NUCLEAR POWER BUSINESS UNIT
CALCULATION REVIEW AND APPROVAL

FILE T24.4

Calculation # 96-0284	
Number of Pages 7 + 1 attachment page	

Title of Calculation:
Uncertainty Associated with Instrumentation used in IT-12 & IT-13 for CCW pumps

☒ Original Calculation ☒ QA-Scope

☐ Revised Calculation. Revision # ________

☐ Superseding Calculation. Supersedes Calculation # ________

Modification #	Description:

Other References:

Prepared By:	Date: 12/23/96

This Calculation has been reviewed in accordance with NP 7.2.4. The review was accomplished by one or a combination of the following (as checked):

____ A review of a representative sample of repetitive calculations.

✓ A detailed review of the original calculation.

____ A review of the calculation against a similar calculation previously performed.

____ A review by an alternate, simplified, or approximate method of calculation.

Comments:

9702050123 970122
PDR ADOCK 05000301
P PDR

Reviewed By:	Date: 12/26/96	Approved By:	Date: 12/27/96

RECEIVED DEC 30

PBF-1608
Revision 1 02/27/95

Reference(s): NP 7.2.4

b. Uncertainty associated with PI-692A (see Section F.3)

U692 = ± 1.10 psi ✓

c. Uncertainty associated with PI-617A (see Section F.4)

U617 = ± 2.24 psi ✓

The uncertainties associated with 1-PI-692A and 1-PI-617A, in psi, must be converted to an equivalent uncertainty in gpm in order to combine the pressure uncertainty with the uncertainty associated with the flow instrument. Therefore, the pump curve at the test point (3400 gpm) was used to approximate an associated change in gallons per minute due to an uncertainty in psi. Selecting this point to take the slope maximizes the error contribution of the pressure indicators. (assumption 2) A tangential line to the pump curve was drawn at the testing point from which a slope (ft/gpm) was obtained to convert the uncertainty in psi to an uncertainty in gpm. This method has been determined to be an acceptable approach and has been evaluated independently by Duke Engineering Services. (reference 10)

The two points taken off the tangential line to develop the slope were 275 feet at 1900 gpm, and 150 feet at 5950 gpm. The conversion factor used to convert ft to psi (2.336) assumes a water temperature of 125 °F which is the upper temperature for the CCW system from the draft CCW Design Basis Document.

$$m = \left| \frac{275\ \text{ft} - 150\ \text{ft}}{1900\ \text{gpm} - 5950\ \text{gpm}} \right| = 3.09\text{E} - 2\ \text{ft/gpm} \times \frac{\text{psi}}{2.336\ \text{ft}} = 1.32\text{E} - 2\ \text{psi/gpm}$$ ✓

$$U692 = \pm 1.10\ \text{psi} \times \frac{\text{gpm}}{1.32\text{E} - 2\ \text{psi}} = \pm 83\ \text{gpm}$$ ✓

$$U617 = \pm 2.24\ \text{psi} \times \frac{\text{gpm}}{1.32\text{E} - 2\ \text{psi}} = \pm 170\ \text{gpm}$$ ✓

Now that the units of the individual uncertainties are consistent, the total uncertainty associated with the instruments used to test the CCW pumps can be calculated via the SRSS method.

d. Combining the uncertainties from these three instruments gives the following for total uncertainty:

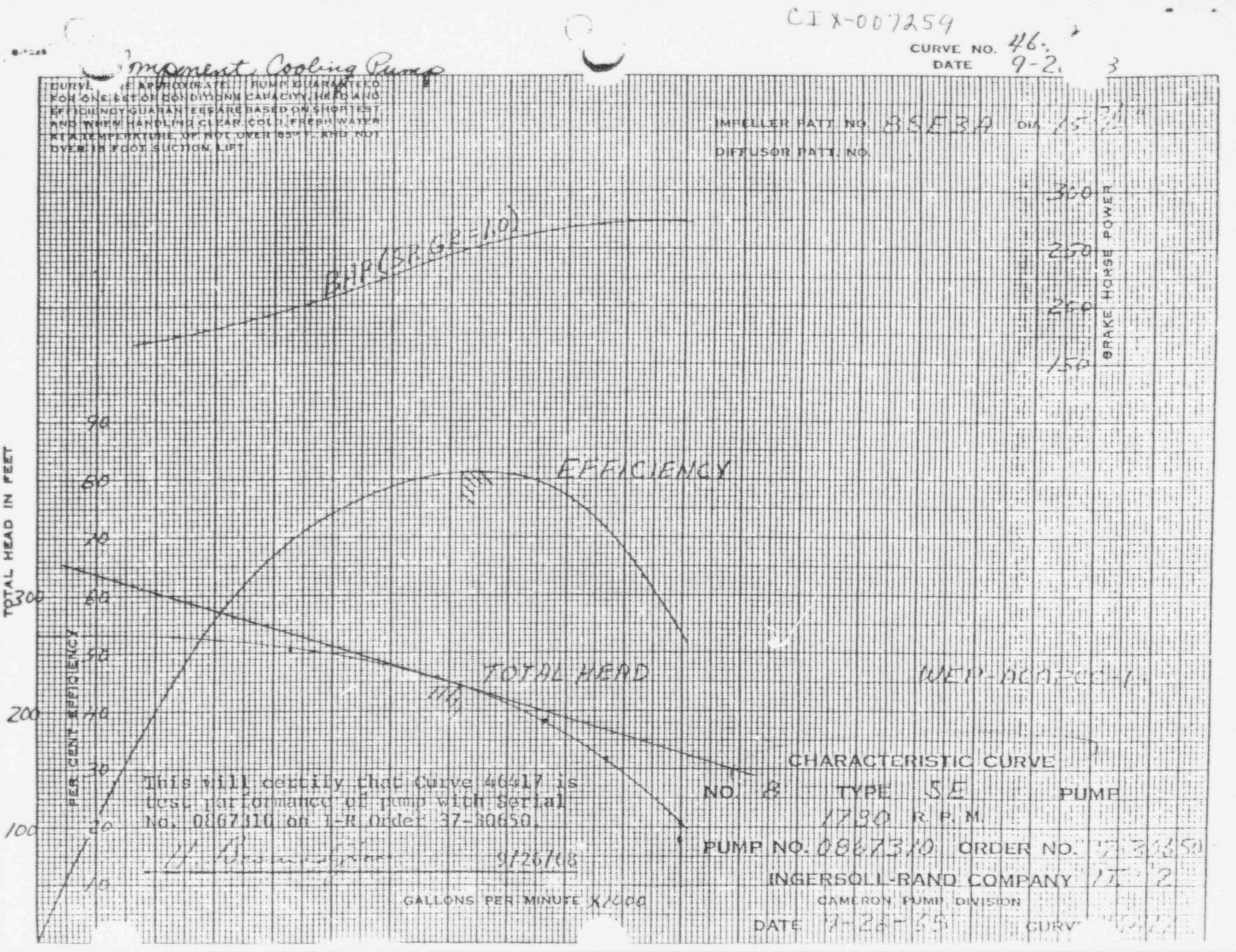
$$Utotal = \pm \sqrt{(U692)^2 + (U617)^2 + (U619)^2}$$

$$Utotal = \pm \sqrt{(83\ gpm)^2 + (170\ gpm)^2 + (529\ gpm)^2}$$ ✓

$$Utotal = \pm\ 562\ gpm$$ ✓

H. Results

The total instrument uncertainty, expressed in gpm, associated with the inservice test procedure for the component cooling water pumps is ± 562 gpm.


