SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT ☐ 6201 S Street, P.O. Box 15830, Sacramento, CA 95813; (916) 452-3211
AN ELECTRIC SYSTEM SERVING THE HEART OF CALIFORNIA

RJR 85-542

November 13, 1985

DIRECTOR OF NUCLEAR REACTOR REGULATION
ATTENTION HUGH L THOMPSON JR DIRECTOR
DIVISION OF LICENSING
U S NUCLEAR REGULATORY COMMISSION
WASHINGTON D C 20555

DOCKET 50-312
RANCHO SECO NUCLEAR GENERATING STATION
UNIT NO. 1
SUMMARY AND SUPPLEMENTAL INFORMATION FROM TRANSIENT OF OCTOBER 2, 1985

At the request of the NRC Rancho Seco Project Manager, Syd Miner, the District is formally transmitting several revisions to attachments from our letter of October 25, 1985, (RJR 85-531). The District sent these attachments, via telecopy, at various times between October 26, 1985 through November 7, 1985. They include:

Attachments 2 (Rev. 2) - HPI "A" Flow Anomoly
Also, we have included as an addendum to Attachment 2, NCR-5150, Rev. 2*
Attachment 5 Part I & II (Rev. 1)** - Auxiliary Feedwater/Main Feedwater Failure Analysis
Attachment 8 - Oil Levels On Safety Related Pumps
Attachment 10 - Housekeeping and General Surveillance in Safety Related Areas

If you have any questions, contact Jerry Delezenski of my staff.

R. J. RODRIGUEZ
ASSISTANT GENERAL MANAGER
NUCLEAR

Attachments

A001
1/1

* An Addendum to Attachment 2 was added as requested
** An Addendum to Attachment 5, Part II was sent on November 1, 1985 (RJR 85-539) and is not included with this letter

ATTACHMENT 2 (Rev 2)

HPI "A" FLOW ANOMALY

As prescribed by plant operating procedures for pressurizer level decreasing below 100 inches, the operator started the High Pressure Injection (HPI) pump (P-238 B) lined up the borated water storage tank and opened loop "A" HPI valve. The loop "A" nozzle is also the path for normal additions necessary to maintain pressurizer level. Although the above actions increased flow to the reactor coolant system (RCS), the pressurizer level continued to decrease. The operator opened the remaining three loop HPI valves, allowing HPI flow through all four paths to the RCS. At this point, he observed "zero" flow on the "A" HPI flow indicator. To further augment the HPI supply, he started the third HPI pump and the loop "A" HPI flow increased to about 80 gpm. Subsequent analysis of plant computer data verified this phenomenon and showed a recovery of flow indication in about 30 seconds, coincident with start of the third HPI pump.

The district has performed an exhaustive investigation consisting of system flow testing, non-destructive examination and formal analysis. This investigation led us to the root cause; a shift in the zero point of the flow transmitter. This shift occurs as the device is calibrated with the system depressurized and then brought to system operating pressure. In the case of these transmitters, this shift can result in no flow indication with as much as 75 gpm of actual flow. Note that, although this problem creates imprecise indication to the operator, it did not affect the ability of the HPI system to perform its safety function. Hydraulic calculation showed that, for the period of "zero" flow indication, the expected loop "A" HPI flow would be nearly identical to the measured zero shift.

The nature of the identified error is that the HPI flow transmitters (Rosemount Model 1153HB6) have a particular characteristic which affects the zero setting as the process pressure changes. Per Rosemount literature, this can be as much as ± .66% of full range per 1000 psi.

Since the normal procedure is to calibrate at ambient pressure, the maximum error for this application could be ± 6.6" H_2O out of 1000" H_2O range. Although the amount of shift differs for each transmitter, the error is repeatable (within the limits of their repeatability specification), and causes a constant dp offset over the range. The net effect then is to introduce a large error at low flows, the flow error diminishing as flow increases as a function of the square root of the error.

The High Pressure Injection system is designed as a fully automatic system. During a Safety Features Actuation, the pump starts, injection valve throttling and make-up and miniflow isolation all occur without operator actions. With the injection valves in any position, they will travel to the properly throttled position upon Safety Features Actuation.

Thus successful mitigation of the accident does not depend on flow indication. In addition, for the entire range of Small Break LOCA's, that is any loss of RCS inventory that would result in RCS pressure dropping below 1600 psig, the flow produced by a single HPI pump through each of the four nozzles would be greater than 100 gpm. Resulting flow indication will be in the linear range and conservative.

The design criteria for the HPI system is defined as follows:

- >1600 psig, in the RCS, balanced flow is not required;
- at $\leq$1600 psig, a single HPI pump provides a nominal 400 gpm, which provides 100 gpm per nozzle meaning that each flow meter is in its linear range;
- at any pressure, SFAS initiation (auto or manual) will balance flows without operator action;
- at 600 psig, acceptable flow is 100 to 150 gmp, in each line, with total flow $\geq$450 gpm, but not to exceed 525 gpm from a single pump per SBLOCA analysis.

Thus low range inaccuracies are of concern only because they may be distracting to the operator during a transient. Based on the District's analyses, the following action will be performed:

- Operators will be informed of the characteristic of the flow indication.
- Each of the flow (ΔP) transmitter has been calibrated such that, with the worst case zero shift, the actual flow will be greater than the indicated flow.

As a long term corrective action, the District will investigate means to reduce the error in the flow indication.

RANCHO SECO

NONCONFORMING REPORT

Page 1 of 8 No. S 5150 Rev. 2

with Attachments

I. DESCRIPTION OF NONCONFORMANCE

Quality Class 1 EQ Item: ☒ Yes ☐ No Date 10/24/85

System SIM Equipment I.D. No. FT-23807 Location Aux -20'

Equip. Name HPI Flow A P. O. / Contract No. - ECN No. A-3651 MOD No. 11 Work Request No.

STP-184 testing of HPI Flow A indicated that installed flow transmitter FT-23807 signal was approximately 75 GPM low.

PREPARED BY J IRWIN EXT.

II. DESIGN REVIEW AND 10 CFR SECTION 50.59 REVIEW REQUIRED

☒ Yes, 50.59 Log No. 699 ☐ No Oper. ☒, Non-Oper. ☐

MANAGER, NUCLEAR OPERATIONS 11-1-85 DATE

COGNIZANT ENGINEER ASSIGNED J. Williams

DATE DISPOSITION DUE

III. DISPOSITION ACTION: ☒ ACCEPT (3) ☐ REJECT ☒ REPAIR (2&1) ☐ REWORK ☐ REPLACE

THIS DISPOSITION AND TECHNICAL JUSTIFICATION WILL REQUIRE: *(Any "Yes" Decision Requires a Buy-Off in Section VII)*

► A Design Calculation ► A Design or Drawing Change ► A Retest of the System / Unit

☒ Yes ☐ No ☐ Yes, ECN or Trans. No. ☒ No ☒ Yes, Test No. I-038 ☐ No

Z-SIM-I0099
Z-SIM-I0100

1. Recalibrate all four (4) HPI transmitters to assure that indicated flow is always less than or equal actual flow, per attached technical justification. Revise I-038 to test zero-shift characteristics. (N.E.)

2. Provide a method to identify to the operator that flow indication below 100 gpm is questionable. (N.E.)

3. Determine as-found zero-shift characteristic of Prz. Level, RCP Seal Inj. flow, AFW flow, and DH flow transmitters. (QA to verify)

NOTE: Verified by Q.A. on 10/30/85 & signed by J Irwin 10/30/85 as documentation on NCR S-5150 Rev 1 & Attachment 1 of same 11/1/85

COGNIZANT ENGINEER J Williams EXT. 11/1/85 DATE

III A. CAUSE OF NONCONFORMANCE

Inherent characteristic of flow transmitter.

J Williams 11/1/85
COGNIZANT ENGINEER DATE

III B. ACTION TAKEN TO PREVENT RECURRENCE

None, error will be compensated for otherwise (Items 1 thru 3 above).

D L Smith 11/1/85
QUALITY ASSURANCE ENGINEER DATE

IV. ENGINEERING REVIEW BOARD *(required on all accept/repair dispositions)* OK from E&C standpoint. Provide calibration results to E&C Group + CH/x1-1-85 E&C record

MANAGER, NUCLEAR OPERATIONS 11-1-85 DATE
MANAGER, NUCLEAR ENGINEERING 11/1/85 DATE
MANAGER, QUALITY ASSURANCE 11/1/85 DATE

V. SCHEDULING OFFICE *(if applicable)* Rev 1 Letter to NCR S-5150 per WR's.

Work Request No(s). ECN No. N/C

VI. REPAIR/REWORK/REPLACE COMPLETE and ACCEPTABLE

INSPECTOR DATE

VII. DOCUMENTATION/RETEST COMPLETE and ACCEPTABLE

☒ Design Calculation Released
☐ ECN or DCN Released
☒ Retest Complete and Acceptable

ENGINEER/INSPECTOR DATE

VIII. NCR CLOSED

QUALITY ASSURANCE SUPERVISOR 11/1/85 DATE

SMUD-0034 4/85

BLUE MEMO

TO:

DATE: 11/1/85

1. QA

2.

FROM: ROBERT ROEHLER 208 (MAIL STOP) 4905 (EXT.)

SUBJECT: NCR S-5150 Rev. 2

The change to the subject NCR does not change the Safety Analysis Log 699 Rev. 1.

Robert Roehler 11/1/85

SMUD-0165 5/84

III. DISPOSITION (Cont'd)

Background

The nature of the identified error is that the HPI flow transmitters (Rosemount Model 1153HB6) have a particular characteristic which affects the zero setting as the process pressure changes. Per Rosemount literature, this can be as much as + .66% of full range per 1000 psi. Since the normal procedure is to calibrate at ambient pressure, the maximum error for our application could be + 6.6" H_2O out of the 1000" H_2O range. Per Rosemount the error is repeatable (within the limits of their repeatability specification), and causes a constant dp offset over the range. The net effect then is to introduce a large error at low flows, the flow error diminishing as flow increases as a function of the square root of the error. This effect is shown in Figure 1 for an assumed pressure (HPI header) of 1000 psig for the four FT's using as-found characteristics. Note that except for the D loop, the errors are in a direction such that actual flow is greater than indicated, and that the D loop error diminishes to 1% of maximum flow at approximately 30 gpm.

