESSURE IS: 985.75" H20 / 27.6807" H20/PSIG = 35.612

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PISO	855	A-26497 UNIT 2 REV.12 INSTRUMENT SETPOINT INDEX INSTRUMENTS 2B21-N015 A-D
PELM	29.633	THE MAXIMUM CST LEVEL IS GIVEN AS 170' 0" FOR THE SETPOINT OF 2P21 N002 ON DRAWING A-26497 REV. 12. THE MINIMUM SUPPRESSION POOL LEVEL WAS CALCULATED AS 101' 7 3/4" IN THE CALCULATION FOR PEL ABOVE. THUS THE HYDROSTATIC DIFFERENCE IS: 170' 0" - 101' 7 3/4" = 68' 4 1/4" = 820.25 "H20 HYDROSTATIC PRESSURE IS: 820.25"H20 / 27.6807 "H20/PSIG = 29.633
PRSS	1090	UNIT 2 TECHNICAL SPECIFICATIONS SECTION 3.4.2.1
PELD	29.488	THE MAXIMUM CST LEVEL IS GIVEN AS 170' 0" FOR THE SETPOINT OF 2P21-N002 ON DRAWING A-26497 REV. 12. THE INSIDE BOTTOM ELEVATION OF THE SUPPRESSION POOL WAS CALCULATED AS

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PELD		89' 5 3/4" IN THE CALCULATION FOR PEL. THE MAXIMUM SUPPRESSION POOL LEVEL IS GIVEN AS 12' 6" IN THE UNIT 2 TECHNICAL SPECIFICATIONS SECTION 3.6.2.1 THE MAXIMUM ELEVATION LEVEL OF THE SUPPRESSION POOL IS: 89' 5 3/4" + 12' 6" = 101' 11 3/4" THUS THE HYDROSTATIC DIFFERENCE IS: 170' 0" - 101' 11 3/4" = 68' 1/4" = 816.25"H20 HYDROSTATIC PRESSURE EQUALS 816.25 "H20 / 27.6807 "H20/PSIG = 29.488
PMF	1300.54	TELEPHONE CONFIRMATION - C.SORENSEN/G.PARKS ON SEPTEMBER 5, 1986.
PV	0.1337	THE RCIC SYSTEM RATED FLOW IS GIVEN AS 400 GPM IN DRAWING S-25171 REV. A. THE SIZE OF THE SIZE OF THE SUCTION LINE IS GIVEN AS 6" HLB ON DRAWING H-26023 REV. 15, WHICH IS SCHEDULE 40 PIPE IN THE UNIT 2 PIPE SPECS. THE INTERNAL DIAMETER IS GIVEN IN CRANE AS 6.065". 6.065" x 12 IN/FT = 0.5054 FEET

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PV		THE VELOCITY HEAD IS EQUAL TO: . [(V)**2] / 2 x gc, FROM CRANE 410 eqn 2-1 . WHERE gc IS THE GRAVITATIONAL CONSTANT . gc = 32.2 FT/SEC**2 . AND V = Q/A; FROM CRANE 410 eqn 3-2 PI=3.1416 V = [400 x 60 x 8.3378] /[PI x (0.5054 ** 2)/4] . = 4.46 FT/SEC VELOCITY HEAD IS: . [4.46**2] / 2 x 32.2 = 0.3089 FT H20 VELOCITY HEAD PRESSURE IS . 0.3089 FT H20 x 0.432781 PSIG/FT H20 . = 0.1337 PSIG
PRV	100	DWG S-27294 REV. F. VALVE COMPOSITE DRAWING FOR 2E51-F017 GIVES THE RELIEF SETTING OF 100 PSIG
PELS	4.4	THE MINIMUM SUPPRESSION POOL ELEVATION WAS DETERMINED TO BE 101' 7 3/4" IN THE CALCULATION FOR PEL. THE ELEVATION FOR THE SUCTION RELIEF VALVE 2E51-F017 IS GIVEN AS 91' 6" ON DRAWING

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PELS		S-36136 REV. 6. THUS THE HYDROSTATIC DIFFERENCE IS: 101' 7 3/4" - 91' 6" = 10' 1 3/4" = 121,75 "H20 HYDROSTATIC PRESSURE IS: 121.75 "H20 / 27.6807 "H20/PSIG = 4.40
PLOC	31.6	NEDO-27569-2 FIG. H2 4.1.2.-1 PG 9.
PLOM1	5.717	THE ACCIDENT SUPPRESSION POOL LEVEL IS GIVEN AS 102' 7 1/2" ON DRAWING S-27535 REV. 1 THE ELEVATION FOR THE SUPPRESSION POOL ISOLATION VALVES 2E51-F029 AND F031 ARE GIVEN AS 89' 5 1/4" ON DRAWING H-26844 REV. H. THUS THE HYDROSTATIC DIFFERENCE IS: 102' 7 1/2" - 89' 5 1/4" = 13' 2 1/4" = 158.25 "H20 THE HYDROSTATIC PRESSURE IS: 158.25 "H20 / 27.6807 "H20/PSIG = 5.717
PLOM2	5.69	THE ACCIDENT SUPPRESSION POOL LEVEL IS GIVEN AS 102' 7 1/2" ON DRAWING S-27535 REV. 1 THE ELEVATION FOR THE TURBINE ACCESSORIES

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PLOM2		VALVE 2E51-F046 IS GIVEN AS 89' 6" DRAWING S-36097 REV. A. THUS THE HYDROSTATIC DIFFERENCE IS: 102' 7 1/2" - 89' 6" = 157.5 = 157.5"H20 THE HYDROSTATIC PRESSURE IS: 157.5 "H20 /27.6807 "H20/PSIG = 5.690
PC	31.6	NEDO-27569-2 FIG.H2 4.1.2-1 PG 9.
PELC	34.9	THE MAXIMUM CST LEVEL IS GIVEN AS 170' 0" PER SETPOINT FOR 2P21-N002 ON DRAWING A-26497 REV. 12. THE ELEVATION FOR THE RCIC TURBINE ACCESSORIES COOLING WATER VALVE 2E51-F046 IS GIVEN AS 89' 6" ON DRAWING S-36097 REV. A. THUS THE HYDROSTATIC DIFFERENCE IS: 170' 0" - 89' 6" = 80' 6" = 966 "H20 THE HYDROSTATIC PRESSURE IS: 966 "H20 /27.6807 "H20/PSIG = 34.90
PSOI	257.074	TELEPHONE CONFIRMATION C.SORENSEN/G.PARKS