CIX-007259
CURVE NO. 46.
DATE 9-2 3
Component Cooling Pump
CURVE ARE APPROXIMATE. PUMP GUARANTEED FOR ONE SET OF CONDITIONS CAPACITY, HEAD AND EFFICIENCY GUARANTEES ARE BASED ON SHOP TEST AND WHEN HANDLING CLEAR COLD FRESH WATER AT A TEMPERATURE OF NOT OVER 85° F. AND NOT OVER 15 FOOT SUCTION LIFT
IMPELLER PATT. NO. 85E3A DIA
DIFFUSOR PATT. NO.
BRAKE HORSE POWER
300
250
200
150
BHP (SP. GR = 1.0)
EFFICIENCY
TOTAL HEAD
TOTAL HEAD IN FEET
300
200
100
PER CENT EFFICIENCY
90
80
70
60
50
40
30
20
10
This will certify that Curve 46417 is test performance of pump with Serial No. 0867310 on I-R Order 37-30650.
9/26/58
GALLONS PER MINUTE X100
CHARACTERISTIC CURVE
NO. 8 TYPE 5E PUMP
1730 R. P. M.
PUMP NO. 0867310 ORDER NO.
INGERSOLL-RAND COMPANY
CAMERON PUMP DIVISION
DATE 9-26-58
CURVE

CR 96-416

~~PROMPT~~ N OPERABILITY DETERMINATION

12/30/96

Note: ***Prompt Operability Determinations should be made as soon as possible commensurate with the safety importance of the SSC affected, and, in most cases, within 24 hours (can be extended up to 72 hours per DCS discretion) (See NP 5.3.7).***

1. Potentially degraded or nonconforming structure, system or component (SSC):

   Component Cooling Water Pumps

2. Structure, system or component's safety function:

   The Safety-Related (SR) heat loads of the Component Cooling (CC) system are: The residual heat removal (RHR) heat exchangers during the recirculation phase of safety injection (SI); the seal water coolers of the RHR, SI and containment spray (CS) pumps during the recirculation phase of SI; the reactor coolant pump (RCP) thermal barriers during heatup, cooldown, hot shutdown and power operation.

   The CC pumps circulate cooling water through the CC system, transferring heat from the SR loads (and non-SR loads) to the service water (SW) system.

3. Under what circumstances (Including postulated accidents) would the problem exist; Identify failure mechanism if possible:

   The IST program does not reflect design basis requirements. As a result Section XI criteria may not be conservative in ensuring design basis requirements are met.

4. Applicable Technical Specification or Current Licensing Basis requirement or commitment and why the requirement or commitment may be met.

   The required flow through the RHR heat exchanger is established by FSAR section 9.3. The FSAR defines RHR heat exchanger shell side (the CC side) flow to be $1.375x10^6$ lb/hr. By performing unit conversions the resultant required flow is 2780 gpm. This basis was further evaluated by SER 96-055.

   The required flows through the seal water coolers of the RHR pumps and of the CS pumps are 10 gpm, per unit. The required flow through the seal water coolers of the SI pumps are 20 gpm, per unit. These flow requirements come from the respective pump component instruction manuals (CIMs) and system design basis documents (DBDs).

   The required flow through the RCP thermal barriers is 50 gpm, per unit. This requirement is listed in the RCP CIM.

   The flows required during the recirculation phase of SI, per the CC draft DBD and WCAP-13938, are the recirculation phase flows listed in #2 above, 2820 gpm, as well as 75 gpm to the sample system heat exchangers. Total component cooling flow required for the recirculation phase loads is 2895 gpm.

   The flow required during plant heatup is 2420 gpm, per the CC draft DBD and WCAP-13938. The plant heatup flow is bounded by the recirculation phase flow requirement of 2895 gpm.

   The flow required during power operation is 2290 gpm for unit one and 2627 gpm for unit two. Unit two is higher due to the radwaste CC loads. These flow requirements are per the CC draft DBD and WCAP-13938. The power operation flows are bounded by the recirculation phase flow requirement of 2895 gpm.

The CC draft DBD and WCAP-13938 list two plant operational modes, plant cooldown and refueling, as requiring flows greater than 2895 gpm. However, these flowrates are to achieve maximum allowed cooldown or heat removal rate. One pump can accommodate the heat removal load on one unit either following a loss-of-coolant (LOCA) accident or during normal plant shutdown, per FSAR section 9.3 and Tech Specs 15.3.3. To accomplish this, flow to a RHR heat exchanger would be adjusted and/or flow to non-essential loads would be throttled or secured. The sump recirc flow requirement is therefore considered to be limiting.

5. How was degradation/nonconformance discovered?

This generic concern was first identified in June 1996 as a specific concern for safety injection pump acceptance criteria from ASME Section XI versus design requirements, Condition Report 96-416.

6. Basis for Declaring SSC Operable:

The flow required during the recirculation phase of SI is 2895 gpm. Calculation 96-0284 (attached) determined that uncertainty associated with the instrumentation used in IT-12 & IT-13 is +/- 562 gpm, for the flow range considered. Therefore design basis (DB) required flow is 3457 gpm.

The CC pumps are operable as long as they are capable of providing the DB required flow of 3457 gpm.

During IT-12 & IT-13, each CC pump is operated at 3600 gpm flow, though the exact flow and pressure is not recorded. This flow is greater than the DB total of 3457 gpm. Thus, the quarterly ITs verify that the CC pumps can meet their DB flow requirements.

The RHR heat exchanger throttle valves, which define CC flow requirements, were set during performance of WMTP 12.11 in 1990 and 1989, for units 1 and 2 respectively. These tests ensured that the throttle valves were set to obtain at least 2780 gpm through the RHR heat exchangers. These tests also defined pump performance at a number of points along the pump curves. As shown on the attached pump curves, subsequent inservice tests show that the pumps are operating at essentially the same performance curve as demonstrated during the WMTPs.

Recommendations:

1) IT-12 & IT-13 should be revised, so that pump performance data is taken at the DB required flow, 3457 gpm, or higher.

2) WMTP 12.11 should be made into a test which is performed on a regularly scheduled basis to better determine system loads and performance.

7. Does initial Operability Determination need more conclusive evidence for support (such as additional testing, research, or analysis)? If yes, list proposed action(s) which will need to be accomplished in the In-Depth Operability Analysis:

No.

Prepared by:	____________	Date/Time:	12/30/96, 1750
Active SRO:	____________	Date/Time:	12/30/96 2130
DCS: ________	____________	Date/Time:	12/31/96 1102

FOR I&C USE ONLY
ET NO ______
COMPLETED ______

POINT BEACH NUCLEAR PLANT

TEMPORARY PROCEDURE REVIEW & APPROVAL

PROCEDURE IWMTP 12.11 Component Cooling System Flow Test

Revision Number 1

DESCRIBE CHANGES

Date 11-02-89

Step | Change/Reason MEE Review Summary

6.31 Change 769 to 766. This is to prevent lifting relief valve 768.

Delete CAUTION prior to step 6.31. The change to step 6.31 makes this caution unnecessary.