Analysis

A search was made of all known pertinent documentation: SAR, operating procedures (normal and EOPs), STP-085/4, ECCS Training Manual, and the original Station (Design) Manual. The result of this search is that there is no identified requirement to control (and therefore to indicate) flow below 100 gpm. Minimum continuous flow through each pump is 105 gpm. The minimum "balanced" flow per STP-085/4 is 100 gpm per loop. The Instrument Engineers Handbook states that a turn-down ratio of 10:1, i.e. attempting to read 60 gpm out of 600 gpm, is very marginal for most flow instrument loops. This is substantiated by Calculation No. Z-SIM-I0100 (Attachment 2) which shows that the HPI flow nozzles, themselves, are not accurate below about 60 gpm.

The effect of system pressure on the zero shift was calculated for all four (4) transmitters at various pressures, resulting in the curves shown in Figure Nos. 2, 3, 4, and 5. These curves indicate that, with proper selection of the calibration pressure, the zero error can be caused to always be in a minus direction (indicated flow less that actual). For example, on the A loop (worst case), indicated flow could vary from 60 gpm, at 3000 psig header pressure, to 100 gpm at 600 psig, for an actual flow of 100 gpm (Calculation No. Z-SIM-I0099, Attachment 3, substantiates these curves).

Rev 2. →
←

In actual operation, pump discharge header pressure will not vary as much as this example, therefore errors will be smaller.

The potential for significant errors being caused by the zero shift problem was reviewed for all Rosemount dp transmitters in Class 1 service. This included the level transmitters shown in Attachment 1, plus RCP Seal Injection, AFW, and DH flows. It was determined that all flow transmitters plus Pressurizer level would be tested to determine if a significant zero shift error existed.

Conclusions

1. The flow indication errors, induced by zero shift characteristics, which were in existance during the 10/2/85 trip, as indicated by as-found calibration data, did not jeopardize the proper function of the HPI system. Actual flow was greater than indicated for all nozzles except for D, which was well within reasonable tolerances.

2. HPI flow indication below 100 gpm is not necessary for proper operation of the HPI system. Since the pressure shift error is repeatable, indicated flow can still be used to provide the operator with adequate information to perform his function.

3. The capability to use the existing instrumentation will require selective calibration of each transmitter considering its unique characteristics, and notification of the operators of this situation.

4. Additional work should be performed to address other types of errors in the HPI flow loop, the significance of the pressure shift on other dp applications, and to develop short and long term projects to upgrade HPI flow indication.

Action Items

1. Nuclear Operations to recalibrate HPI transmitters to assure that indicate flow is below actual flow as noted in Figures 2, 3, 4 and 5.

2. Nuclear Engineering to develop numan engineered method to alert operators that lower portion of indicators are not accurate.

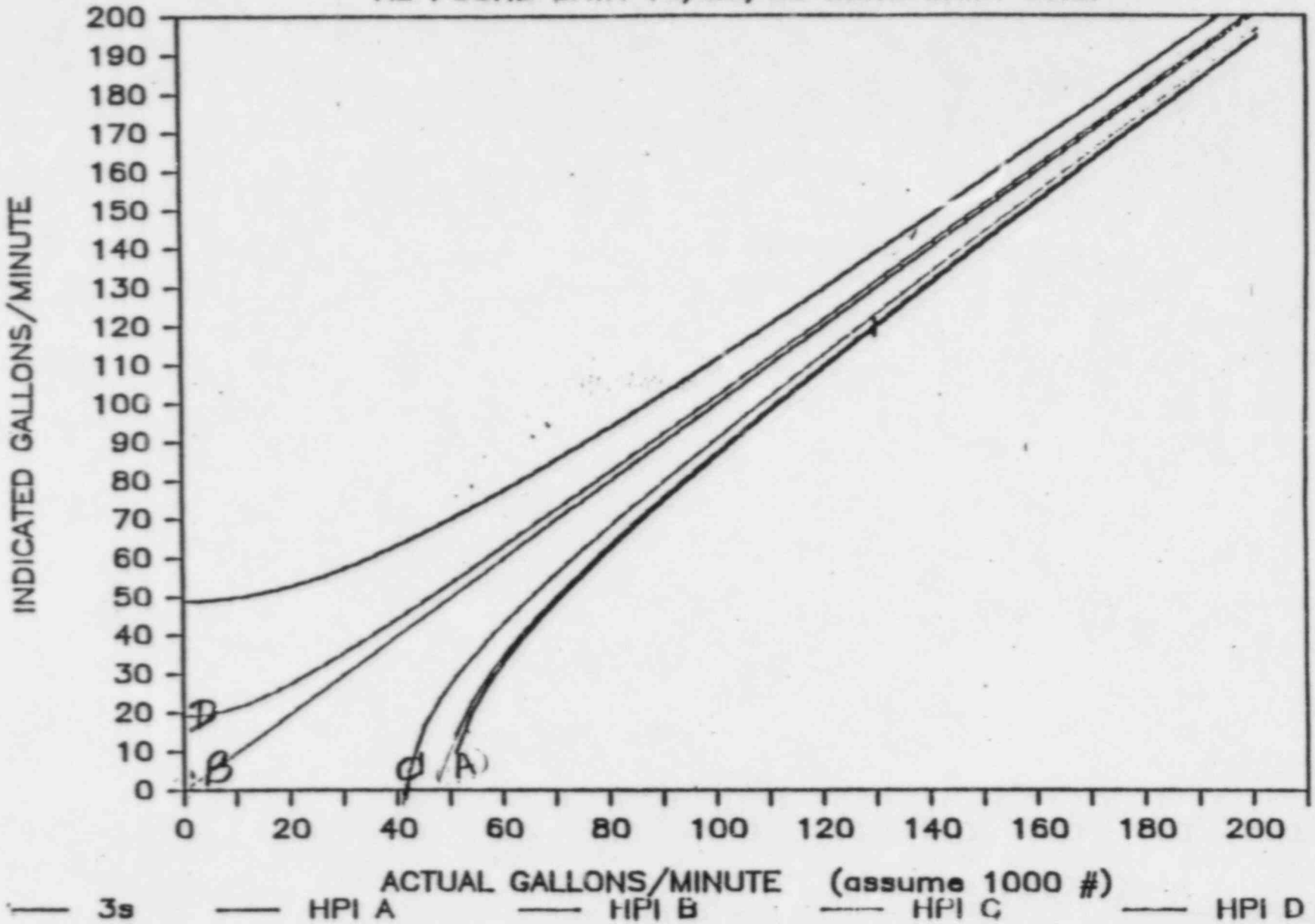
3. Nuclear Operations to notify operators of HPI flow accuracy limitations.

4. Nuclear Engineering to evaluate short/long term upgrade of HPI flow, submit Pre-Mods as appropriate.

5. Nuclear Operations to determine zero shift characteristics of other Rosemount dp transmitter applications, specifically for Pressurizer level, RCP seal injection flow, AFW flow, and DH flow.