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PSOI		ON SEPTEMBER 5, 1986.
PATM	Ø	NORMAL ATMOSPHERIC PRESSURE = 14.696 PSIA. PSIG = PSIA - 14.696 = Ø
PVEL1	Ø	P & I DIAGRAMS H-26023 REV.15 AND H-26024 REV. 13 SHOW THAT THE UPSTREAM PIPING IS CONNECTED TO THE CONDENSATE STORAGE TANK. IT IS ASSUMED THAT ANY WATER HAMMER EFFECTS IN THE UPSTREAM PIPING WOULD BE DISSIPATED WITHIN THE CST VOLUME, AND PRODUCE NO RESULTANT PRESSURE RISE UPON THE VALVE. THE REFERENCED DRAWINGS ALSO SHOW THAT THE DOWNSTREAM PIPING IS INTERCONNECTED WITH THE SUPPRESSION POOL SUCTION LINE. IT IS ASSUMED THAT THE RCIC PUMP IS OPERATING TO DRAW A SUCTION FROM THE SUPPRESSION POOL WHEN 2E51-FØ1Ø BEGINS TO CLOSE. THEREFORE, NO DOWNSTREAM FLUID DECELERATION WILL RESULT. IT MAY BE CONCLUDED THAT NO INCREASE IN PRESSURE BECAUSE OF WATER HAMMER WILL RESULT. CONSIDERING THE ABOVE FACTS, VALVE 2E51-FØ1Ø CAN BE CONSIDERED TO HAVE NO WATER HAMMER PRESSURE

UNIT 2 RCIC TERM DERIVATIONS 09/21/86

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PVEL1		INCREASE. THEREFORE PVEL1 = 0
PVEL2	3.029	SYSTEM VELOCITY GATE FOR 2E51-F013 FLOW RATE = 400 GPM FROM . RCIC FLOW DIAGRAM S-25171 REV. A AREA OF 4" SCH 80 PIPE = 11.5 SQ IN . FROM CRANE 410 VELOCITY = [400 GPM X 0.3211] / 11.5 SQ IN . 11.1687 FT/SEC CLOSURE TIME . TC = 15 SEC . FROM DATA SHEET A-26503 VALVE THROAT DIAMETER . VALVE DIAMETER = 3 7/16" . TELEPHONE CON. D SCHERER OF POWELL AND . B. HARRIN OF SCS ON 9/11/86 LENGTH UPSTREAM (LU) AND DOWNSTREAM (LD) . LU = 99.995 FT . KELLOGG ISOMETRIC S-27083 REV. J . KELLOGG ISOMETRIC S-27085 REV. J . LD = 19.75 FT . KELLOGG ISOMETRIC S-27085 REV. J . KELLOGG ISOMETRIC SX-23286 REV. B

UNIT 2 RCIC TERM DERIVATIONS 09/21/86

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PVEL2		PVEL2 = 3.029 FROM COMPUTER PRINTOUT
PVEL3	3.710641	SYSTEM VELOCITY FOR 2E51-F019 FLOW RATE = 50 GPM FROM . RCIC FLOW DIAGRAM S-25171 REV. A AREA OF 2" SCH 80 PIPE = 2.953 SQ IN . CRANE 410 VELOCITY = [50 GPM X 0.3211] / 2.953 SQ IN . = 5.4368 FT/SEC CLOSURE TIME . TC = 4 SEC . DATA SHEET A-2650 VALVE THROAT DIAMETER . VALVE DIAMETER = 1.403 . TELECOPY D. HARASONYSH OF YARWAY TO . J. ROBYN OF SCS ON 9/11/86. LENGTH UPSTREAM (LU) AND DOWNSTREAM (LD) . LU = 8.6146 FT . KELLOGG ISOMETRICS S-36100A, S-27083J . LD = 119 FT . KELLOGG ISOMETRICS S-3610 2 A, S-3609 5 A, . AND S-3609 6 REV. 0. PVEL3 = 3.710641 FROM COMPUTER PRINTOUT

UNIT 2 RCIC TERM DERIVATIONS 09/21/86

TERM	PRESSURE (PSIG)	DERIVATION OF TERM
PVEL4	0.091729	SYSTEM VELOCITY FOR 2E51-F046
		FLOW RATE = 16 GPM FROM
		. RCIC FLOW DIAGRAM S-25171 REV. A
		AREA OF 2" SCH 80 PIPE = 2.953 SQ IN
		. CRANE 410
		VELOCITY = [16 GPM X 0.3211] / 2.953 SQ IN
		. = 1.7398 FT/SEC
		CLOSURE TIME
		. TC = 10 SEC FROM DATA SHEET A-26503
		. HNP2 FSAR TABLE 6.2-5 SHT 21 NOTE 7.
		VALVE THROAT DIAMETER
		. VALVE DIAMETER = 1.403
		. TELECOPY D. HARASONYSH OF YARWAY TO
		. J. ROBYN OF SCS ON 9/11/86
		LENGTH UPSTREAM (LU) AND DOWNSTREAM (LD)
		. LU = 9.3125 FT
		. KELLOGG ISOMETRIC S-36097 A
		. LD = 15.3333 FT
		. KELLOGG ISOMETRIC S-36097 A
		. KELLOGG ISOMETRIC S-36098 A
		PVEL4 = 0.091729 FROM COMPUTER PRINTOUT

GATE VALVE PVEL CALCULATION

MPL NUMBER	2E51-FØ13
VALVE DIAMETER (INCHES)	3.4375
CLOSING TIME (SECONDS)	15
UPSTREAM PIPE LENGTH (FT)	94.995
DOWNSTREAM PIPE LENGTH (FT)	19.75
UPSTREAM SYSTEM VEL (FT/SEC)	11.1687
DOWNSTREAM SYSTEM VEL (FT/SEC)	11.1687
delta TIME UPSTREAM (SECONDS)	Ø.Ø474975
delta TIME DWNSTREAM (SECONDS)	Ø.ØØ9875
TIME UPSTREAM 1 (SECONDS)	14.952502
TIME UPSTREAM 2 (SECONDS)	15
TIME DOWNSTREAM 1 (SECONDS)	14.99Ø125
TIME DOWNSTREAM 2 (SECONDS)	15
RISE UPSTREAM 1	1.7133Ø76
RISE UPSTREAM 2	1.71875
RISE DOWNSTREAM 1	1.7176185
RISE DOWNSTREAM 2	1.71875
CHORD UPSTREAM 1	3.4374828
CHORD UPSTREAM 2	3.4375
CHORD DOWNSTREAM 1	3.4374993
CHORD DOWNSTREAM 2	3.4375
MAX AREA (IN SQ)	9.3546549
AREA FLOW UPSTREAM 1	Ø.Ø389633
AREA FLOW UPSTREAM 2	Ø
AREA FLOW DOWNSTREAM 1	Ø.ØØ81Ø27
AREA FLOW DOWNSTREAM 2	Ø
a/Au1	Ø.ØØ41984
a/Au2	Ø
a/Ad1	Ø.ØØØ8731
a/Ad2	Ø
VELOCITY UPSTREAM 1 (FT/SEC)	Ø.Ø468Ø3
VELOCITY UPSTREAM 2 (FT/SEC)	Ø
VELOCITY DOWNSTREAM 1 (FT/SEC)	Ø.ØØ97512
VELOCITY DOWNSTREAM 2 (FT/SEC)	Ø
delta VEL UPSTREAM (FT/SEC)	Ø.Ø468Ø3
delta VEL DOWNSTREAM (FT/SEC)	Ø.ØØ97512
Pvu UPSTREAM PRESSURE (PSIG)	2.5Ø77756
Pvd DOWNSTREAM PRESSURE (PSIG)	Ø.5215117