6.26 Delete actions for B RHR heat exchanger. This is to minimize the possibility of lifting the RCP CCW relief valves.

Use EQR-26c for additional description of changes

YES	NO	
☐	☒	10 CFR 50.59 REQUIRED IN ACCORDANCE WITH QP 3-3. IF YES, ATTACH A COMPLETED QP 3-3.1.
☐	☒	CHECK IF THIS PROCEDURE CHANGE IMPLEMENTS A TEMPORARY CHANGE/MODIFICATION TO THE FACILITY AND ATTACH FORM PBF-2013 COMPLETED AS DESCRIBED IN PBNP 2.1.1.
☒	☐	PERMANENT PROCEDURE CHANGE REQUIRED Initiated by: LDW Date 7-3-90

APPROVALS

MAJOR ALL CHANGES	APPROVAL PRIOR TO USE	Date 6-21-90 *Cognizant DSS or Group Head Approval Date Performed 6-22-90	DOS Approval Date 6/21/90 Unit 1 (If Applicable)
	SUBSEQUENT REVIEW AND APPROVAL	Manager's Supervisory Staff Review** Date 7/3/90 (For the Supervisory Staff)	MSSM 90-12 Date ______ Manager - PBNP Approval Date 7/3/90
		**Form PBF-0026d must accompany this sheet if serial review and approval was conducted.	
MINOR SPECIAL ALL CHANGES	APPROVAL PRIOR TO USE	Date *DSS or Cognizant Supervisor Approval	SMPs/RMPs (signatures of both Operations and cognizant group heads or a designated alternate required)
AND PROCESSES	SUBSEQUENT REVIEW AND APPROVAL	Operating/Other Procedures Date Cognizant Group Head Approval	Cognizant Group Head Date Supt - Operations Approval (If Required)
NSSR	APPROVAL PRIOR TO USE	Date Group Head Approval Date Other Approval (If Required)	Date Manager - PBNP Approval (If Required) Date Other Approval (If Required)

*DSS for Operations procedures and Group Head or Supervisor, as specified, for other group procedures.

See other side for summary of PBNP 2.1.1 approval requirements.

PBF-0026b

MICROFILMED

POINT BEACH NUCLEAR PLANT

PROCEDURE REVIEW AND APPROVAL CONTINUATION SHEET

PROCEDURE WMTF 12.11 Component Cooling System Flow Test

Revision 1 Date 11-02-89

DESCRIBE CHANGES (Continued)

Step	Change/Reason
6.27a	Add new step to perform the actions to isolate "B" RHR HX. These actions were deleted by the change to step 6.26. FEW

DESCRIBE DESIRED TRAINING (If Applicable):

Initials

EOP I&C USE ONLY
SHEET NO. ______
COMPLETED ______

POINT BEACH NUCLEAR PLANT

TEMPORARY PROCEDURE REVIEW & APPROVAL

PROCEDURE WMTP 12.11 Component Cooling System Flow Test

Revision Number 1

DESCRIBE CHANGES

Date 11-2-89

Step	Change/Reason
	Full Revision Summary
6.16	change to read "START P11B, THEN Secure P11A. Restart P11A if its discharge check valve Sticks open."
	This Step is changed to allow manual starting of the pump rather than the auto Starting due to Temp Mod 90-23 disabling the Auto Start feature of P11B. Operator Aid 90-19

Use EQR-26c for additional description of changes

YES	NO	
☐	☒	10 CFR 50.59 REQUIRED IN ACCORDANCE WITH QP 3-3. IF YES, ATTACH A COMPLETED QP 3-3.1
☐	☒	CHECK IF THIS PROCEDURE CHANGE IMPLEMENTS A TEMPORARY CHANGE/MODIFICATION TO THE FACILITY AND ATTACH FORM PBF-2013 COMPLETED AS DESCRIBED IN PBNP 2.1.1.
☐	☒	PERMANENT PROCEDURE CHANGE REQUIRED Initiated by: [signature] Date ______

APPROVALS

MAJOR CHANGES (ALL CHANGES)	APPROVAL PRIOR TO USE	Date 6/20/90 *Cognizant DSS or Group Head Approval Date Performed 6-22-90	Date 6/20/90 DCS Approval Unit 1 (If Applicable)
	SUBSEQUENT REVIEW AND APPROVAL	Manager's Supervisory Staff Review** Date 7/3/90 (For the Supervisory Staff)	MSSM 90-13 Date ______ Date 7/3/90 Manager - PBNP Approval
		**Form PBF-0026d must accompany this sheet if serial review and approval was conducted.	
MINOR AND SPECIAL PROCEDURES (ALL CHANGES)	APPROVAL PRIOR TO USE	Date ______ *DSS or Cognizant Supervisor Approval	SMPs/RMPs (signatures of both Operations and cognizant group heads or a designated alternate required)
	SUBSEQUENT REVIEW AND APPROVAL	Operating/Other Procedures Date ______ Cognizant Group Head Approval	Cognizant Group Head Date ______ Supt-Operations Approval (If Required)
NSSR	APPROVAL PRIOR TO USE	Date ______ Group Head Approval Date ______ Other Approval (If Required)	Date ______ Manager - PBNP Approval (If Required) Date ______ Other Approval (If Required)

*DSS for Operations procedures and Group Head or Supervisor, as specified, for other group procedures.

See other side for summary of PBNP 2.1.1 approval requirements.

UNIT 1 ONLY

1.0 PURPOSE

To demonstrate that the performance of the component cooling water system has not degraded significantly since the initial functional test. Specific items covered are:

1.1 Flow balance

1.2 Pump performance

1.3 Throttle valve position

2.0 REFERENCES

2.1 Component Cooling System Description TRHB 10.9.

2.2 Final Facility Description and Safety Analysis Report, Volume 3, Chapter 9.

2.3 Westinghouse Flow Diagram 110E018 Sheet 1
Westinghouse Flow Diagram 110E018 Sheet 2
Westinghouse Flow Diagram 110E018 Sheet 3

2.4 Component Cooling System Functional Tests.

WMTP H-2.3, Revision 1, January 8, 1971
WMTP H-2.3, Revision 3, June 25, 1970
WMTP H-2.3A, Supplement "A", March 10, 1971

2.5 Operating Procedure OP-6A, Operation of Component Cooling System.

3.0 DISCUSSION

This test will try to verify normal operating flows of the component cooling water system. If the flow appears to be incorrect, valves 824A and 824B will be manipulated to try to establish the correct flow.

4.0 PRECAUTIONS AND LIMITATIONS

All precautions in operating procedure OP-6A must be observed during this test.

5.0 INITIAL CONDITIONS

	Initials	Date
5.1 The component cooling water system is aligned for normal plant operation.	FDW	6-21-90
5.2 The RHR heat exchangers are not receiving CCW flow.	FDW	6-21-90

		Initials	Date
5.3	CCW pump P11A is operating. CCW pump P11B is secured.	MH	6/22/90
5.4	<u>The following equipment is not required for operation.</u>		
5.4.1	Boric acid evaporator		
5.4.2	Excess letdown heat exchanger		
5.4.3	Waste evaporator (Unit 1 test only)		
5.4.4	Blowdown evaporator bottoms cooler (Unit 2 test only)		
5.4.5	Unit 2 letdown gas stripper system (Unit 2 test only)	FDW	6-21-90
5.5	Install temporary instruments to allow current measurements to be taken for both CCW pumps.	FDW	6-22-90
5.6	Unit 1 letdown flow is about 40 gpm (Unit 2 test only).	NA	6-21-90
5.7	The non-regenerative heat exchanger CCW flow is less than 300 gpm.	FDW	6-21-90

6.0 <u>PROCEDURE</u>

		Initials	Date
6.1	Record the data specified in Table 6-1.	MH	6-22-90
6.2	Secure component cooling water flow to one of the CCW heat exchangers.		
	B CCW heat exchanger secured.	MH	6-22-90
6.3	<u>Secure the following systems if they are receiving CCW flow</u>:		

FDW 6-21-90 ~~CAUTION: RELIEF VALVE 768 MAY LIFT WHEN SECURING THE EXCESS LETDOWN HEAT EXCHANGER. IF IT LIFTS, SHUT VALVE 766 TO STOP THE DISCHARGE.~~