HPI DP FLOW ERROR

AS FOUND DATA 10/26/85 ZERO SHIFT ONLY

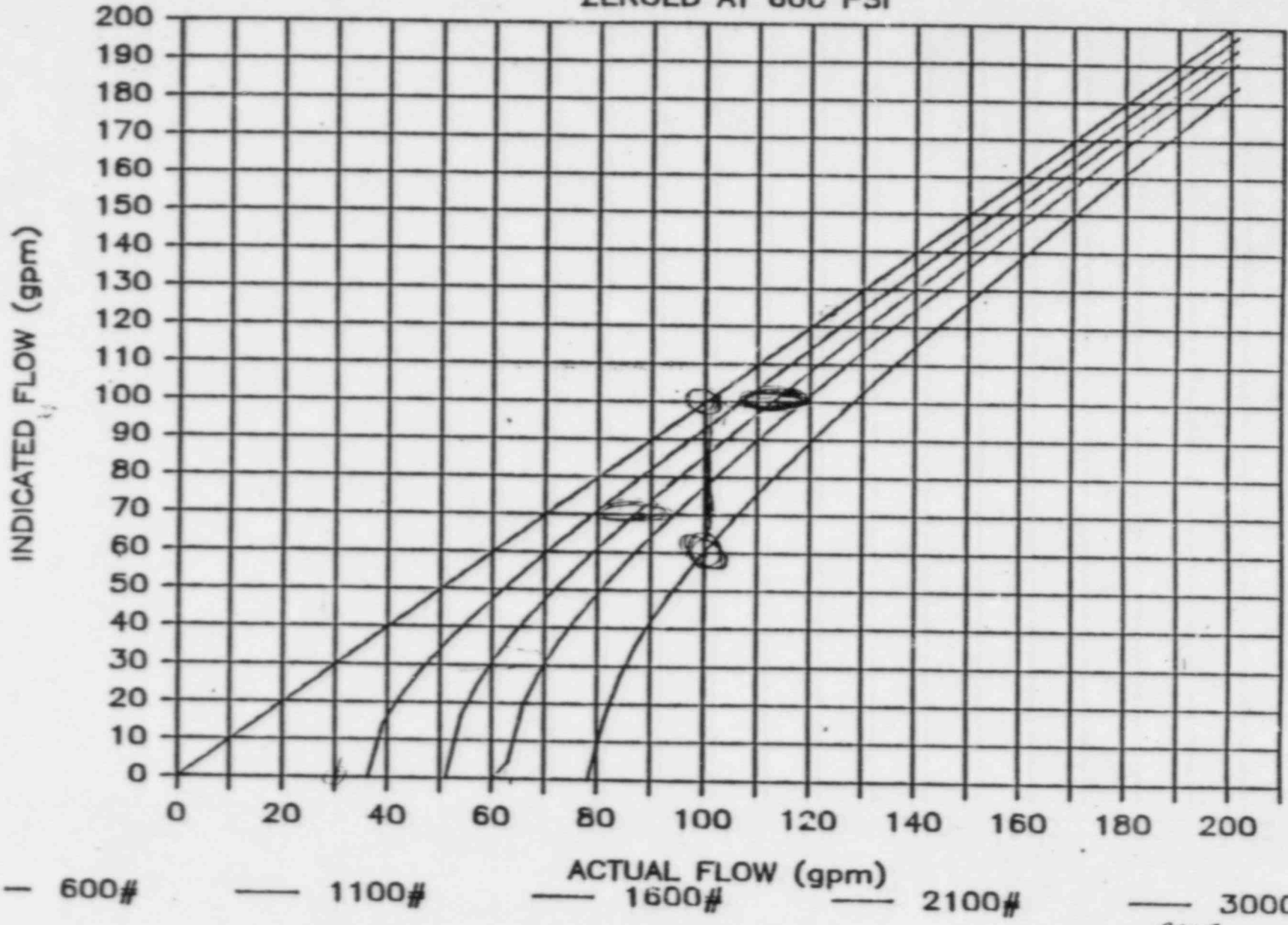


NCR S-5150 Figure 1

MCB 10-28-85

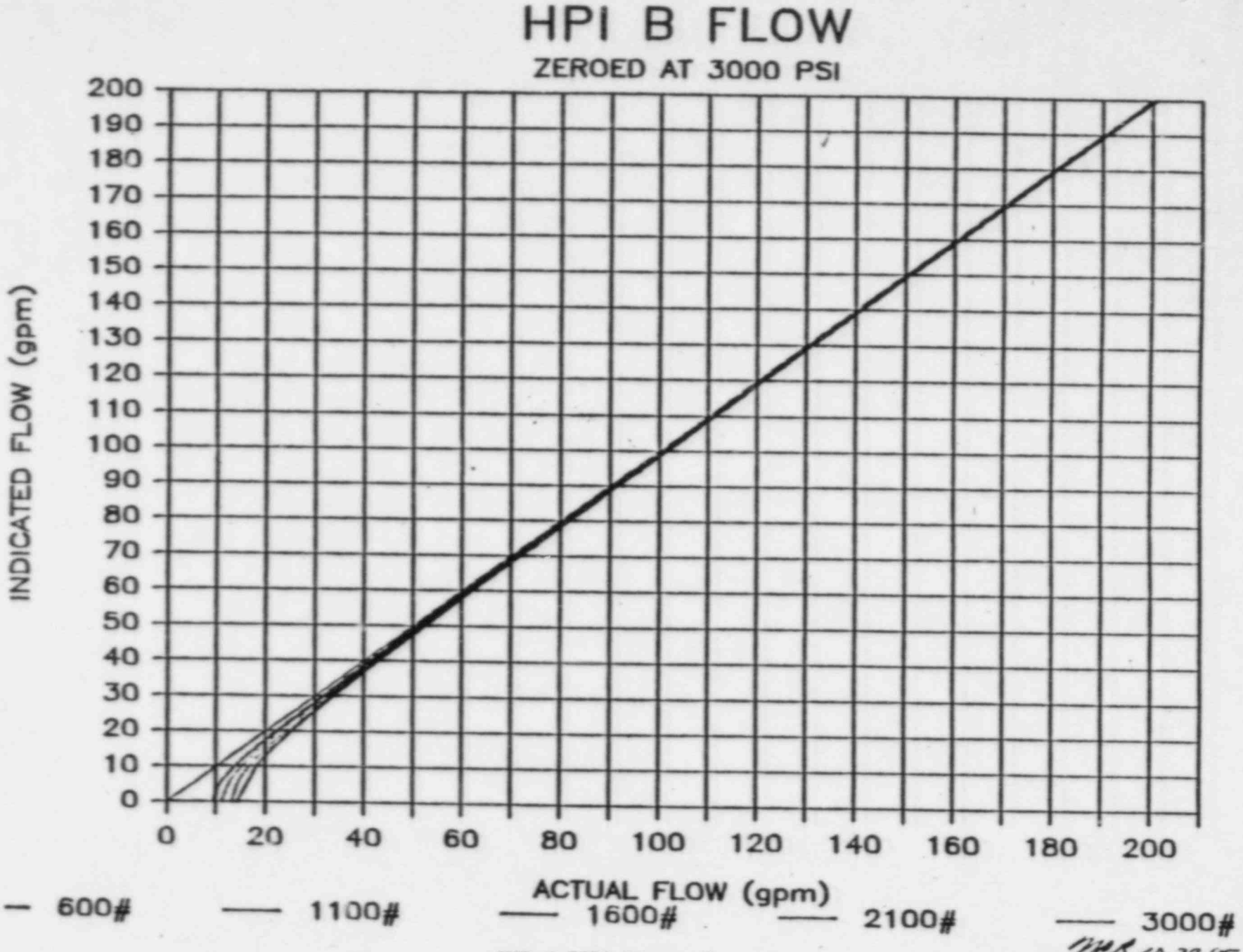
HPI A FLOW

ZEROED AT 600 PSI



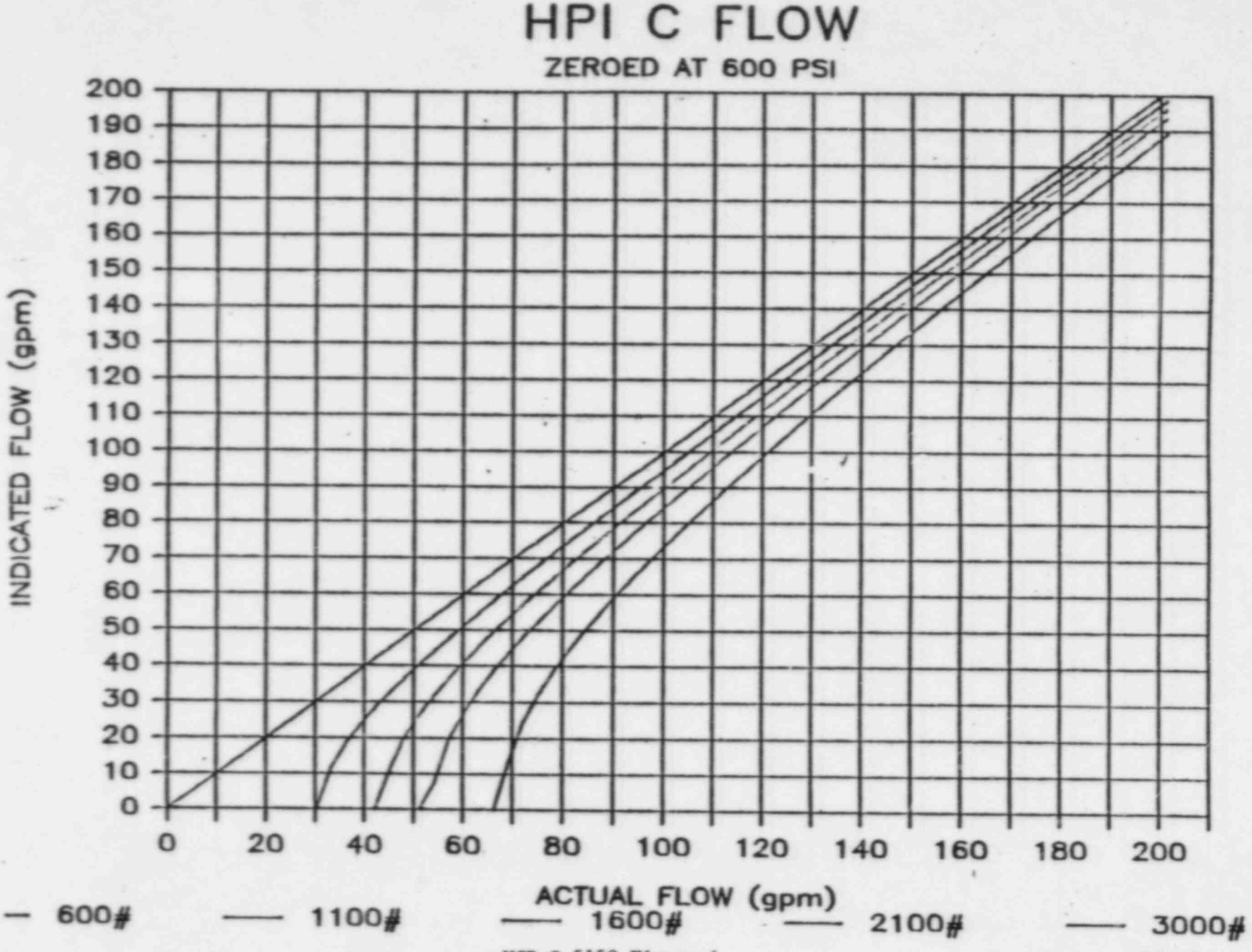
MCB 10-28-85

NCR S-5150 Figure 2



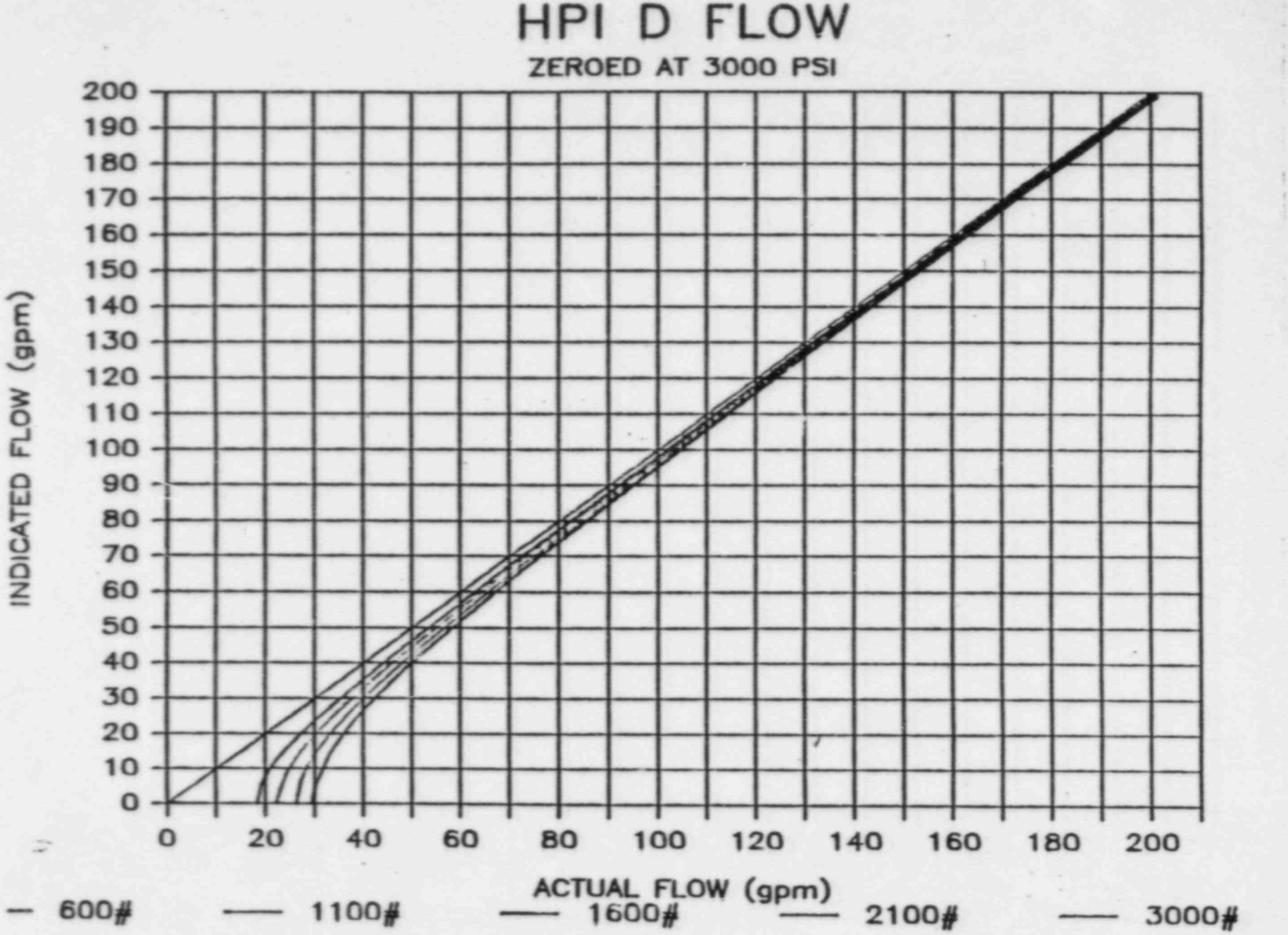
NCR S-5150 Figure 3

10-28-85



NCR S-5150 Figure 4

WEB 10-29-85



NCR S-5150 Figure 5

MB 10-8-85

ROSEMOUNT LEVEL TRANSMITTERS
(Zero Shift Due to Process Pressure)