Pvel2(PSIG) 3.Ø292873

TWO INCH GLOBE VALVE PVEL CALCULATIONS

MPL NUMBER	2E51-F019
VALVE DIAMETER (INCHES)	1.403
CLOSING TIME (SECONDS)	4
UPSTREAM PIPE LENGTH (FT)	8.6146
DOWNSTREAM PIPE LENGTH (FT)	119
UPSTREAM SYSTEM VEL (FT/SEC)	5.4368
DOWNSTREAM SYSTEM VEL (FT/SEC)	5.4368
delta TIME UPSTREAM (SECONDS)	0.0043073
delta TIME DWNSTREAM (SECONDS)	0.0595
TIME UPSTREAM 1 (SECONDS)	2
TIME UPSTREAM 2 (SECONDS)	2.0043073
TIME DOWNSTREAM 1 (SECONDS)	2
TIME DOWNSTREAM 2 (SECONDS)	2.0595
% OPEN UPSTREAM 1	50
% OPEN UPSTREAM 2	50.107682
% OPEN DOWNSTREAM 1	50
% OPEN DOWNSTREAM 2	51.4875
% CV UPSTREAM 1	40
% CV UPSTREAM 2	40.086146
% CV DOWNSTREAM 1	40
% CV DOWNSTREAM 2	41.19
delta VEL UPSTREAM (FT/SEC)	0.0046836
delta VEL DOWNSTREAM (FT/SEC)	0.0646979
Pvu UPSTREAM (PSIG)	0.2504862
Pvd DOWNSTREAM (PSIG)	3.4601555

Pvel3(PSIG) 3.7106417

TWO INCH GLOBE VALVE PVEL CALCULATIONS

MPL NUMBER	2E51-F046
VALVE DIAMETER (INCHES)	1.403
CLOSING TIME (SECONDS)	10
UPSTREAM PIPE LENGTH (FT)	9.3125
DOWNSTREAM PIPE LENGTH (FT)	15.3333
UPSTREAM SYSTEM VEL (FT/SEC)	1.7398
DOWNSTREAM SYSTEM VEL (FT/SEC)	1.7398
delta TIME UPSTREAM (SECONDS)	0.0046562
delta TIME DWNSTREAM (SECONDS)	0.0076666
TIME UPSTREAM 1 (SECONDS)	5
TIME UPSTREAM 2 (SECONDS)	5.0046563
TIME DOWNSTREAM 1 (SECONDS)	5
TIME DOWNSTREAM 2 (SECONDS)	5.0076666
% OPEN UPSTREAM 1	50
% OPEN UPSTREAM 2	50.046563
% OPEN DOWNSTREAM 1	50
% OPEN DOWNSTREAM 2	50.076667
% CV UPSTREAM 1	40
% CV UPSTREAM 2	40.03725
% CV DOWNSTREAM 1	40
% CV DOWNSTREAM 2	40.061333
delta VEL UPSTREAM (FT/SEC)	0.0006481
delta VEL DOWNSTREAM (FT/SEC)	0.0010671
Pvu UPSTREAM (PSIG)	0.0346602
Pvd DOWNSTREAM (PSIG)	0.057069

Pvel^4(PSIG) 0.0917292

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	C Brown	9.19.86
Subject/Title	Reviewed By	Date
Unit 2 RCIC Motor Operated Valve	A.S. Kirk	9-20-86
Differential Pressure Calculation	Calculation Number SNH-86-018	Sheet 22 of 52

DETERMINE THE PRESSURE INCREASE DUE TO THE RAPID DECELERATION OF FLUID CAUSED BY THE MOVEMENT OF A PROCESS GATE OR GLOBE VALVE

ASSUMPTIONS

1) Valve openings result in no waterhammer effects. The differential pressure across a valve during opening is decreased by an increase in fluid velocity. The maximum actuator loading takes place before the valve lift occurs.

2) Steam valve closure results in only minor or no waterhammer effect. The compressible nature of the fluid medium coupled with maximum anticipated velocity changes make the pressure addition insignificant.

3) Area of flow through a gate valve is a direct and linear relation to system velocity.

4) The percentage of valve opening is a direct relation to opening time.

5) It is assumed that flowing pressure does not drop below the fluids vapor pressure.

The pressure increase due to sudden deceleration of fluid may be expressed as:

$$PVEL = P1 + P2$$

Where P1 is the upstream pressure change, and P2 is the downstream pressure change.

The respective valves for P1 and P2 may be calculated as follows:

$$P_1, P_2 = \frac{\rho C \Delta V_{MAX}}{144\ g}$$

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	[signature]	9-19-86
Subject/Title	Reviewed By	Date
Unit 2 RCIC Motor Operated Valve	[signature]	9-20-86
Differential Pressure Calculation	Calculation Number SNH-86-018	Sheet 23 of 52

Where: ρ is the fluid density

C is the speed of sound through the fluid

Δ VMAX is the maximum system fluid differential velocity

144 is a conversion factor

and g is the Gravatational Constant

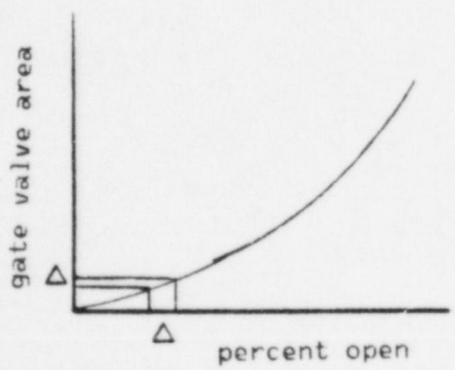
The fluid ΔV is assumed to be a direct relation to flow area, as shown in the gate valve area - percent open curves, and is a direct relation to Cv, as shown on the globe valve Cv - percent open curves.

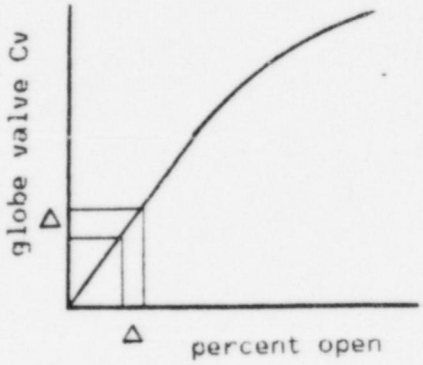
The valve Δt is a direct relation to Δ percentage open.

Therefore:

$$\frac{\Delta A}{\Delta \% \text{ Open}} \approx \frac{\Delta Cv}{\Delta \% \text{ Open}} \approx \frac{\Delta V}{\Delta t}$$

Having plotted a velocity relation against a time relation the region of highest differential velocity is examined.





Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	C Lorenzo	9.19.86
Subject/Title	Reviewed By	Date
Unit 2 RCIC Motor Operated Valve	A.S. Kirk	9-20-86
Differential Pressure Calculation	Calculation Number SNH-86-018	Sheet 24 of 52

Incremental time is Defined As:

$$\Delta t = t2 - t1 = \frac{2L}{c}$$

Where the term 2L/C is the time require for a pressure wave to travel down a pipe's flow length and rebound to it's source valve.

Knowing the equation of the curve, the maximum ΔV for Δt (ie; greatest slope) is calculated and entered into the pressure equations.