		Initials	Date
6.3.1	The excess letdown heat exchanger by closing valve ~~769.~~ 766. (FDW 6-21-90)	MH	6-22-90

		Initials	Date
6.3.2	(Unit 1 test only). The waste evaporator condenser by closing inlet and outlet valves 776A and 776B.	MH	6-22-90
6.3.3	The boric acid evaporator condenser and distillate cooler by closing inlet valves 744A and 748A and outlet valve 744B.	MH	6-22-90
6.3.4	(Unit 2 test only) The blowdown evaporator bottoms cooler by securing the bottoms cooler circ pump, P136.	N/A	N/A
6.4	(Unit 2 test only) Divert Unit 2 letdown from the gas stripper system.	N/A	N/A
6.5	Record data specified in Table 6-1.	MH	6-22-90
6.6	(Unit 2 test only). Determine the flow to the radwaste system by subtracting all measured CCW loads from the total CCW flow. Radwaste system flow N/A gpm.	N/A	N/A
6.7	Establish flow to "A" RHR heat exchanger by opening Valve 738A.	MH	6-22-90
6.8	Record the data specified in Table 6-1.	MH	6-22-90
6.9	Determine flow to RHR heat exchanger by subtracting the total flow of the other users (including radwaste system) from the indicated flow at FT619. Record this number in Table 6-1 under the Heading 6.8 or 6.14 as appropriate.	MH	6-22-90

CAUTION: THE FOLLOWING STEP MAY CAUSE UNDESIRABLE FLOW CHANGES IN OTHER CCW FLOW PATHS. THE VALVE MANIPULATION SHOULD BE DONE SLOWLY TO ALLOW THE OPERATOR TIME TO EVALUATE THE EFFECTS ON OTHER SYSTEMS.

		Initials	Date
6.10	If the RHR heat exchanger flow is not equal to or a little more than the design value (2780 gpm), then adjust Valve 824A (824B) to obtain the desired flow.	MH	6-22-90

		Initials	Date
6.11	Record the data specified in Table 6-1.	MH	6-22-90
6.12	Isolate "A" RHR heat exchanger by closing Valve 738A.	MH	6-22-90
6.13	Supply CCW flow to "B" RHR heat exchanger by opening Valve 738B.	MH	6-22-90
6.14	Repeat Steps 6.8, 6.9 and 6.10.	MH	6-22-90
6.15	Record the data specified in Table 6-1.	MH	6-22-90
6.16	START P11B, THEN SECURE P11A. ~~Secure component cooling pump P11A and allow component cooling pump P11B to start.~~ Restart P11A if ~~P11B does not start or if~~ discharge check valve sticks open.	MH	6/22
6.17	Record the data specified in Table 6-1.	MH	6/22
6.18	Isolate "B" RHR heat exchanger by closing Valve 738B.	MH	6/22
6.19	Record the data specified in Table 6-1.	MH	6/22
6.20	Supply CCW flow to "A" RHR heat exchanger by opening Valve 738A.	MH	6/22
6.21	Record the data specified in Table 6-1.	MH	6/22
6.22	Start component cooling water pump P11A and leave both CCW pumps operating.	MH	6/22

CAUTION: MINIMIZE THE TIME THAT TWO CCW PUMPS ARE SUPPLYING ONE CCW HEAT EXCHANGER.

		Initials	Date
6.23	Vent and establish flow to the component cooling water heat exchanger secured in Step 6.2.	MH	6/22
6.24	Reestablish flow to "B" RHR heat exchanger by opening Valve 738B.	MH	6/22
6.25	Do not change any throttle valve positions and record the data specified in Table 6-1.	MH	6/22
6.26	Isolate flow to "A" ~~both~~ RHR heat exchanger~~s~~ by closing Valve~~s~~ ~~738B and~~ 738A.	MH	6/22

		Initials	Date
6.27	Secure component cooling water pump P11A.	MH	6/22
6.28	Reestablish flow to any of the following systems that are desired for normal operation.		
6.28.1	The excess letdown heat exchanger by opening Valves 766 (if shut in Step 6.3) and 769.	MH	6/22
6.28.2	(Unit 1 test only) The waste evaporator condenser by opening inlet and outlet Valves 776A and 776B.	MH	6/22
6.28.3	The boric acid evaporator condenser and distillate cooler by opening inlet and outlet Valves 744A, 748A and 744B.	MH	6/22
6.28.4	(Unit 2 test only) The blowdown evaporator bottoms cooler by starting the bottoms cooler circ pump, P136.	N/A	N/A
6.29	(Unit 2 test only) Reestablish Unit 2 letdown flow to the gas stripper system if desired.	N/A	N/A
6.30	Record the data specified in Table 6-1.	[illegible]	6-22-90

7.0 RESULTS

7.1 Acceptance Criteria

Verify that flow to each RHR heat exchanger is at least 2780 gpm under accident conditions.

7.2 Review Criteria

7.2.1 Review flow data to assure all flows seem consistent with the system lineups.

7.2.2 Evaluate pump head curves and pump current to show that the pump is operating as expected.

7.2.3 Verify that flow to any RHR heat exchanger is not likely to exceed 1.5 times the design flow, or about 4100 gpm, during accident or any other conditions.

6.27a Isolate flow to B RHR heat exchanger by closing valve 738B. MH 6/22

TABLE 6-1
COMPONENT COOLING DATA

DESCRIPTION	STEP NUMBER										
	6.1	6.5	6.8	6.11	6.14	6.15	6.17	6.19	6.21	6.25	6.30
Boric Acid & Dist. Cooler Flow FI-642	0	0	0	0	0	0	0	0	0	0	0
Total RCP Flow FI613	225	226	159	174	152	175	180	226	176	170	226
FI609	223	224	115	145	115	147	156	226	152	145	224
RHR Pump Flow FI640	28.5	28.5	19	21.5	19	21.5	22	28.5	22	21.5	28.6
Waste Gas Compressor K1A Flow (Unit 1 only) FI643	25	25	19	20	19	20	20.5	24.3	20.5	20	24
Waste Gas Compressor K1B Flow (Unit 1 only) FI645	25	24.5	18	19	18	19	19.5	24	19	19	23.2
Excess Letdown HXE Flow FI607	111	0	0	0	0	0	0	0	0	0	114
Waste Evap. Cond. Flow FI647 (Unit 1 only)	0	0	0	0	0	0	0	0	0	0	0
Seal Water Heat Exchanger Flow FI605	132	33	95	104	95	105	106	131.5	106	104	133
Non-Regenerative Heat Exchanger FI601	5	5	5	5	5	5	5	5	5	5	5
Containment Spray Pump HXE FI649	36	32	19	21	19.5	21	21.5	28	21.5	20.8	27.5
Safety Injection Pump HXE FI650	42	42	29	32	29	31	31.5	41.2	31.5	31	42
Sample Heat Exchanger FI603	96	96	68	73	67	73	75	96	75	74	97
→ Total CCW Flow FT619 (from PPCS)	1044	975	4275	3825	4270	3800	3810	960	3840	6575	1025
Residual Heat Exchanger Flow	—	—	3127 ~~3309~~ [illegible]	3440 50 ~~3825~~ [illegible]	3756 ~~3295~~ [illegible]	3182 ~~3025~~ [illegible]	3173 ~~3025~~ [illegible]	—	3211 ~~2880~~ [illegible]	5864 ~~5675~~ [illegible]	—
CCW Pump Discharge Pressure PSIG	134	134	97	112	96	105	106	135	106	111 / 111	135
CCW Pump Suction Temperature TI616	100	97	92	94	91	92	92	97	92	93	98
→ CCW Pump Current	172	168	262	250	263	249	250	162	248	~~213~~ 237	169
Valve 824A Position (0-90°)	40	40	40	35	35	35	35	35	35	35	35
Valve 824B Position (0-90°)	40	40	40	40	40	35	35	35	35	35	35