Function	Type	Zero Shift Per 1000 psig	Assumed Process Press.	Process	Zero Shift Error
OTSG	1153DD5	±0.2%	1000 psig	641" to 63"	1.5"
CFT	1153DD5	±0.2%	600 psig	0 to 14'	0.9"
Prz. Lvl.	1153HG5	±0.66%	2200 psig	0 to 320"	10.89"
Cst. Lvl.	1155HB5	±0.66%	20 psig	0 to 50'	0.11"

MB 10-28-85

SACRAMENTO MUNICIPAL UTILITY DISTRICT

OFFICE MEMORANDUM

TO: J.V. McColligan

DATE: October 28, 1985
85-28

FROM: Norm Brock NCBrock

SUBJECT: **HPI FLOW INDICATION PROBLEM**

The investigation of the HPI flow problem has resulted in the identification of a previously unidentified error in our HPI flow indications. The PRC has determined that a 10CFR-21 Report is justified, and Nuclear Notepad has been notified to alert other utilities of a possible problem.

The instruction manual for the Rosemount 1153HB6 pressure transmitters used for high pressure injection flow measurements here at Rancho Seco has a serious ommission. There is no instruction to provide a calibration that takes into account the large zero shift caused by system operating pressure changes. In fact this zero shift is not mentioned. A calibration performed by these instructions can result in large flow errors at low system flows.

This was the cause of the apparent flow anomaly in the high pressure inject system A nozzle during the October 2 incident. Even though this characteristic of the transmitter is not described in the supplied vendor manual, it is described in the other vendor literature. This literature states that a maximum of .66% of the upper range limit per 1000 lbs. process pressure can result. Attachment 1 shows the differential pressure (dp) vs flow for the installed flow elements. It is apparent that the dp produced by the element is based on the square root of the flow-ie a dp error of -20 inches at 300 GPM actual flow results in an error of approximately -15 GPM. The same -20 inch dp error at 85 GPM actual flow where dp is only 20 inches results in an indication error of -85 GPM, and an indication of zero.

This error of -20 inches dp almost exactly corresponds to the error of the A HPI transmitter at a system pressure of 3000 psi and agrees with the observed results of the Oct. 2 event and STP-180 and 184 data.

Rosemount has verbally stated that the zero shift with system pressure is a characteristic for a particular transmitter and is a constant and will not change with other system parameters. Therefore, it is possible to measure that shift for a particular transmitter and calculate the error in indicated flow at any given static pressure. The four HPI pressure transmitters have been tested and exhibit the following characteristics:

1) HPI A flow error is approximately -.69% per 1000 lbs.
2) HPI B is approximately +.05% per 1000 lbs.
3) HPI C is approximately -.48% per 1000 lbs.
4) HPI D is approximately +.1% per 1000 lbs.

This static pressure induced error can be zeroed out at any particular pressure, and for a range of system pressures, the indication error can be calculated for the entire range. These calculated errors have been determined and compared with the required characteristics for the HPI flow instrumentation. HPI system pressure can be expected to range from approximately 600 lbs. to 3000 lbs. The flow error for the A and C transmitters is a negative error, this means that as static pressure increases the indicated flow decreases. Transmitters B and D both have a positive error. This means that as static pressure increases the indicated flow increases.

The criteria has been established that at no time will actual flow be less than the indicated flow. In order to meet this criteria several considerations must be met. Transmitter A and transmitter C must be zeroed at a pressure at the bottom of the operating pressure range. Transmitter B and D have to be zeroed at a pressure at the top of their operating range. This assures that the errors in indicated flow are always negative. At high operating pressures such as those which we normally encounter for HPI injection under normal, non-accident conditions, there is no serious concern of pump run out. Pump run out can only occur at low system pressures.

At 1600 lbs., the automatic initiation point for safety features, automatic flow balancing occurs equalizing the flow in the 4 lines at 125 GPM each. This 125 GPM flow is sufficiently large to ensure that all 4 flow meters are on scale. If system pressure then decays towards 600 lbs. the indicated flow from the worst transmitters, transmitters A and C becomes increasing accurate. With indicated flow equaling actual flow at 600 lbs. system pressure. Transmitters B and D become less accurate at these low system pressures, but the maximum flow error in transmitter D only approaches 30 gallons per minute error at zero actual flow. The operator can be sure that his indications will be either accurate or lower than actual flows, he can use the limit switch lights on his valves to indicate valves closed and therefore zero flow.

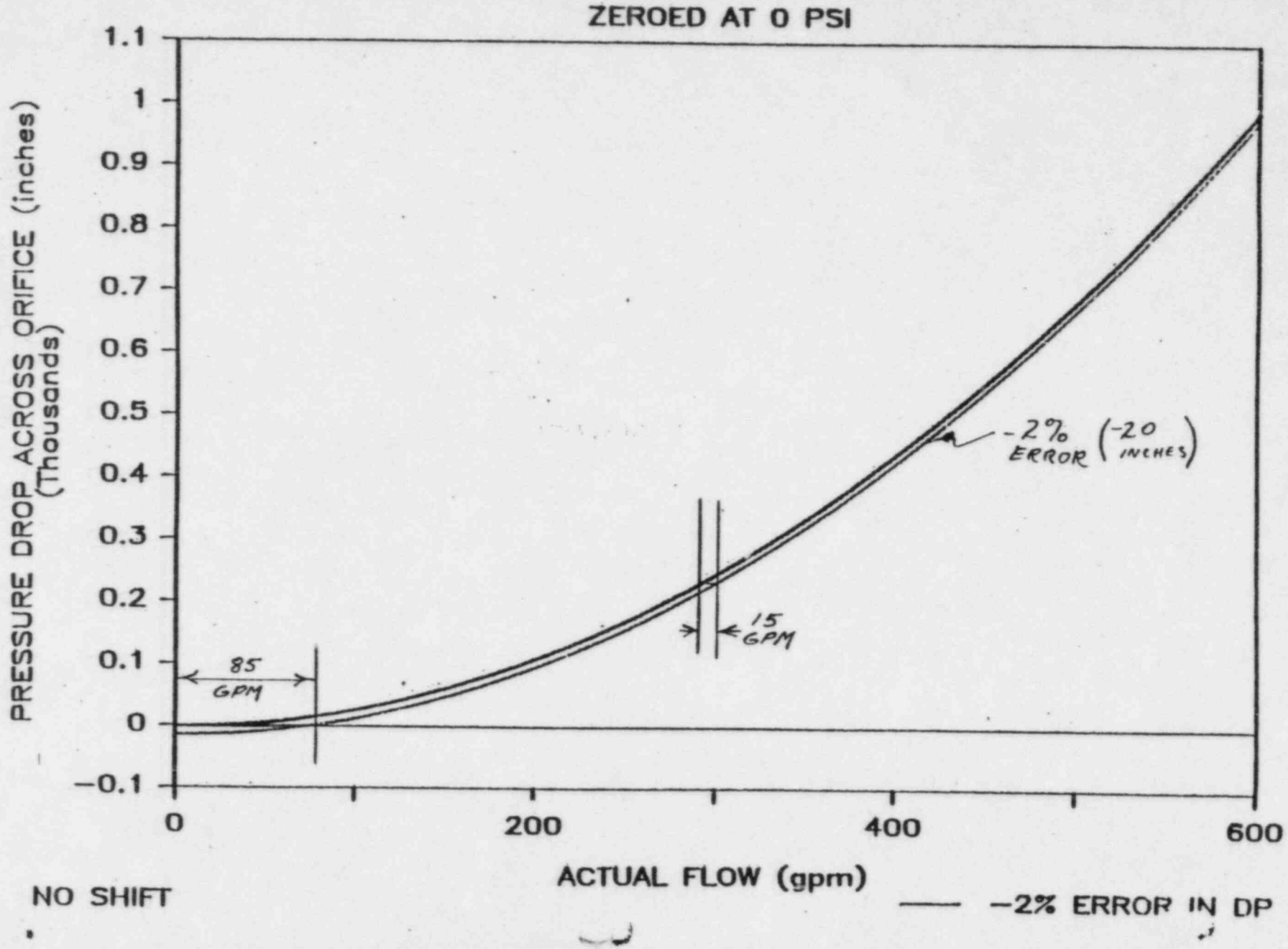
Indicated vs actual flows are shown on attachment 2-5 for a range of system pressures. These curves demonstrate that the indicated flows are indeed always less than actual flows and that at the flows of normal interest, namely greater than 90 gallons per minute, the flow errors are acceptabley small. At 1600 lbs. when the flows are automatically balanced all four flows read within 30 GPM of the 125 actual.