The procedure is once again performed for the down stream side of the valve and added as follows to produce PVEL

$$PVEL = P1 + P2$$

Reference: BWROG REPORT APP. B

0082d

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	[signature]	9-19-86
Subject/Title	Reviewed By	Date
Unit 2 RCIC Motor Operated Valve	[signature]	9/21/86
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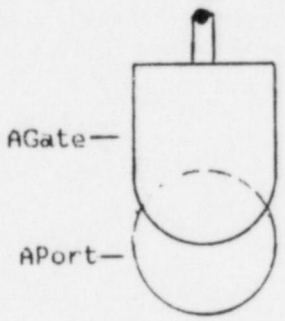
RELATIONSHIP OF THE GATE VALVE FLOW AREA TO THE PERCENTAGE OPENING OF A TYPICAL GATE VALVE

It is assumed that the diameter of the gate is equal to the port diameter of the valve since the difference in diameters is insignificantly small.

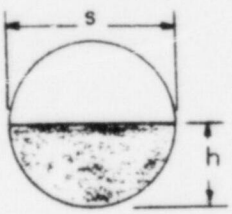
THE FLOW AREA OF THE VALVE MAY BE DETERMINED BY SUBTRACTING THE AREA OF THE GATE OCCLUDING THE TOTAL PORT AREA.



A = Area

AFlow = APort - AGate

THE AREA OF THE PORT IS CALCULATED USING THE CIRCULAR SEGMENT CALCULATION



$ASEG = h/6s\ (3h^2 + 4s^2)$

WITH h = RISE = RADIUS
AND s = CHORD = DIAMETER

THE AREA OF THE PORT IS EQUAL TO TWICE ASEG

APORT = 2ASEG = R/6D (3R**2 + 4D**2)

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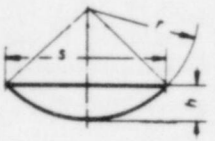
E.I. Hatch Nuclear Plant Unit 2	C Loeran	9.19.86
Subject/Title	Reviewed By	Date
Unit 2 RCIC Motor Operated Valve	GD McHatt	9/21/86
Differential Pressure Calculation	Calculation Number SNH-86-018	Sheet 26 of 52

THE OCCLUDING AREA OF THE GATE IS FOUND BY USING THE AREA OF A CIRCULAR SEGMENT CALCULATION.



$$ASEG = h/6s\ (3h^2 + 4s^2)$$

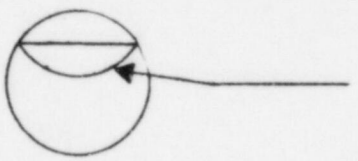
$$r = h/2 + s^2/8h$$

TRANSFORMING THE LATER EQUATION

$$s = (\ 8h\ (r-(h/2)))^{1/2}$$

WHICH COMBINED WITH THE ASEG CALCULATION MAY BE READILY SOLVED.

THE AREA OCCLUDED IS EQUAL TO TWICE ASEG.



AGATE = 2 ASEG.

THUS THE AREA OF FLOW THROUGH THE VALVE IS CALCULATED AS:

AFlow = APORT - AGATE

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2		9.19.86
Subject/Title	**Reviewed By**	**Date**
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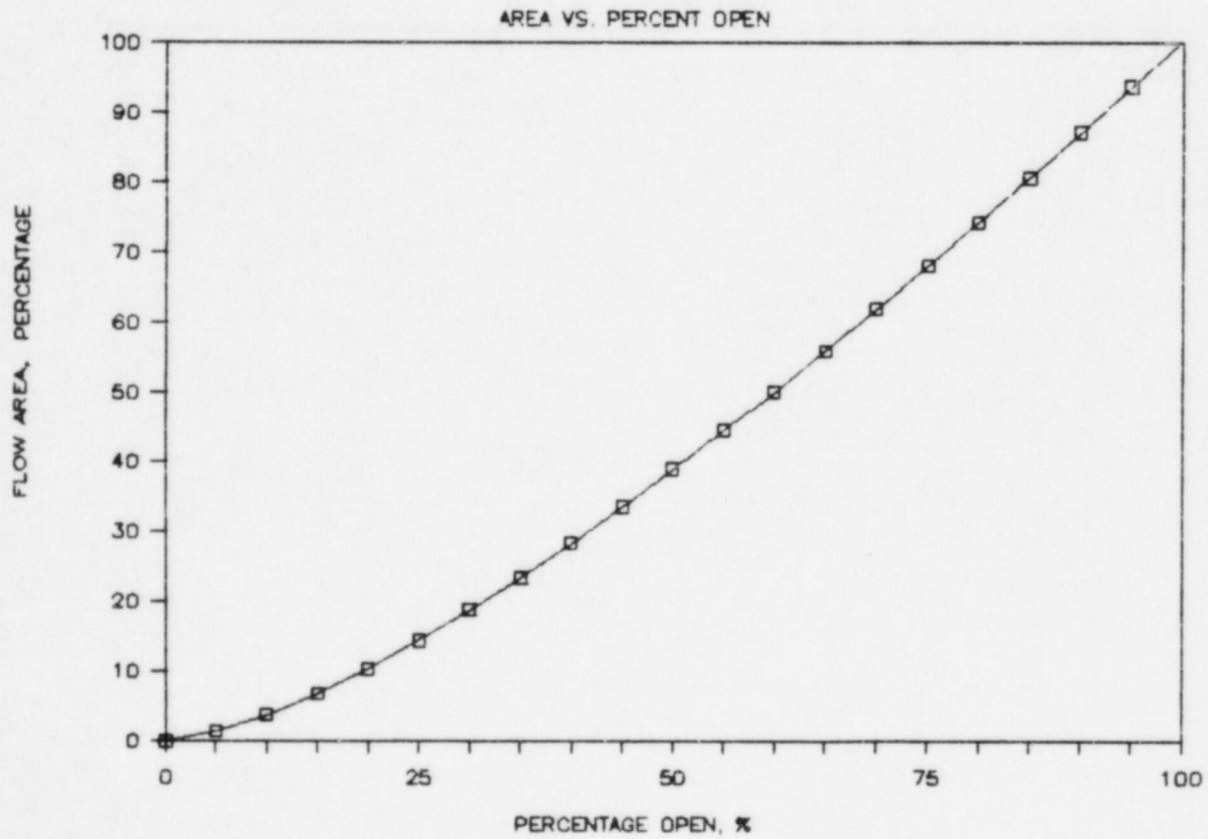
A GRAPHIC PRESENTATION OF THE TYPICAL FLOW AREA VS. PERCENT VALVE OPENING IS GIVEN AS FOLLOWS.



REFERENCE: ENGINEERING FORMULAS 4th EDITION, PAGE B3.

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	C Lorenz	9-19-86
Subject/Title	Reviewed By	Date
Unit 2 RCIC Motor Operated Valve	A.S. Kirk	9-19-86
Differential Pressure Calculation	Calculation Number SNH-86-018	Sheet 28 of 52

NUMERICAL RELATIONSHIP BETWEEN A GRAPHICAL PRESENTATION OF MANUFACTURER'S 2" GLOBE VALVE OPENING VS. MANUFACTURER'S CV DATA

Given a curve of 0-100 % opening (see attached), It is Desired to numerically relate the first 60% of opening to CV.