Completed Test '89
Remove Radwaste equipment -

1.0 PURPOSE

To demonstrate that the performance of the component cooling water system has not degraded significantly since the initial functional test. Specific items covered are:

1.1 Flow balance

1.2 Pump performance

1.3 Throttle valve position

2.0 REFERENCES

2.1 Component Cooling System Description TRHB 10.9.

2.2 Final Facility Description and Safety Analysis Report, Volume 3, Chapter 9.

2.3 Westinghouse Flow Diagram 110E018 Sheet 1
Westinghouse Flow Diagram 110E018 Sheet 2
Westinghouse Flow Diagram 110E018 Sheet 3

2.4 Component Cooling System Functional Tests.

WMTP H-2.3, Revision 1, January 8, 1971
WMTP H-2.3, Revision 3, June 25, 1970
WMTP H-2.3A, Supplement "A", March 10, 1971

2.5 Operating Procedure OP-6A, Operation of Component Cooling System.

3.0 DISCUSSION

This test will try to verify normal operating flows of the component cooling water system. If the flow appears to be incorrect, valves 824A and 824B will be manipulated to try to establish the correct flow.

4.0 PRECAUTIONS AND LIMITATIONS

All precautions in operating procedure OP-6A must be observed during this test.

5.0 INITIAL CONDITIONS

	Initials	Date
5.1 The component cooling water system is aligned for normal plant operation.	[initials]	12-8-89
5.2 The RHR heat exchangers are not receiving CCW flow.	[initials]	12-8-89

		Initials	Date
5.3	CCW pump P11A is operating. CCW pump P11B is secured.	[initials]	12-8-89
5.4	The following equipment is not required for operation.		
5.4.1	Boric acid evaporator		
5.4.2	Excess letdown heat exchanger		
5.4.3	Waste evaporator (Unit 1 test only)		
5.4.4	Blowdown evaporator bottoms cooler (Unit 2 test only)		
5.4.5	Unit 2 letdown gas stripper system (Unit 2 test only)	[initials]	12-8-89
5.5	Install temporary instruments to allow current measurements to be taken for both CCW pumps.	[initials]	12-8-89
5.6	Unit 1 letdown flow is about 40 gpm (Unit 2 test only).	[initials]	12-8-89
5.7	The non-regenerative heat exchanger CCW flow is less than 300 gpm.	[initials]	12-8-89

6.0 PROCEDURE

		Initials	Date
6.1	Record the data specified in Table 6-1.	[initials]	12-8-89
6.2	Secure component cooling water flow to one of the CCW heat exchangers.		
	C CCW heat exchanger secured.	[initials]	12-8-89
6.3	Secure the following systems if they are receiving CCW flow:		

CAUTION: RELIEF VALVE 768 MAY LIFT WHEN SECURING THE EXCESS LETDOWN HEAT EXCHANGER. IF IT LIFTS, SHUT VALVE 766 TO STOP THE DISCHARGE.

		Initials	Date
6.3.1	The excess letdown heat exchanger by closing valve 769.	[initials]	12-8-89

11220

No changed TC inlet valve 766 because

		Initials	Date
6.3.2	(Unit 1 test only). The waste evaporator condenser by closing inlet and outlet valves 776A and 776B.	N/A	N/A
6.3.3	The boric acid evaporator condenser and distillate cooler by closing inlet valves 744A and 748A and outlet valve 744B.	[initials]	12-8-89
6.3.4	(Unit 2 test only) The blowdown evaporator bottoms cooler by securing the bottoms cooler circ pump, P136.	[initials]	12-8-89
6.4	(Unit 2 test only) Divert Unit 2 letdown from the gas stripper system.	[initials]	12-8-89
6.5	Record data specified in Table 6-1.	[initials]	12-8-89
6.6	(Unit 2 test only). Determine the flow to the radwaste system by subtracting all measured CCW loads from the total CCW flow. Radwaste system flow 361.4 gpm.	[initials]	12-8-89
6.7	Establish flow to "A" RHR heat exchanger by opening Valve 738A.	[initials]	12-8-89
6.8	Record the data specified in Table 6-1.	[initials]	12-8-89
6.9	Determine flow to RHR heat exchanger by subtracting the total flow of the other users (including radwaste system) from the indicated flow at FT619. Record this number in Table 6-1 under the Heading 6.8 or 6.14 as appropriate.	[initials]	12-8-89

CAUTION: THE FOLLOWING STEP MAY CAUSE UNDESIRABLE FLOW CHANGES IN OTHER CCW FLOW PATHS. THE VALVE MANIPULATION SHOULD BE DONE SLOWLY TO ALLOW THE OPERATOR TIME TO EVALUATE THE EFFECTS ON OTHER SYSTEMS.

		Initials	Date
6.10	If the RHR heat exchanger flow is not equal to or a little more than the design value (2780 gpm), then adjust Valve 824A (824B) to obtain the desired flow.	N/A	12-8-89

Handwritten margin notes: "0-10", "Added" (beside 6.3.4, 6.4 and 6.6)

	Initials	Date
6.11 Record the data specified in Table 6-1.	N/A	12-8-89
6.12 Isolate "A" RHR heat exchanger by closing Valve 738A.	AD	12-8-89
6.13 Supply CCW flow to "B" RHR heat exchanger by opening Valve 738B.	AD	12-8-89
6.14 Repeat Steps 6.8, 6.9 and 6.10.	AD	12-8-89
6.15 Record the data specified in Table 6-1.	N/A	12-8-89
6.16 Secure component cooling pump P11A and allow component cooling pump P11B to start. Restart P11A if P11B does not start or if discharge check valve sticks open.	AD	12-8-89
6.17 Record the data specified in Table 6-1.	AD	12-8-89
6.18 Isolate "B" RHR heat exchanger by closing Valve 738B.	AD	12-8-89
6.19 Record the data specified in Table 6-1.	AD	12-8-89
6.20 Supply CCW flow to "A" RHR heat exchanger by opening Valve 738A.	AD	12-8-89
6.21 Record the data specified in Table 6-1.	AD	12-8-89
6.22 Start component cooling water pump P11A and leave both CCW pumps operating.	AD	12-8-89

CAUTION: MINIMIZE THE TIME THAT TWO CCW PUMPS ARE SUPPLYING ONE CCW HEAT EXCHANGER.

	Initials	Date
6.23 Vent and establish flow to the component cooling water heat exchanger secured in Step 6.2.	AD	12-8-89
6.24 Reestablish flow to "B" RHR heat exchanger by opening Valve 738B.	AD	12-8-89
6.25 Do not change any throttle valve positions and record the data specified in Table 6-1.	AD	12-8-89
6.26 Isolate flow to both RHR heat exchangers by closing Valves 738B and 738A.	AD	12-8-89

		Initials	Date
6.27	Secure component cooling water pump P11A.	[initials]	12-8-89
6.28	Reestablish flow to any of the following systems that are desired for normal operation.		
6.28.1	The excess letdown heat exchanger by opening Valves 766 (if shut in Step 6.3) and 769.	[initials]	12-8-89
6.28.2	(Unit 1 test only) The waste evaporator condenser by opening inlet and outlet Valves 776A and 776B.	N/A	12-8-89
6.28.3	The boric acid evaporator condenser and distillate cooler by opening inlet and outlet Valves 744A, 746A and 744B.	[initials]	12-8-89
6.28.4	(Unit 2 test only) The blowdown evaporator bottoms cooler by starting the bottoms cooler circ pump, P136.	N/A	12-8-89
6.29	(Unit 2 test only) Reestablish Unit 2 letdown flow to the gas stripper system if desired.	N/A	12-8-89
6.30	Record the data specified in Table 6-1.	[initials]	12-8-89

7.0 RESULTS

7.1 Acceptance Criteria

Verify that flow to each RHR heat exchanger is at least 2780 gpm under accident conditions.