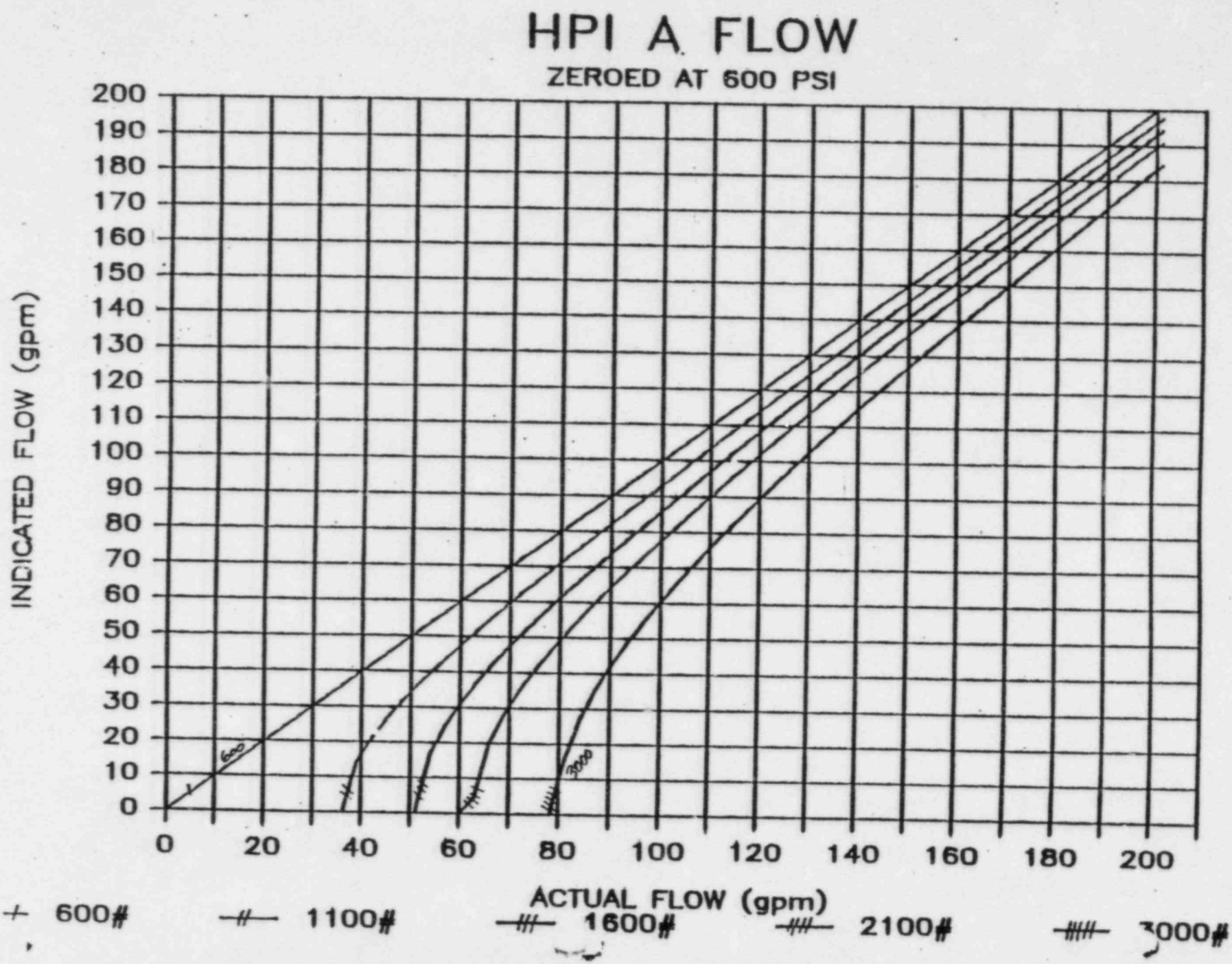
Other applications of these transmitters have been identified and the errors due to static pressure zero shift are being evaluated. A preliminary look indicates that the only concern will probably be the pressurizer level, which may have an error as large as ± 11 inches. It should be possible to zero out this error at system pressure.