The First 60% of opening is a linear function thus, the curve may be equated using linear regression of the point-slope form.

$$y - y1 = m(x-x1)$$

Using the points (0,0) and (50,40)

$$40-0 = m(50-0)$$

Solving for m

$$m = 40/50 = 0.8$$

The equation of a line is given as:

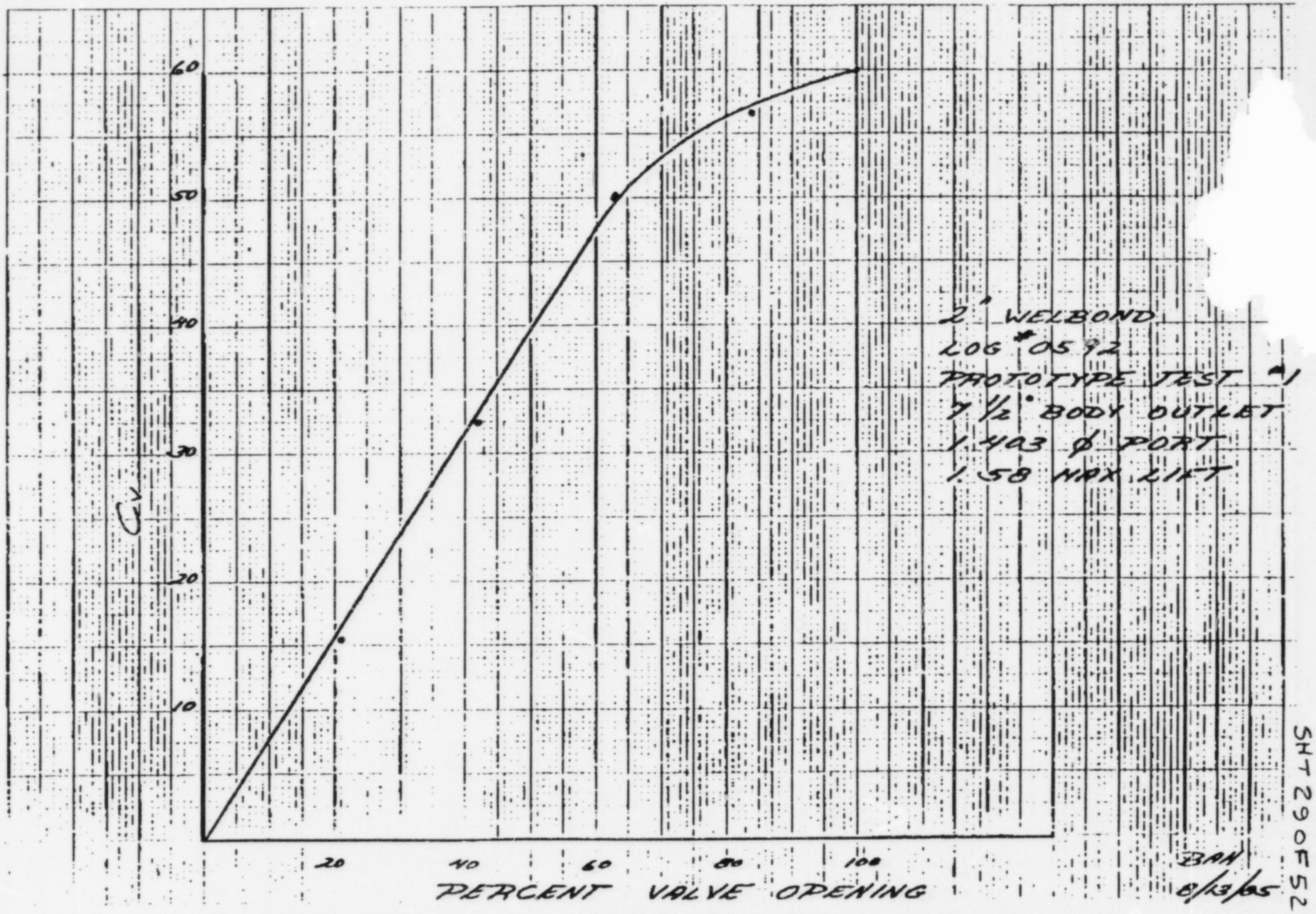
$$y = mx$$

Hence, the equation relating cv with percent opening is:

$$CV = 0.8 \text{ (percentage opening)}$$

FOR ALL OPENINGS LESS THAN 60%.

Reference: THE ENGINEER'S COMPANION 1966 PG. 13.


Cv
60
50
40
30
20
10
20
40
60
80
100
PERCENT VALVE OPENING
2" WELBOND
LOG #0592
PROTOTYPE TEST #1
2 1/2" BODY OUTLET
1.493 Ø PORT
1.58 MAX. LIFT
BAH
8/13/85

SHT 2 OF 2

DIFFERENTIAL PRESSURE CALCULATION

MPL NUMBER:	2E51-F007
VALVE DESCRIPTION:	RCIC STEAM INBOARD ISOL VALVE
VALVE FUNCTION:	RCIC STEAM LINE ISOLATION VALVE
SAFETY ACTION (YES/NO):	YES
DP CALCULATION FORMULA:	DP=PRSS
SAFETY ACTION ON OPEN/CLOSE:	CLOSE
MAXIMUM DP ON OPEN/CLOSE:	CLOSE
MAXIMUM DP UPSTREAM/DOWNSTREAM	UPSTREAM

VALUES USED:

PRSS =1090

DP (PSID)	1090

DIFFERENTIAL PRESSURE CALCULATION

MPL NUMBER:	2E51-F008
VALVE DESCRIPTION:	RCIC STEAM OUTBOARD ISOL VLV
VALVE FUNCTION:	RCIC STEAM LINE ISOLATION VALVE
SAFETY ACTION (YES/NO):	YES
DP CALCULATION FORMULA:	DP=PRSS
SAFETY ACTION ON OPEN/CLOSE:	CLOSE
MAXIMUM DP ON OPEN/CLOSE:	CLOSE
MAXIMUM DP UPSTREAM/DOWNSTREAM	UPSTREAM

VALUES USED:

PRSS =1090

DP (PSID)	1090

DIFFERENTIAL PRESSURE CALCULATION

MPL NUMBER: 2E51-F010

VALVE DESCRIPTION: PUMP SUCT FRM COND STG TNK

VALVE FUNCTION: RCIC CST SUCTION ISOLATION VALVE

SAFETY ACTION (YES/NO): YES

DP CALCULATION FORMULA: DP=PELD+PV+PVEL1

SAFETY ACTION ON OPEN/CLOSE: CLOSE

MAXIMUM DP ON OPEN/CLOSE: CLOSE

MAXIMUM DP UPSTREAM/DOWNSTREAM UPSTREAM

VALUES USED:

PELD =29.488

PV =0.1337

PVEL1 =0

DP (PSID) 29.6217

DIFFERENTIAL PRESSURE CALCULATION

MPL NUMBER:	2E51-FØ12
VALVE DESCRIPTION:	RCIC PUMP OUTBOARD DISCH VLV
VALVE FUNCTION:	RCIC INJECTION VALVE TEST VALVE
SAFETY ACTION (YES/NO):	NO
DP CALCULATION FORMULA:	NO SAFETY ACTION
SAFETY ACTION ON OPEN/CLOSE:	NONE
MAXIMUM DP ON OPEN/CLOSE:	N/A
MAXIMUM DP UPSTREAM/DOWNSTREAM	N/A

VALUES USED:

=

DP (PSID) N/A

DIFFERENTIAL PRESSURE CALCULATION

MPL NUMBER: 2E51-FØ13

VALVE DESCRIPTION: RCIC PUMP INBOARD DISCH VLV

VALVE FUNCTION: RCIC INJECTION VALVE

SAFETY ACTION (YES/NO): YES

DP CALCULATION FORMULA: DP=PRSS+PEL (b)

SAFETY ACTION ON OPEN/CLOSE: OPEN/CLOSE

MAXIMUM DP ON OPEN/CLOSE: OPEN/CLOSE

MAXIMUM DP UPSTREAM/DOWNSTREAM DOWNSTREAM

VALUES USED:

PRSS =1Ø9Ø

PEL =35.612

DP (PSID) 1125.612

DIFFERENTIAL PRESSURE CALCULATION

MPL NUMBER: 2E51-FØ19

VALVE DESCRIPTION: TEST BYPASS TO COND STG TANK

VALVE FUNCTION: RCIC MINIMUM FLOW BYPASS ISOL VALVE

SAFETY ACTION (YES/NO): YES

DP CALCULATION FORMULA: DP=PSOH+PELM

SAFETY ACTION ON OPEN/CLOSE: OPEN/CLOSE

MAXIMUM DP ON OPEN/CLOSE: OPEN

MAXIMUM DP UPSTREAM/DOWNSTREAM UPSTREAM

VALUES USED:

PSOH =1300.54

PELM =29.633

DP (PSID) 1330.173

DIFFERENTIAL PRESSURE CALCULATION

MPL NUMBER: 2E51-FØ19

VALVE DESCRIPTION: TEST BYPASS TO COND STG TANK

VALVE FUNCTION: RCIC MINIMUM FLOW BYPASS ISOL VALVE

SAFETY ACTION (YES/NO): YES

DP CALCULATION FORMULA: DP=PMF+PELM+PVEL3

SAFETY ACTION ON OPEN/CLOSE: OPEN/CLOSE

MAXIMUM DP ON OPEN/CLOSE: CLOSE

MAXIMUM DP UPSTREAM/DOWNSTREAM UPSTREAM

VALUES USED:

PMF =1300.54

PELM =29.633

PVEL3 =3.710641

DP (PSID) 1333.883641

DIFFERENTIAL PRESSURE CALCULATION

MPL NUMBER: 2E51-FØ22

VALVE DESCRIPTION: TEST BYPASS TO COND STG TANK

VALVE FUNCTION: RCIC CST TEST RETURN VALVE

SAFETY ACTION (YES/NO): NO

DP CALCULATION FORMULA: NO SAFETY ACTION

SAFETY ACTION ON OPEN/CLOSE: NONE

MAXIMUM DP ON OPEN/CLOSE: N/A

MAXIMUM DP UPSTREAM/DOWNSTREAM N/A

VALUES USED:

=

DP (PSID) N/A

DIFFERENTIAL PRESSURE CALCULATION

MPL NUMBER: 2E51-F029

VALVE DESCRIPTION: RCIC PMP SUCT VLV FRM SUP POOL

VALVE FUNCTION: RCIC SUPP POOL SUCTION ISOL VALVE

SAFETY ACTION (YES/NO): YES

DP CALCULATION FORMULA: DP=PLOC+PLOM1 (c)

SAFETY ACTION ON OPEN/CLOSE: OPEN/CLOSE

MAXIMUM DP ON OPEN/CLOSE: CLOSE

MAXIMUM DP UPSTREAM/DOWNSTREAM UPSTREAM

VALUES USED:

PLOC =31.6

PLOM1 = 5.717

DP (PSID) 37.317

DIFFERENTIAL PRESSURE CALCULATION

MPL NUMBER:	2E51-F029
VALVE DESCRIPTION:	RCIC PMP SUCT VLV FRM SUP POOL
VALVE FUNCTION:	RCIC SUPP POOL SUCTION ISOL VALVE
SAFETY ACTION (YES/NO):	YES
DP CALCULATION FORMULA:	DP=PRV-PELS
SAFETY ACTION ON OPEN/CLOSE:	OPEN/CLOSE
MAXIMUM DP ON OPEN/CLOSE:	OPEN
MAXIMUM DP UPSTREAM/DOWNSTREAM	DOWNSTREAM

VALUES USED:

PRV =100

PELS =4.4

DP (PSID) 95.6

DIFFERENTIAL PRESSURE CALCULATION

MPL NUMBER: 2E51-FØ31

VALVE DESCRIPTION: RCIC PMP SUCT VLV FRM SUP POOL

VALVE FUNCTION: RCIC SUPP POOL SUCTION ISOL VALVE

SAFETY ACTION (YES/NO): YES

DP CALCULATION FORMULA: DP=PRV-PELS

SAFETY ACTION ON OPEN/CLOSE: OPEN/CLOSE

MAXIMUM DP ON OPEN/CLOSE: OPEN

MAXIMUM DP UPSTREAM/DOWNSTREAM DOWNSTREAM

VALUES USED:

PRV =1ØØ

PELS =4.4

DP (PSID) 95.6

DIFFERENTIAL PRESSURE CALCULATION

MPL NUMBER: 2E51-F031

VALVE DESCRIPTION: RCIC PMP SUCT VLV FRM SUP POOL

VALVE FUNCTION: RCIC SUPP POOL SUCTION ISOL VALVE

SAFETY ACTION (YES/NO): YES

DP CALCULATION FORMULA: DP=PLOC+PLOM1 (c)

SAFETY ACTION ON OPEN/CLOSE: OPEN/CLOSE

MAXIMUM DP ON OPEN/CLOSE: CLOSE

MAXIMUM DP UPSTREAM/DOWNSTREAM UPSTREAM

VALUES USED:

PLOC =31.6

PLOM1 =5.717

DP (PSID) 37.317

DIFFERENTIAL PRESSURE CALCULATION

MPL NUMBER: 2E51-FØ45

VALVE DESCRIPTION: TURBINE STEAM SUPPLY VALVE

VALVE FUNCTION: RCIC STEAM ADMISSION VALVE

SAFETY ACTION (YES/NO): YES

DP CALCULATION FORMULA: DP=PRSS

SAFETY ACTION ON OPEN/CLOSE: OPEN/CLOSE

MAXIMUM DP ON OPEN/CLOSE: OPEN/CLOSE

MAXIMUM DP UPSTREAM/DOWNSTREAM UPSTREAM

VALUES USED:

PRSS =1Ø9Ø

DP (PSID) 1Ø9Ø

DIFFERENTIAL PRESSURE CALCULATION

MPL NUMBER: 2E51-F046

VALVE DESCRIPTION: COOLING WATER SUPPLY VALVE

VALVE FUNCTION: RCIC TURBINE ACCESSORY COOL WTR VALVE

SAFETY ACTION (YES/NO): YES

DP CALCULATION FORMULA: DP=PLOC+PLOM2+PVEL4

SAFETY ACTION ON OPEN/CLOSE: OPEN/CLOSE

MAXIMUM DP ON OPEN/CLOSE: CLOSE

MAXIMUM DP UPSTREAM/DOWNSTREAM UPSTREAM

VALUES USED:

PLOC =31.6

PLOM2 =5.69

PVEL4 =0.091729

DP (PSID) 37.381729

DIFFERENTIAL PRESSURE CALCULATION

MPL NUMBER: 2E51-FØ46

VALVE DESCRIPTION: COOLING WATER SUPPLY VALVE

VALVE FUNCTION: RCIC TURBINE ACCESSORY COOL WTR VALVE

SAFETY ACTION (YES/NO): YES

DP CALCULATION FORMULA: DP=PSOI+PELC

SAFETY ACTION ON OPEN/CLOSE: OPEN/CLOSE

MAXIMUM DP ON OPEN/CLOSE: OPEN

MAXIMUM DP UPSTREAM/DOWNSTREAM UPSTREAM

VALUES USED:

PSOI =257.Ø74

PELC = 34.9

DP (PSID) 291.974

DIFFERENTIAL PRESSURE CALCULATION

MPL NUMBER:	2E51-F1Ø4
VALVE DESCRIPTION:	GATE VALVE 1.5 IN MO
VALVE FUNCTION:	RCIC VACUUM BREAKER LINE ISOL VALVE
SAFETY ACTION (YES/NO):	YES
DP CALCULATION FORMULA:	DP=PC+PATM
SAFETY ACTION ON OPEN/CLOSE:	CLOSE
MAXIMUM DP ON OPEN/CLOSE:	CLOSE
MAXIMUM DP UPSTREAM/DOWNSTREAM	UPSTREAM

VALUES USED:

PC =31.6

PATM = Ø

DP (PSID)	31.6

DIFFERENTIAL PRESSURE CALCULATION

MPL NUMBER: 2E51-F105

VALVE DESCRIPTION: GATE VALVE 2 IN MO

VALVE FUNCTION: RCIC VACUUM BREAKER LINE ISOL VALVE

SAFETY ACTION (YES/NO): YES

DP CALCULATION FORMULA: DP=PC+PATM

SAFETY ACTION ON OPEN/CLOSE: CLOSE

MAXIMUM DP ON OPEN/CLOSE: CLOSE

MAXIMUM DP UPSTREAM/DOWNSTREAM UPSTREAM

VALUES USED:

PC =31.6

PATM = 0

DP (PSID) 31.6

DIFFERENTIAL PRESSURE CALCULATION

MPL NUMBER: 2E51-F119

VALVE DESCRIPTION: LSTB VALVE

VALVE FUNCTION: RCIC STEAM ADMISSION BYPASS VALVE

SAFETY ACTION (YES/NO): YES

DP CALCULATION FORMULA: DP=PRSS

SAFETY ACTION ON OPEN/CLOSE: CLOSE

MAXIMUM DP ON OPEN/CLOSE: CLOSE

MAXIMUM DP UPSTREAM/DOWNSTREAM UPSTREAM

VALUES USED:

PRSS =1090

DP (PSID) 1090

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	Dawn C. Wilson	09/19/86
Subject/Title	**Reviewed By**	**Date**
Unit 2 RCIC Motor Operated Valve	G D McGlothlin	9/20/86
Differential Pressure Calculation	Calculation Number SNH-86-018	Sheet 48 of 52

TWO INCH GLOBE VALVE PVEL CALCULATIONS PAGE 1 OF 2

```
A3: [W11] ^MPL
B3: ^VALVE
C3: ^CLOSING
D3: ^UPSTR
E3: ^DNSTR
F3: 'UPSTRSYS
G3: 'DNSTRSYS
I3: ^dT UP
J3: ^dTDN
K3: ^TIMEu1
L3: ^TIMEu2
M3: ^TIMEd1
N3: ^TIMEd2
O3: ^% OPEN
P3: ^% OPEN
Q3: ^% OPEN
R3: ^% OPEN
S3: ^% CV
T3: ^% CV
U3: ^% CV
V3: ^% CV
W3: ^dVu
X3: ^dVd
Y3: ^Pvu
Z3: ^Pvd
AA3: ^Pvel
A4: [W11] ^NUMBER
B4: ^DIA, "
C4: ^T, SECS
D4: ^PIPE L'
E4: ^PIPE L'
F4: ^VEL FPS
G4: ^VEL FPS
O4: ^UPSTR1
P4: ^UPSTR2
Q4: ^DNSTR1
R4: ^DNSTR2
S4: ^UPSTR1
T4: ^UPSTR2
U4: ^DNSTR1
V4: ^DNSTR2
A5: [W11] \-
B5: \-
C5: \-
D5: \-
E5: \-
F5: \-
G5: \-
```

Project	Prepared By	Date
E.I. Hatch Nuclear Plant Unit 2	Dawn C. Wilson	09/19/96
Subject/Title	Reviewed By	Date
Unit 2 RCIC Motor Operated Valve	A D McGahee	9/20/96
Differential Pressure Calculation	Calculation Number SNH-86-018	Sheet 49 of 52

TWO INCH GLOBE VALVE PVEL CALCULATIONS PAGE 2 OF 2

```
H5: [W2] \-
I5: \-
J5: \-
K5: \-
L5: \-
M5: \-
N5: \-
O5: \-
P5: \-
Q5: \-
R5: \-
S5: \-
T5: \-
U5: \-
V5: \-
W5: \-
X5: \-
Y5: \-
Z5: \-
AA5: \-
A6: [W11] '1E41-F059
B6: 1.75
C6: 10
D6: 25
E6: 31.42
F6: 7.601
G6: 7.601
H6: [W2] '|
I6: (2*D6)/$D$28
J6: (2*E6)/$D$28
K6: +$C6*0.5
L6: +$C6*0.5+I6
M6: +$C6*0.5
N6: +$C6*0.5+J6
O6: (+K6*100)/$C6
P6: (+L6*100)/$C6
Q6: (+M6*100)/$C6
R6: (+N6*100)/$C6
S6: +O6*0.8
T6: +P6*0.8
U6: +Q6*0.8
V6: +R6*0.8
W6: (+F6*(T6-S6))/100
X6: (+G6*(V6-U6))/100
Y6: (W6*$D$27*$D$28)/(144*32.2)
Z6: (X6*$D$27*$D$28)/(144*32.2)
AA6: +Y6+Z6

C27: 'DENSITY
D27: 61.996
E27: 'LB/FT3
C28: 'C
D28: 4000
E28: 'FT/SEC
```

GATE VALVE PVEL CALCULATIONS


```
A3: [W11] ^MPL
B3: ^VALVE
C3: ^CLOSING
D3: ^UPSTR
E3: ^DNSTR
F3: 'UPSTRSYS
G3: 'DNSTRSYS
I3: ^dT UP
J3: ^dTDN
K3: ^TIMEu1
L3: ^TIMEu2
M3: ^TIMEd1
N3: ^TIMEd2
O3: ^RISEu1
P3: ^RISEu2
Q3: ^RISEd1
R3: ^RISEd2
S3: ^CHORDu1
T3: ^CHORDu2
U3: ^CHORDd1
V3: ^CHORDd2
W3: 'MAX AREA
X3: ^Af1u1
Y3: ^Af1u2
Z3: ^Af1d1
AA3: ^Af1d2
AB3: ^a/Au1
AC3: ^a/Au2
AD3: ^a/Ad1
AE3: ^a/Ad2
AF3: ^Vu1
AG3: ^Vu2
AH3: ^Vd1
AI3: ^Vd2
AJ3: ^dVu
AK3: ^dVd
AL3: ^Pvu
AM3: ^Pvd
AN3: ^Pvel
A4: [W11] ^NUMBER
B4: ^DIA, "
C4: ^T, SECS
D4: ^PIPE L'
E4: ^PIPE L'
F4: ^VEL FPS
G4: ^VEL FPS
W4: 'FLOW
A5: [W11] \-
```