7.2 Review Criteria

7.2.1 Review flow data to assure all flows seem consistent with the system lineups.

7.2.2 Evaluate pump head curves and pump current to show that the pump is operating as expected.

7.2.3 Verify that flow to any RHR heat exchanger is not likely to exceed 1.5 times the design flow, or about 4100 gpm, during accident or any other conditions.

TABLE 6-1
COMPONENT COOLING DATA

DESCRIPTION	STEP NUMBER										
	6.1	6.5	6.8	6.11	6.14	6.15	6.17	6.19	6.21	6.25	6.30
Boric Acid & Dist. Cooler Flow FI-642	0	0	0	N/A	0	N/A	0	0	0	0	0
Total RCP Flow FI613	238	226	159	N/A	162	N/A	165	230	158	159	229
FI609	223	224	173	N/A	174	N/A	178	228	171	169	227
RHR Pump Flow FI640	27.6	27.6	19.2	N/A	19.5	N/A	19.5	27.6	19.5	19.0	27.6
Waste Gas Compressor K1A Flow (Unit 1 only) FI643	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Waste Gas Compressor K1B Flow (Unit 1 only) FI645	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excess Letdown HXE Flow FI607	112	0	0	N/A	0	N/A	0	0	0	0	112
Waste Evap. Cond. Flow FI647 (Unit 1 only)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Seal Water Heat Exchanger Flow FI605	135	135	98	N/A	99	N/A	99	135	98	97	135
Non-Regenerative Heat Exchanger FI601	20	20	10	N/A	10	N/A	10	10	10	10	20
Containment Spray Pump HXE FI649	33	33	23.5	N/A	24	N/A	24	33	24	24	33.4
Safety Injection Pump HXE FI650	44	44	31.5	N/A	32	N/A	32	44	32	32	44.5
Sample Heat Exchanger FI603	93	93	65	N/A	65	N/A	66	91.8	64	62	93
Total CCW Flow FT619 (from PPCS)	1382	1166	3870	N/A	3840	N/A	3875	1195	3940	7320	1308
Residual Heat Exchanger Flow	N/A	N/A	2929.4	N/A	2893	N/A	2920.1	N/A	3002.1	6386.4	N/A
CCW Pump Discharge Pressure PSIG (FI CM)	139	140	99	N/A	99	N/A	101	141	100	106	140
CCW Pump Suction Temperature TI616	103	101	93	N/A	96	N/A	96	103	95	97	104
CCW Pump Current	185 amps	185	270	N/A	260	N/A	270	180	270	250 / 260	185
Valve 824A Position (0-90°)	40°	40°	40°	N/A	40°	N/A	40°	40°	40°	40°	40°
Valve 824B Position (0-90°)	40°	40°	40°	N/A	40°	N/A	40°	40°	40°	40°	40°

[illegible]

PRESSURE TEST

Pump Reference
Values and Limits

Pump#: 1P11A   IT-012   Date Established: 6/10/93
Entered By: leh

Reference Values

Reference Pressure: 103.40 psig   Flow: 2602.00 gpm

Reference Vibration

Motor End		Pump End	
Point C:	.166 ips	Point A:	.143 ips
Point D:	.116 ips	Point B:	.146 ips
Point E:	.301 ips		

Acceptable Range

Pressure: 96.16 psig to 105.47 psig

Vibration

Motor End		Pump End	
Point C: ≤	.325 ips	Point A: ≤	.325 ips
Point D: ≤	.290 ips	Point B: ≤	.325 ips
Point E: ≤	.325 ips		

Alert Range

Low Pressure: 93.06 psig to 96.16 psig
High Pressure: 105.47 psig to 106.50 psig

Vibration

Motor End		Pump End	
Point C:	.325 ips to .700 ips	Point A:	.325 ips to .700 ips
Point D:	.290 ips to .696 ips	Point B:	.325 ips to .700 ips
Point E:	.325 ips to .700 ips		

Required Action Range

Low Pressure: 93.06 psig
High Pressure: 106.50 psig

Vibration

Motor End		Pump End	
Point C: >	.700 ips	Point A: >	.700 ips
Point D: >	.696 ips	Point B: >	.700 ips
Point E: >	.700 ips		

Comment: Reference values changed as a result of 06/10/93 evaluation.

Pump: 1P11A

Test: 012

Pressure Test

Test Date	Diff P	Vert Inbd	Horz Inbd	Axial	Vert Outbd	Horz Outbd	Int	Remarks
		Vibrations (ips)						
6/13/91	101	.130	.090	.300	.200	.130	BAT	ROUTINE SURVEILLANCE
8/22/91	103	.160	.130	.150	1.050	.320	LEH	POST MAINTAINANCE OP
9/15/91	100	.150	.130	.330	.150	.150	BAT	ROUTINE SURVEILLANCE
12/16/91	102	.210	.140	.360	.250	.140	LEH	ROUTINE SURVEILLANCE
3/02/92	101	.160	.140	.310	.150	.130	BAT	ROUTINE SURVEILLANCE
6/09/92	100	.190	.170	.300	.170	.160	JH	ROUTINE SURVEILLANCE
6/09/92	100	.190	.170	.300	.170	.160	JH	ROUTINE SURVEILLANCE
6/09/92	100	.190	.170	.300	.170	.160	JH	ROUTINE SURVEILLANCE
7/31/92	102	.310	.140	.370	.160	.150	JH	MWR 923363
9/01/92	101	.157	.132	.342	.173	.150		
9/01/92	101	.160	.130	.340	.170	.150	LEH	ROUTINE SURVEILLANCE
10/15/92	102	.233	.144	.321	.227	.137		
10/15/92	102	.230	.140	.320	.230	.140	BAT	INCREASED FREQUENCY
12/01/92	100	.207	.154	.308	.146	.156		
12/01/92	100	.210	.150	.310	.150	.160	LEH	ROUTINE SURVEILLANCE
3/01/93	103	.183	.127	.199	.141	.311		
3/23/93	116	.167	.115	.310	.185	.144		
6/10/93	103	.166	116	.301	.143	.146		
7/12/93	103	.218	.170	.363	.140	.145		
9/01/93	103	.193	.134	.333	.155	.154		
12/23/93	103	.185	.139	.320	.181	.127		
2/28/94	103	.196	.145	.367	.159	.156		
6/01/94	103	.144	121	.366	.152	.154		
9/02/94	103	.155	.124	.363	128	.133	LEH	ROUTINE SURVEILLANCE
12/09/94	103	.141	.118	.309	.139	.190	BAT	ROUTINE SURVEILLANCE
2/17/95	103	.200	.114	.298	.199	.120	LEH	ROUTINE SURVEILLANCE
3/02/95	103	.142	.085	.364	.147	.109	LEH	ROUTINE SURVEILLANCE
6/01/95	104	.330	.126	.345	.191	.111	LRD	ROUTINE SURVEILLANCE
7/16/95	104	.166	.142	.300	164	.113	LRD	SPECIAL TEST. # 9507
9/01/95	104	.150	.097	.273	298	.113	BAT	ROUTINE SURVEILLANCE
12/05/95	104	.213	.156	.276	.212	.124	BAT	ROUTINE SURVEILLANCE
3/01/96	105	.180	.107	.346	.211	.127	LEH	ROUTINE SURVEILLANCE
3/26/96	104	.220	.142	.296	.186	.129	LEH	INCREASED FREQ. 1P11
6/01/96	104	.241	.152	.371	.184	.163	LRD	ROUTINE SURVEILLANCE
9/03/96	104	.252	.146	.115	.199	.115	LEH	ROUTINE SURVEILLANCE
11/29/96	104	.281	.133	.357	.187	.118	LEH	ROUTINE SURVEILLANCE