Attachments

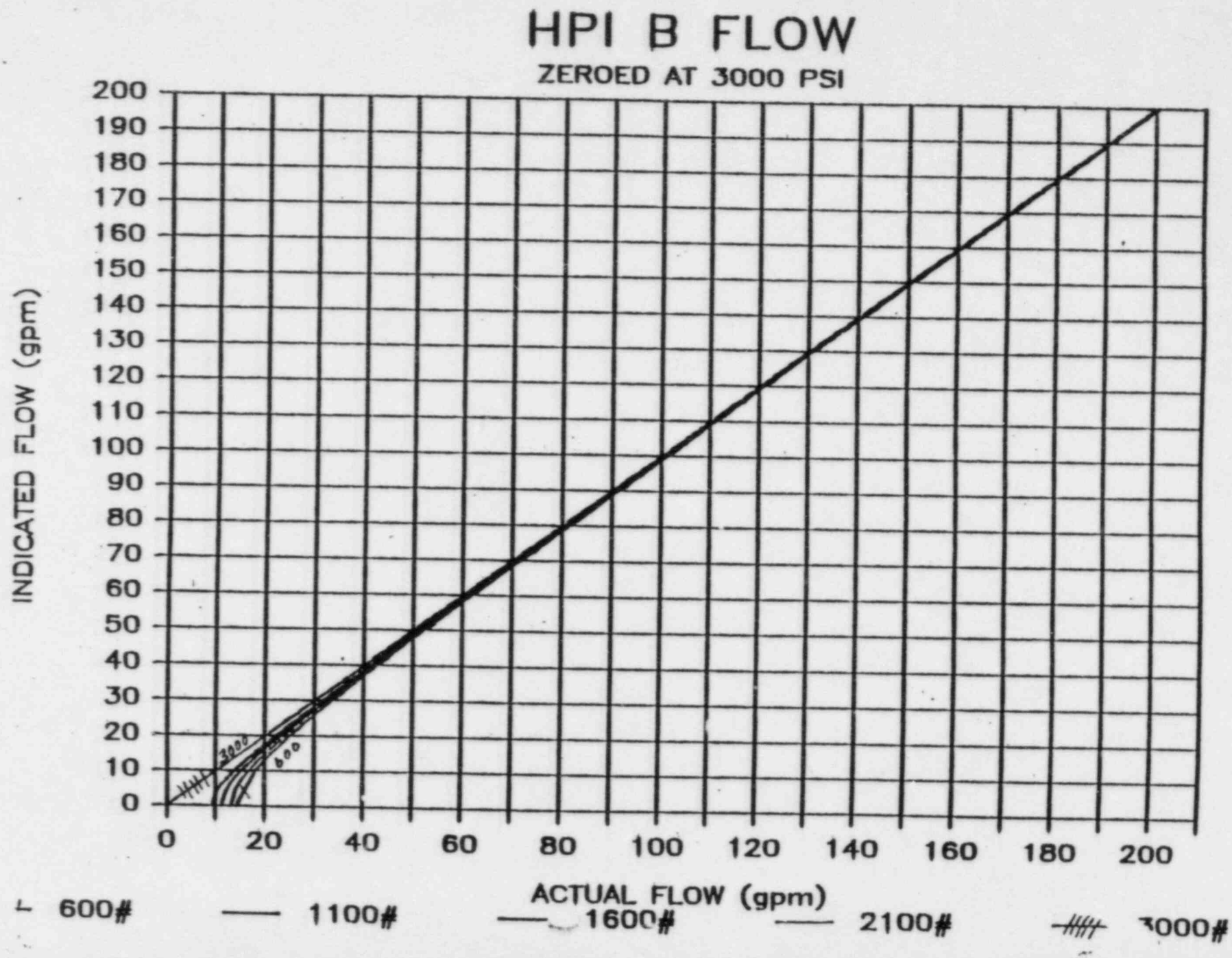
cc: S. Redeker
J. Field
J. Williams

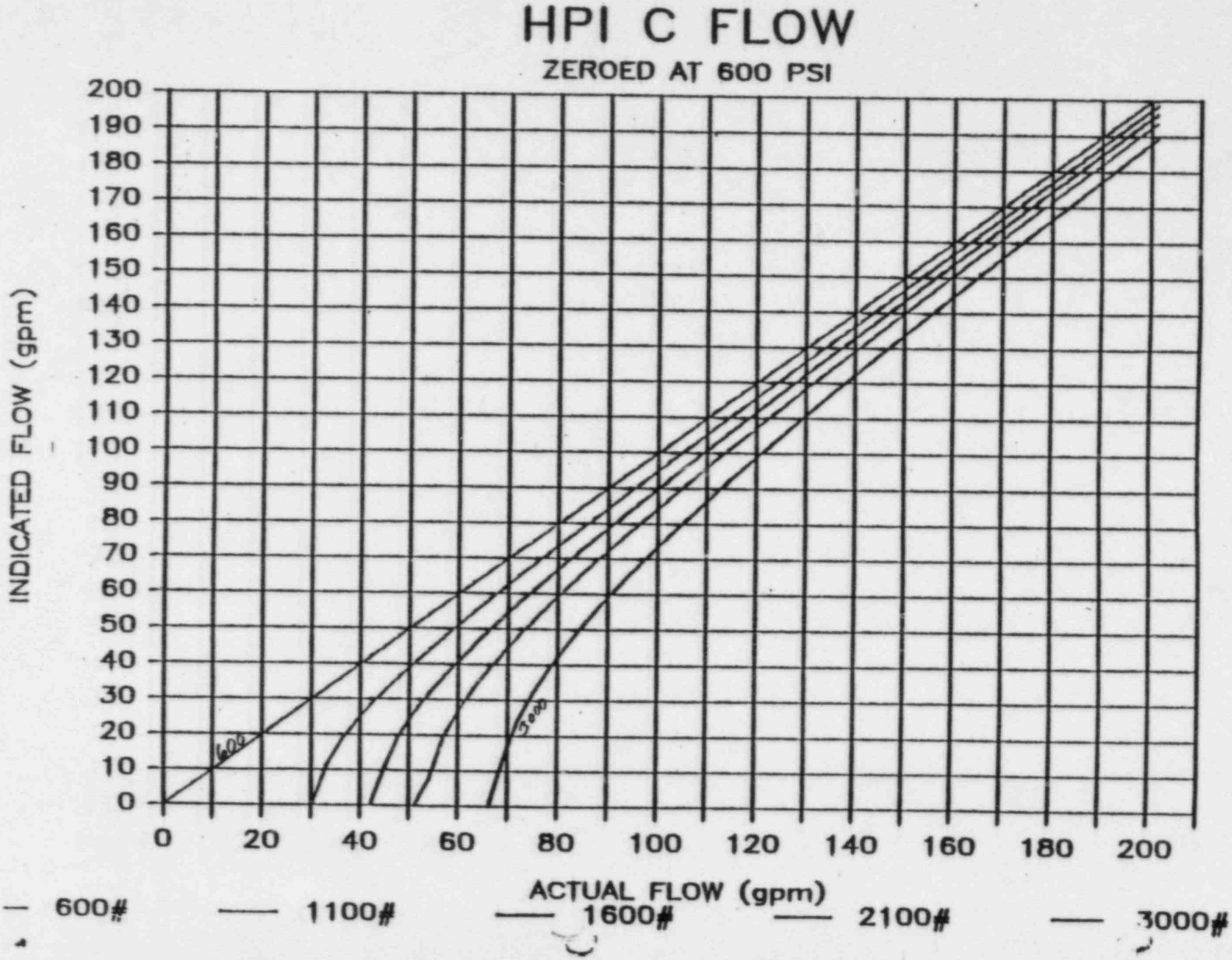
HPI FLOW VS. MEASURED DELTA PRESSURI



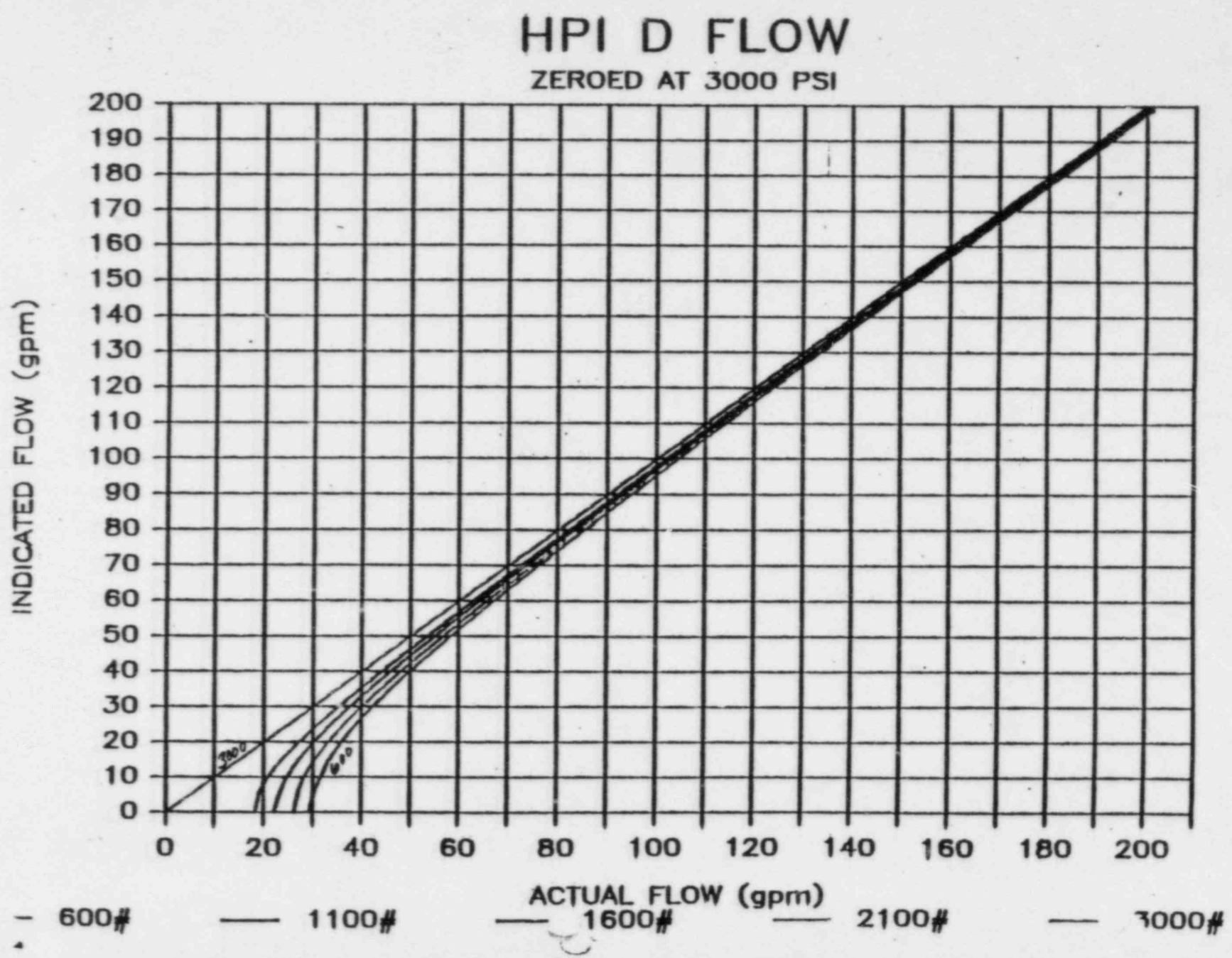

HPI A FLOW
ZEROED AT 600 PSI
INDICATED FLOW (gpm)
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
20
40
60
80
100
120
140
160
180
200
ACTUAL FLOW (gpm)
600
3000
600#
1100#
1600#
2100#
3000#

Attachment 3




HPI C FLOW
ZEROED AT 600 PSI
INDICATED FLOW (gpm)
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
20
40
60
80
100
120
140
160
180
200
ACTUAL FLOW (gpm)
600#
1100#
1600#
2100#
3000#

Attachment 5



SMUD

RANCHO SECO NUCLEAR GENERATING STATION NCR S-5150 Attachment 3

CALCULATION COVER SHEET

SUBJECT HPI Flow meter

CALC. NO. Z-SIM-I0099
FILE NO. 1019.115
QUALITY CLASS 1
SAFETY CLASS F
SEISMIC CLASS 1

ORIGINATOR SIG. Paul L Johnson DISCIPLINE I & C DATE 10.28.85
CHECKER SIG. Jogendra Singh Bagga DISCIPLINE I & C DATE 10/28/85

RECORD OF ORIGINAL ISSUE AND REVISIONS

REV. NO.	REVISION DESCRIPTION	DATE	ORIG	CKR	SUPVY REVIEW	NUCLEAR ENGRG ACCEPTANCE DOE	DSE
0	ISSUE (ORIGINAL)	10.28.85	PLJ	JSB	JU 10/28/85		

RESULTS OF CHECKER REVIEW

ITEM DESCRIPTION		ORIG. ISSUE	REVISION NO.					
MUST INITIAL ONE: FINAL RESULT NUMERICAL DIFFERENCES ARE NOT SIGNIFICANT; NO CORRECTIONS NECESSARY	INITIAL	JSB						
	DATE	10/28/85						
FINAL RESULT NUMERICAL DIFFERENCES ARE SIGNIFICANT. NECESSARY CORRECTIONS HAVE BEEN MADE.	INITIAL							
	DATE							
CHECK MADE BY ATTACHED ALTERNATE CALCULATIONS.	INITIAL							
	DATE							

Name	Sig.	Initial
PAUL L. JOHNSON	Paul L Johnson	PLJ
JOGENDRA SINGH BAGGA	Jogendra Singh Bagga	JSB

SMUD-1418 10-84

SMUD

CALCULATION COVER SHEET

SACRAMENTO MUNICIPAL UTILITY DISTRICT ☐ 6201 S Street, P.O. Box 15830, Sacramento CA 95852-1830 (916) 452-3211

SUBJECT: HPI FLOW ELEMENT; LOW FLOW LIMIT			CALC. NO.: I-51M-I0100
			FILE NO.: S-5150
			QUALITY CLASS: N/A 1
ORIGINATOR SIGNATURE: H.I. BEESE	DISCIPLINE: I & C	DATE: 27 OCT. 85	SAFETY CLASS: 1
CHECKER SIGNATURE: Paul L Johnson	DISCIPLINE: I & C	DATE: OCT 27, 85	SEISMIC CLASS: N/A 1

RECORD OF ORIGINAL ISSUE AND REVISIONS

REV. NO.	REVISION DESCRIPTION	DATE	ORIG.	CKR.	SUPVY. REVIEW	NUCLEAR ENGRG ACCEPTANCE: DE	SE
0	ISSUE	27 OCT 85	HIB	PLJ	JW 10/28/85		

RESULTS OF CHECKER REVIEW

	ITEM DESCRIPTION		ORIG. ISSUE	REVISION NO.					
MUST INITIAL ONE	FINAL RESULT NUMERICAL DIFFERENCES ARE NOT SIGNIFICANT; NO CORRECTIONS NECESSARY.	INITIAL	PLJ						
		DATE	10-27-85						
	FINAL RESULT NUMERICAL DIFFERENCES ARE SIGNIFICANT, NECESSARY CORRECTIONS HAVE BEEN MADE.	INITIAL							
		DATE							
	CHECK MADE BY ATTACHED ALTERNATE CALCULATIONS.	INITIAL							
		DATE							

NAME	SIGNATURE	INITIAL
H.I. BEESE	H.I. Beese	HIB
PAUL L. JOHNSON	PL Johnson	PLJ

SMUD-1418 10/84

RANCHO SEC[illegible] REQUIRES CLOSURE PRIOR TO STARTUP

NONCONFORMING REPORT

Page 1 of 8 No. S 5150 Rev. 1

I. DESCRIPTION OF NONCONFORMANCE with attachments

Quality Class 1 EQ Item: ☒ Yes ☐ No Date 10/24/85

System SIM Equipment I.D. No. FT-23807 Location Aux -20'

Equip. Name HPI Flow A P. O. / Contract No. NCR ECN No. A-3651E MOD No. 11 Work Request No.

~~NCR~~ VOID

~~DISCREPANCY~~ testing of ~~HPI~~ flow A indicated that installed flow transmitter FT-23807 signal was approximately 75 GPM low.

Rev 2 issued
The worst case example stated in the analysis section was revised. The revision has no impact on the disposition QAC 11/2/85

NUCLEAR ENGINEERING

NUCLEAR OPERATIONS

QUALITY ASSURANCE Clarence L. Coleman 11-2-85

PREPARED BY Jeff Irwin EXT.

II. DESIGN REVIEW AND 10 CFR SECTION 50.59 REVIEW REQUIRED

☒ Yes, 50.59 Log No. 699, ☐ No Oper. ☒, Non-Oper. ☐

COGNIZANT ENGINEER ASSIGNED J. Williams x 4986

W M Leiby 10-29-85
MANAGER, NUCLEAR OPERATIONS DATE

DATE DISPOSITION DUE 10-29-85

III. DISPOSITION ACTION: ☒ ACCEPT (3) ☐ REJECT ☒ REPAIR (1&2) ☐ REWORK ☐ REPLACE

THIS DISPOSITION AND TECHNICAL JUSTIFICATION WILL REQUIRE: *(Any "Yes" Decision Requires a Buy-Off in Section VII)*

► A Design Calculation ► A Design or Drawing Change ► A Retest of the System / Unit

☒ Yes ☐ No ☐ Yes, ECN or Trans. No. ☒ No ☒ Yes, Test No. I-038 ☐ No

Z-SIM-I0099
Z-SIM-I0100

1. Recalibrate all four (4) HPI transmitters to assure that indicated flow is always less than or equal actual flow, per attached technical justification. Revise I-038 to test zero-shift characteristics. (N.O.)