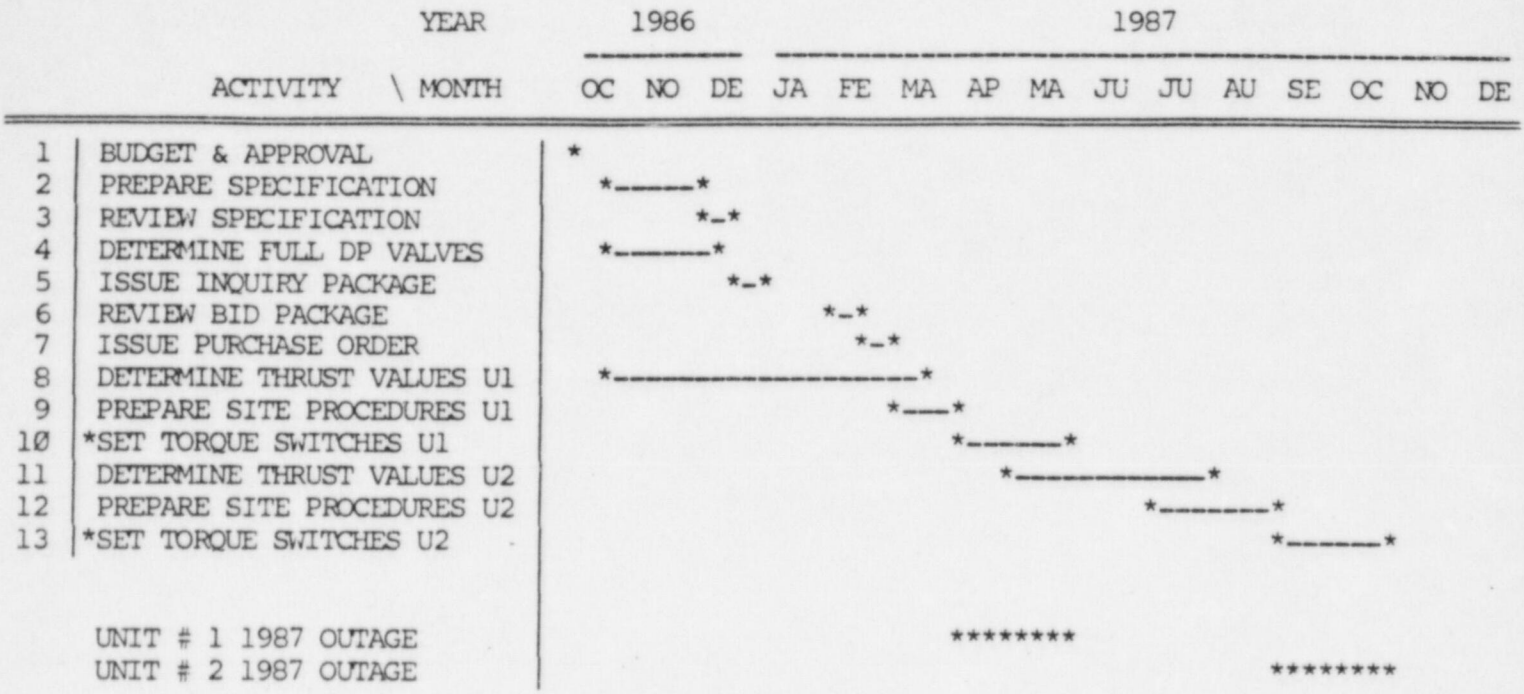
B5: \-
C5: \-
D5: \-
E5: \-
F5: \-
G5: \-
H5: [W2] \-
I5: \-
J5: \-
K5: \-
L5: \-
M5: \-
N5: \-
O5: \-
P5: \-
Q5: \-
R5: \-
S5: \-
T5: \-
U5: \-
V5: \-
W5: \-
X5: \-
Y5: \-
Z5: \-
AA5: \-
AB5: \-
AC5: \-
AD5: \-
AE5: \-
AF5: \-
AG5: \-
AH5: \-
AI5: \-
AJ5: \-
AK5: \-
AL5: \-
AM5: \-
AN5: \-
A6: [W11] '1E51-FØ13
B6: 3+5/16
C6: 15
D6: 99.9
E6: 16.6
F6: 11.62
G6: 12.46
H6: [W2] '|
I6: (2*D6)/$D$29

GATE VALVE PVEL CALCULATIONS


```
J6: (2*E6)/$D$29
K6: ($D$30*$C6)-I6
L6: +$D$30*$C6
M6: ($D$30*$C6)-J6
N6: +$D$30*$C6
O6: (K6/$C6)*($B6/2)
P6: (L6/$C6)*($B6/2)
Q6: (M6/$C6)*($B6/2)
R6: (N6/$C6)*($B6/2)
S6: @SQRT(8*O6*(($B6/2)-(O6/2)))
T6: @SQRT(8*P6*(($B6/2)-(P6/2)))
U6: @SQRT(8*Q6*(($B6/2)-(Q6/2)))
V6: @SQRT(8*R6*(($B6/2)-(R6/2)))
W6: 2*((1/12)*(((3*B6*B6)/4)+(4*B6*B6)))
X6: (F6) (W6)-(2*((O6/(6*S6))*((3*O6*O6)+(4*S6*S6))))
Y6: (F6) (W6)-(2*((P6/(6*T6))*((3*P6*P6)+(4*T6*T6))))
Z6: (F6) ($W6)-2*((Q6/(6*U6))*((3*Q6*Q6)+(4*U6*U6)))
AA6: (F6) ($W6)-2*((R6/(6*V6))*((3*R6*R6)+(4*V6*V6)))
AB6: (F6) +X6/((@PI*$B6*$B6)/4)
AC6: (F6) +Y6/((@PI*$B6*$B6)/4)
AD6: (F6) +Z6/((@PI*$B6*$B6)/4)
AE6: (F6) +AA6/((@PI*$B6*$B6)/4)
AF6: (F6) +AB6*$F6
AG6: (F6) +AC6*$F6
AH6: (F6) +AD6*$G6
AI6: (F6) +AE6*$G6
AJ6: (F6) +AF6-AG6
AK6: (F6) +AH6-AI6
AL6: (F6) (AJ6*$D$28*$D$29)/(144*32.2)
AM6: (F6) (AK6*$D$28*$D$29)/(144*32.2)
AN6: (F6) +AL6+AM6
C28: 'DENSITY
D28: 61.996
E28: 'LB/FT3
C29: 'C
D29: 4000
E29: 'FT/SEC
C30: 'FUDGE FAC
D30: 1
E30: 'DIMLESS
```

ENCLOSURE 5

SCHEDULE FOR MOV TESTING



* NOTE: BASED ON CURRENT INFORMATION ON OUTAGE SCHEDULES.