2. Provide a method to identify to the operator that flow indication below 100 gpm is questionable. (N.E.)

3. Determine as-found zero shift characteristic of Prz. Level, RCP Seal Inj. flow, AFW flow, and DH flow transmitters. (QA to verify)
Note: VERIFIED BY QA ON 10/30/85 – Del Dunnett 10/30/85

J. Williams EXT. 4986 10/29/85
COGNIZANT ENGINEER DATE

REQUIRES CLOSURE PRIOR TO STARTUP

REQUIRES CLOSURE PRIOR TO STARTUP

III A. CAUSE OF NONCONFORMANCE

Inherent characteristic of flow transmitter.

J. Williams 10/29/85
COGNIZANT ENGINEER DATE

III B. ACTION TAKEN TO PREVENT RECURRENCE

None, error will be compensated for otherwise (Items 1 thru 3 above).

Clarence L. Coleman 10-29-85
QUALITY ASSURANCE ENGINEER DATE

IV. ENGINEERING REVIEW BOARD *(required on all accept/repair dispositions)*

OK from QA standpoint, but provide recalibration results to QA when recal. done
CLK 10/29 GE COOKE

W M Leiby 10-30-85
MANAGER, NUCLEAR OPERATIONS DATE

Dennis 10/29/85
MANAGER, NUCLEAR ENGINEERING DATE

Del Dunnett 10/30/85
MANAGER, QUALITY ASSURANCE DATE

SCHEDULING OFFICE *(if applicable)* 105423, 105424, 106144

Work Request No(s) 105421, 105422, 77 ECN No. —

VI. REPAIR/REWORK/REPLACE COMPLETE and ACCEPTABLE
Item 1 only SN Lewis 10-31-85

INSPECTOR DATE

VII. DOCUMENTATION/RETEST COMPLETE and ACCEPTABLE

☐ Design Calculation Released
☐ ECN or DCN Released
☐ Retest Complete and Acceptable

ENGINEER/INSPECTOR DATE

VIII. NCR CLOSED

QUALITY ASSURANCE SUPERVISOR DATE

SMUD-0034 4/85

Part I: Auxiliary Feedwater Control Logic Modification

I. Purpose of Design Change

A. Initiate ICS control of AFW valve on same parameter as that which initiates AFW pumps, low MFWP discharge pressure.

B. Reduce probability of loss of AFW during re-establishment of MFW.

II. Summary of Change

A. Scope

The work to be performed is entirely in the ICS cabinets. This change will modify relay logic for initiation of AFW auto flow control and MFW block valves. No other systems are affected.

Wiring will be removed from contacts of 86-1/AFWPT and 86-1/BFWPT and added to spare contacts of 86/AFWPL and 86/BFWPL.

B. Design Basis

Improve probability of AFW successfully completing its design function on demand.

C. Equipment Class & Power Requirements

SMUD QA Class 2. No modifications to existing power is required.

D. Testing

A special test procedure has been written and approved by the Plant Review Committee. Testing was completed on October 25.

III. Calculations and Design Information

A. Design Features

Currently, "A&B MFW pump tripped" affects three ICS functions:

- Pseudo Auto MFW pump control
- MFW Block Valve
- AFW Valve Control

This modification has the following impact:

Pseudo Auto Control - No change.

MFW Block Valves - The "A&B MFW pumps tripped" signal will be replaced with the "MFW pumps discharge pressure low" signal. The remainder of the logic will remain the same (4RCP's tripped to close the block valve). (Rev. 1

AFW Valve Control - The "A&B MFW pumps tripped" signal will be replaced with the "MFW pumps discharge pressure low" signal. This signal will allow the ICS to control the AFW valves on low OTSG level.

B. Functional Description

The two functional signals associated with this ECN are "MFWP low discharge pressure" and "MFW pumps tripped " "MFWP low discharge pressure" provides the best indication of MFW status. "MFWP trip" provides the best indication of MFWP not running.

- Signal to initiate ICS control of AFW flow valves will be "MFWP low discharge pressure" vs. current "MFWP trip" signal.

- Signal to MFW block valve logic will be MFWP low discharge pressure vs. current MFWP trip signal; however, it shall require at least 1 RCP tripped to activate this function, as at present.

- Signal to pseudo auto logic which is used to run MFWP speed demand to minimum will still require the MFWP trip signal in order that the MFW pumps may be started without requiring the logic to be disabled.

- Signal to ICS runback logic will remain MFWP low discharge pressure.

IV. Logic Diagram

The logic diagram from the Design Basis Report is attached. (See Figure A)

NOT ORIGINAL

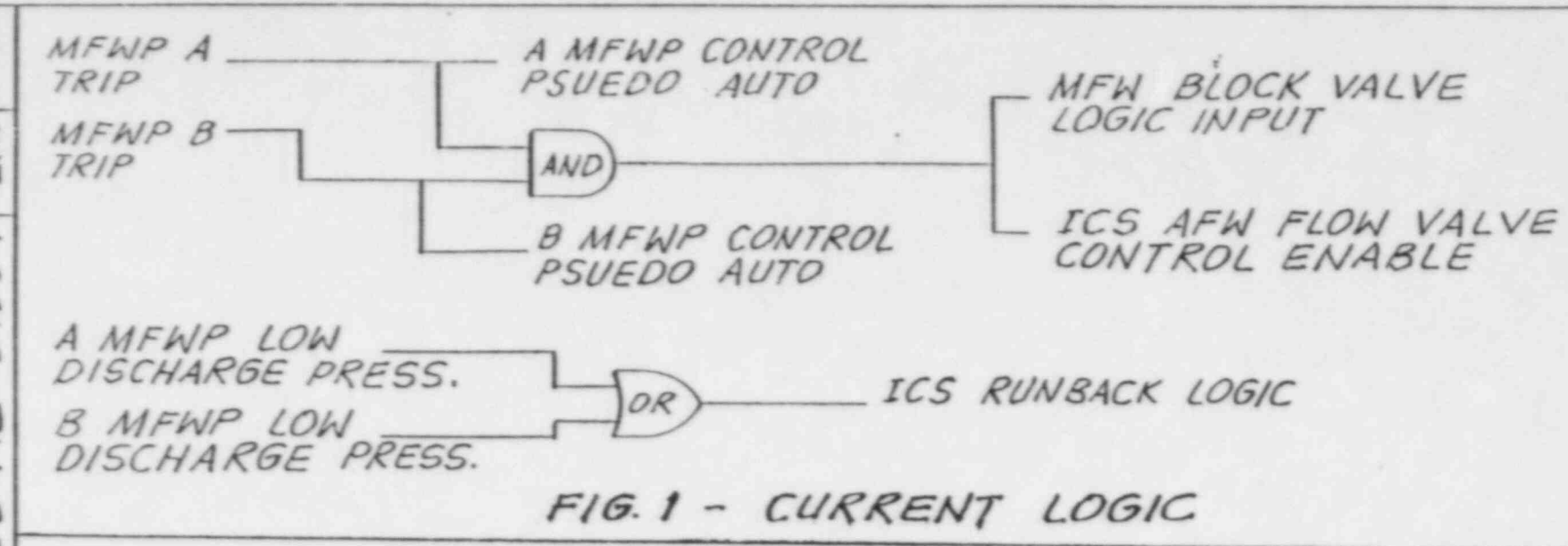


FIG. 1 - CURRENT LOGIC

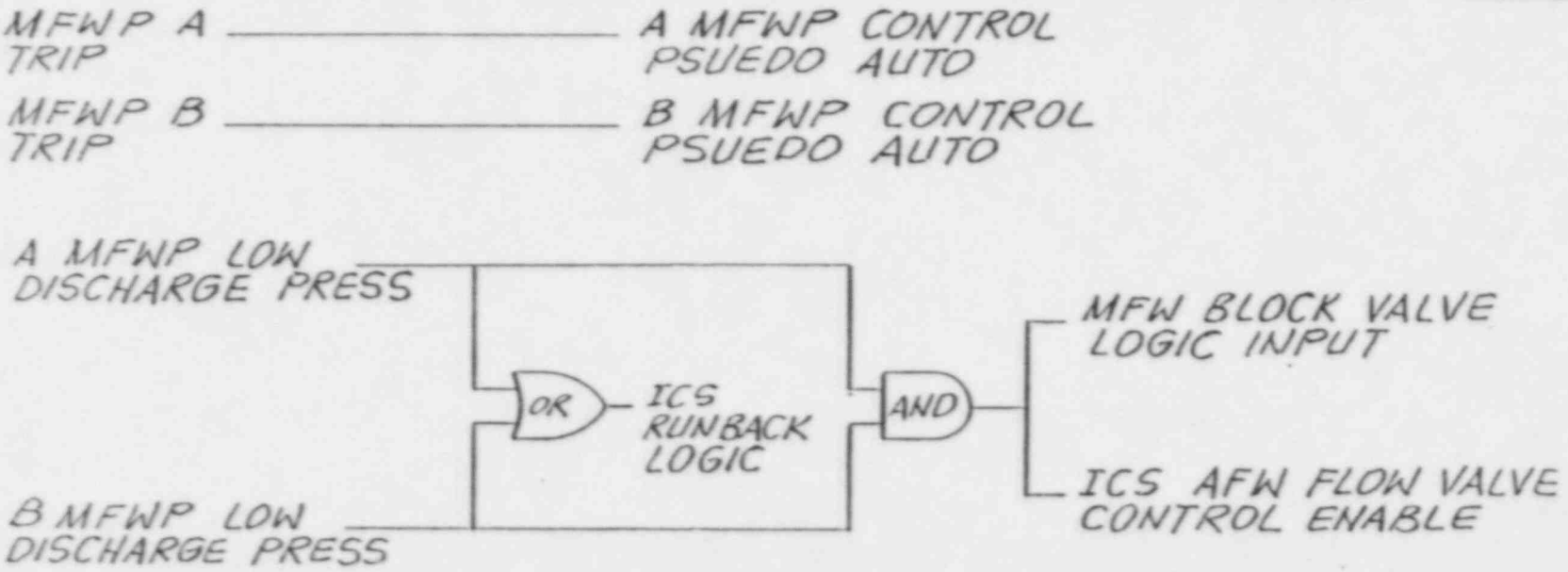


FIG. A - POST ECN CHANGE LOGIC

1 | JNI | LOGIC DIAGRAM

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT

DBR 1 R0196

ATTACHMENT 5

Rev. 1

Part II: Auxiliary Feedwater/Main Feedwater Failure Analysis

The NRC requested information regarding single failures as relating to MFW/AFW during the phone conversation of October 25, 1985. A particular question raised was: "Is there a scenario in which one failure in the ICS could close all four MFW valves, interrupting MFW to both OTSG's, and not result in automatic start of AFW flow?"

The ICS controls the MFW valves and the automatic OTSG level control AFW valves. Since the ICS is control grade and not designed to single failure criteria, it cannot be conclusively stated that the above scenario is impossible. The following discussion, however, shows that there is no single failure which can interrupt MFW flow and result in the inability to manually from the control room, provide AFW flow in a timely manner using class 1 equipment which is completely independent of the ICS.

The design of the AFW system was presented in detail to the NRC staff during the October 23, 1985, meeting in Bethesda. It was clearly shown that there are two separate and distinct activate/control systems and flow paths within AFW (see Figure B attached). Either system can supply AFW to the OTSG's regardless of failures in the other. The systems are briefly described below.

1) The first system is the ICS Control/Class 1 Pump Start System. It automatically starts and controls OTSG level when loss of feedwater/main feedwater pumps is sensed by low main feed pump discharge pressure or when all four (4) RCP's trip. Manual start and flow control is available in the control room.

   The control grade ICS, which also controls MFW, operates one of two parallel flow path valves to each OTSG (FV 20527 OTSG A, FV 20528 OTSG B). The other flow path to each OTSG is a class 1 safety feature (SFAS) valve (SFV 20577 OTSG A, SFV 20578 OTSG B). The ICS controlled FV's automatically operate to control OTSG level once main feed pump discharge pressure drops below 700 psig. A class 1 circuit (independent of SFAS) automatically starts both AFW pumps (P319 motor and P318 turbine drive) when main feed pump discharge pressure drops below 850 psig. The pumps and valves also automatically operate when all four (4) RCP's are not running, as sensed by class 1 underpower/phase imbalance monitors.

2) The second system is the Class 1 Safety Feature Activation System (SFAS). This system provides automatic AFW pump start and flow to the OTSG's when LOCA conditions are sensed. Class 1 manual start and flow control is available in the control room.

   The SFAS system operates the second of two parallel flow path valves to each OTSG (SFV 20577 OTSG A, SFV 20578 OTSG B). The other flow path to each OTSG is through an ICS controlled valve described above. The SFAS valves automatically fully open and the AFW pumps automatically start to provide AFW flow to the OTSG's upon low RCS pressure (1600 psig) or high reactor building pressure (4 psig).

The SFAS system is completely independent of the ICS/Class 1 Pump Start System. Thus, it follows that there is no single failure which could cause loss of main feedwater flow (for example, closure of all ICS controlled main feedwater control valves), and cause the inability to provide AFW flow with the SFAS system. SFAS system AFW flow would require manual control room pump start and flow control since SFAS does not detect loss of main feedwater.

Manual AFW flow start will be rapid and effective because there are specific symptom based Emergenc Operating Procedures (EOP's) and extensive operator simulator training regarding loss of main feedwater events. The loss of main feedwater would result in a reactor trip on either anticipatory trip on loss of main feedwater pump control oil pressure or high RCS pressure due to reduced primary to secondary heat transfer. Upon reactor trip, the operators immediately implement the EOP's which require them to constantly monitor for three main symptoms of off-normal conditions:

a) Lack of subcooling

b) Lack of primary to secondary heat transfer (overheating)

c) Excessive primary to secondary heat transfer (overcooling)

Rapid identification of loss of main feedwater (overcooling) will occur because there are numerous alarms and indicators which will alert the operator. The operators receive extensive simulator training in recognizing the three main off-normal symptoms. Among the main annunciator audible alarms and other indicators are MFP discharge pressure low alarm, MFP low flow alarm, MFP trip alarm, MFP zero speed alarm, SPDS post trip RCS pressure temperature display, MFP control panel indication of MFP turbine trip, speed, turbine governor valve position, and panel indication of feedwater flow and OTSG levels.

The EOP for overheating gives specific direction to establish feedwater to the OTSG's using AFW. Additionally the abnormal operation procedure for AFW directs the operator to use the SFAS control valves whenever ICS control is unavailable or undesirable.

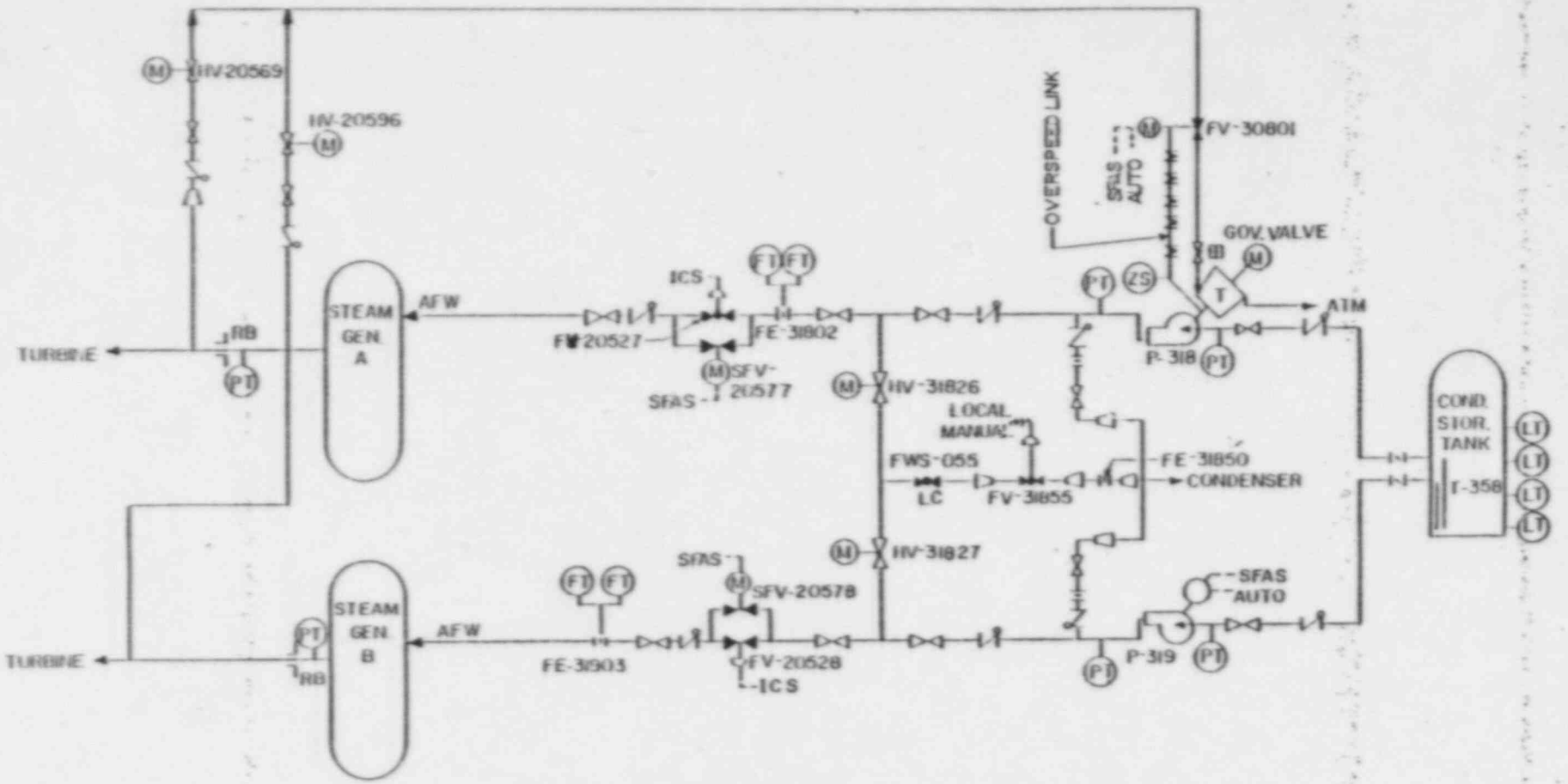


FIGURE 8

RANCHO SECO
AUX. FEEDWATER SYSTEM
OCT. 1985

ATTACHMENT 8

OIL LEVELS ON SAFETY RELATED PUMPS

The District has reviewed its lubrication practices for safety related pumps and motors. The District will complete the following prior to startup:

- Operator instructions in:
  - proper oil levels
  - use of various indicators to verify correct oil levels in pumps
  - operation and configuration of automatic oilers

- Maintenance personnel verification of correct adjustment and installation of oilers and sight-glasses for pumps. Inspections included checks for cleanliness of sightglasses, verifications for proper oil levels, and assurances that vents are functional on vertical sightglasses. If needed, maintenance has added or replaced oilers or sightglasses.

- Any pumps with the oil ring sump lubrication design that have had maintenance performed on the bearing assemblies since initial operation have had the oil rings inspected for proper assembly and operation.

The District has determined that completion of the above items satisfies the concern of proper lubrication.

ATTACHMENT 10

HOUSEKEEPING AND GENERAL SURVEILLANCE

IN SAFETY RELATED AREAS

The District performed a housekeeping survey of selected safety related areas that included the east and west Decay Heat Cooler and Pump Rooms, HPI and Makeup Pump Rooms, and the Auxiliary Feed Pump area. This field survey focused on the observation of oil leakage, proper threaded fastener engagement and fasteners that were loose and/or missing. The maintenance personnel conducting this survey examined an estimated 20,000 fasteners, and 33 individual components.

From this survey, no electrical or instrument and control items were identified that could have adversely affected safety. The survey revealed ten mechanical items that required additional analysis:

- Nine fasteners had a maximum of 3½ threads not engaged on nut;
- One pipe support was missing a fastener which had previously been identified and accepted;
- One wall mounting plate was missing an anchor bolt, and;
- One MOV operator had excessive oil drippage which Maintenance is opening and inspecting prior to startup to assure proper lubrication.

The initial engineering evaluations conclude the safety function of the items was not affected. The evaluations will be available to the resident NRC inspector.