PRESSURE TEST

Pump Reference
Values and Limits

Pump#: 1P11B   IT-012   Date Established: 6/10/93
Entered By: LEH

Reference Values

Reference Pressure: 107.20 psig   Flow: 2583.00 gpm

Reference Vibration

Motor End		Pump End	
Point C:	.142 ips	Point A:	.143 ips
Point D:	.149 ips	Point B:	.114 ips
Point E:	.251 ips		

Acceptable Range

Pressure: 99.70 psig to 109.34 psig

Vibration

Motor End		Pump End	
Point C: ≤	.325 ips	Point A: ≤	.325 ips
Point D: ≤	.325 ips	Point B: ≤	.285 ips
Point E: ≤	.325 ips		

Alert Range

Low Pressure: 96.48 psig to 99.70 psig
High Pressure: 109.34 psig to 110.42 psig

Vibration

Motor End		Pump End	
Point C:	.325 ips to .700 ips	Point A:	.325 ips to .700 ips
Point D:	.325 ips to .700 ips	Point B:	.285 ips to .684 ips
Point E:	.325 ips to .700 ips		

Required Action Range

Low Pressure: 96.48 psig
High Pressure: 110.42 psig

Vibration

Motor End		Pump End	
Point C: >	.700 ips	Point A: >	.700 ips
Point D: >	.700 ips	Point B: >	.684 ips
Point E: >	.700 ips		

Comment: Reference values established due to post maintenance MWR 925782, 921603, 932609.

Pump: 1P11B

Test: 012

Pressure Test

Test Date	Diff P	Vibrations (ips) Vert Inbd	Horz Inbd	Axial	Vert Outbd	Horz Outbd	Int	Remarks
6/13/91	106	.110	.100	.270	.130	.110	BAT	ROUTINE SURVEILLANCE
7/23/91	107	.130	.110	.260	.150	.120	BAT	POST MAINT. AFTER OI
9/15/91	105	.140	.110	.280	.150	.130	BAT	ROUTINE SURVEILLANCE
12/16/91	107	.140	.120	.130	.150	.120	LEH	ROUTINE SURVEILLANCE
1/06/92	106	.070	.100	.250	.150	.110	LEH	INCREASED FREQUENCY
1/16/92	107	.080	.090	.250	.130	.110	LEH	POST MAINTENANCE 1P1
3/03/92	106	.120	.100	.210	.150	.100	BAT	ROUTINE SURVEILLANCE
6/09/92	106	.130	.200	.250	.130	.130	JH	ROUTINE SURVEILLANCE
6/09/92	106	.130	.200	.250	.130	.130	JH	ROUTINE SURVEILLANCE
6/09/92	106	.130	.200	.250	.130	.130	JH	ROUTINE SURVEILLANCE
9/02/92	107	.142	.226	.276	.144	.160		
9/02/92	107	.140	.230	.280	.140	.160	LEH	ROUTINE SURVEILLANCE
10/15/92	105	.208	.314	.234	.123	.236		
10/15/92	105	.210	.310	.230	.120	.240	BAT	INCREASED FREQUENCY
12/01/92	106	.140	.265	.278	.132	.202		
12/01/92	106	.140	.270	.280	.130	.200	LEH	ROUTINE SURVEILLANCE
1/15/93	107	.148	.260	.128	.191	.304		
3/02/93	107	.165	.247	.127	.164	.266		
3/05/93	107	.204	.261	.167	.138	.269		
3/23/93	107	.149	.266	.235	.130	.160		
5/31/93	107	.146	.217	.252	.128	.140		
6/10/93	107	.142	.149	.251	.143	.114		
9/01/93	107	.131	.202	.252	.133	.140		
12/23/93	107	.123	.218	.225	.133	.141		
12/30/93	107	.013	.184	.245	.130	.122		
3/01/94	107	.119	.197	.280	.135	.120		
6/01/94	105	.123	.264	.262	.137	.168		
6/03/94	105	.125	.270	.247	.145	.203		
9/02/94	106	.109	.150	.230	.134	.148	LEH	ROUTINE SURVEILLANCE
12/09/94	106	.104	.285	.228	.129	.191	BAT	ROUTINE SURVEILLANCE
3/03/95	106	.116	.305	.255	.130	.186	LEH	ROUTINE SURVEILLANCE
6/01/95	107	.202	.249	.256	.146	.195	LRD	ROUTINE SURVEILLANCE
9/01/95	107	.147	.243	.230	.134	.165	BAT	ROUTINE SURVEILLANCE
12/05/95	107	.124	.224	.227	.128	.180	BAT	ROUTINE SURVEILLANCE
3/01/96	107	.136	.271	.265	.125	.149	LEH	ROUTINE SURVEILLANCE
3/26/96							LEH	INCREASED FREQ. 1P11
6/01/96	107	.113	.289	.278	.117	.203	LRD	ROUTINE SURVEILLANCE
9/03/96	105	.180	.259	.106	.167	.183	LEH	ROUTINE SURVEILLANCE
11/29/96	107	.141	.252	.229	.143	.147	LEH	ROUTINE SURVEILLANCE

PRESSURE TEST

Pump Reference
Values and Limits

Pump#: 2P11A   IT-013   Date Established: 3/16/96
Entered By: LEH

Reference Values

Reference Pressure: 105.80 psig   Flow: 2628.00 gpm

Reference Vibration

Motor End		Pump End	
Point C:	.102 ips	Point A:	.100 ips
Point D:	.065 ips	Point B:	.105 ips
Point E:	.190 ips		

Acceptable Range

Pressure: 98.40 psig to 107.90 psig

Vibration

Motor End		Pump End	
Point C: ≤	.254 ips	Point A: ≤	.250 ips
Point D: ≤	.164 ips	Point B: ≤	.262 ips
Point E: ≤	.325 ips		

Alert Range

Low Pressure: 95.20 psig to 98.40 psig
High Pressure: 107.90 psig to 109.00 psig

Vibration

Motor End		Pump End	
Point C:	.254 ips to .610 ips	Point A:	.250 ips tc .599 ips
Point D:	.164 ips to .392 ips	Point B:	.262 ips to .629 ips
Point E:	.325 ips to .700 ips		

Required Action Range

Low Pressure: 95.20 psig
High Pressure: 109.00 psig

Vibration

Motor End		Pump End	
Point C: >	.610 ips	Point A: >	.599 ips
Point D: >	.392 ips	Point B: >	.629 ips
Point E: >	.700 ips		

Comment:

Pump: 2P11A

Test: 013

Pressure Test

Test Date	Diff P	Vert Inbd	Horz Inbd	Axial	Vert Outbd	Horz Outbd	Int	Remarks
				Vibrations (ips)				
								TESTING "PUMPPRNT"
		.800						ROUTINE SURVEILLANCE
6/15/91	107	.140	.110	.130	.080	.160	LEH	INITIAL ROUTINE SURV
9/15/91	103	.130	.100	.180	.110	.080	BAT	ROUTINE SURVEILLANCE
12/15/91	105	.120	.110	.220	.140	.090	LEH	ROUTINE SURVEILLANCE
3/04/92	102	.140	.090	.140	.120	.080	BAT	ROUTINE SURVEILLANCE
6/01/92	101	.130	.130	.240	.120	.090	JH	ROUTINE SURVEILLANCE
6/01/92	101	.130	.130	.240	.120	.090	JH	ROUTINE SURVEILLANCE
9/02/92	104	.158	.131	.230	.145	.126		
9/02/92	104	.160	.130	.230	.140	.130	LEH	ROUTINE SURVEILLANCE
9/03/92	103	.140	.140	.230	.140	.210	LEH	OIL CHANGE
11/30/92	104	.140	.150	.250	.120	.080	LEH	ROUTINE SURVEILLANCE
3/12/93	103	.156	.103	.114	.082	.228		
6/11/93	105	.146	.104	.236	.117	.129		
9/01/93	105	.120	.108	.217	.109	.093		
12/03/93	106	.127	.117	.260	.116	.096		
3/02/94	105	.109	.083	.210	.102	.092		
6/03/94	105	.117	.094	.243	.115	.086		
9/08/94	105	.149	.108	.152	.118	.077	LEH	ROUTINE SURVEILLANCE
12/09/94	106	.114	.091	.195	.108	.080	BAT	ROUTINE SURVEILLANCE
3/04/95	107	.037	.042	.204	.112	.076	LEH	ROUTINE SURVEILLANCE
6/01/95	106	.119	.091	.203	.097	.065	LAT	ROUTINE SURVEILLANCE
9/02/95	106	.117	.102	.205	.101	.076	BAT	ROUTINE SURVEILLANCE
12/04/95	105	.124	.084	.231	.114	.072	BAT	ROUTINE SURVEILLANCE
2/14/96	107	.121	.093	.242	.155	.096	LEH	ROUTINE SURVEILLANCE
6/02/96	106	.116	.093	.161	.103	.097	LRC	ROUTINE SURVEILLANCE
8/29/96	105	.144	.120	.199	.109	.093	LEH	ROUTINE SURVEILLANCE
12/11/96	105	.156	.169	.170	.123	.084	LEH	ROUTINE SURVEILLANCE

PRESSURE TEST

Pump Reference
Values and Limits

Pump#: 2P11B   IT-013   Date Established: 8/29/96
Entered By: LEH

Reference Values

Reference Pressure: 104.00 psig   Flow: 2600.00 gpm

Reference Vibration

Motor End		Pump End	
Point C.	.173 ips	Point A:	.168 ips
Point D:	.217 ips	Point B:	.152 ips
Point E:	.174 ips		

Acceptable Range

Pressure: 96.70 psig to 106.10 psig

Vibration

Motor End		Pump End	
Point C: ≤	.325 ips	Point A: ≤	.325 ips
Point D: ≤	.325 ips	Point B: ≤	.325 ips
Point E: ≤	.325 ips		

Alert Range

Low Pressure: 93.60 psig to 96.70 psig
High Pressure: 106.10 psig to 107.10 psig

Vibration

Motor End	Pump End
Point C: .325 ips to .700 ips	Point A: .325 ips to .700 ips
Point D: .325 ips to .700 ips	Point B: .325 ips to .700 ips
Point E: .325 ips to .700 ips	

Required Action Range

Low Pressure: 93.60 psig
High Pressure: 107.10 psig

Vibration

Motor End		Pump End	
Point C: >	.700 ips	Point A: >	.700 ips
Point D: >	.700 ips	Point B: >	.700 ips
Point E: >	.700 ips		

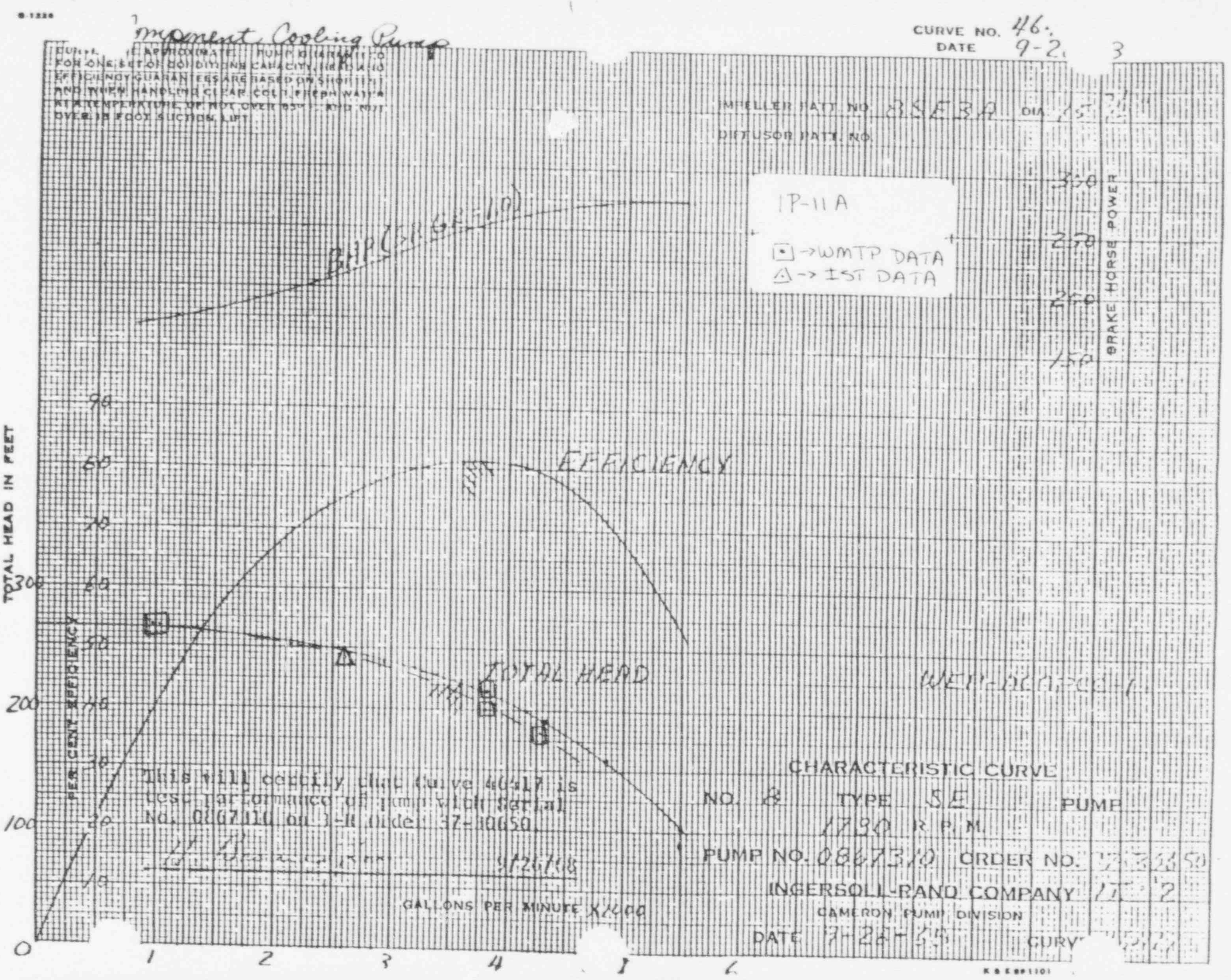
Comment: New reference value for DP provided as result of PPE evaluation for 08/29/96. Vibration data retained from 02/14/96 data.

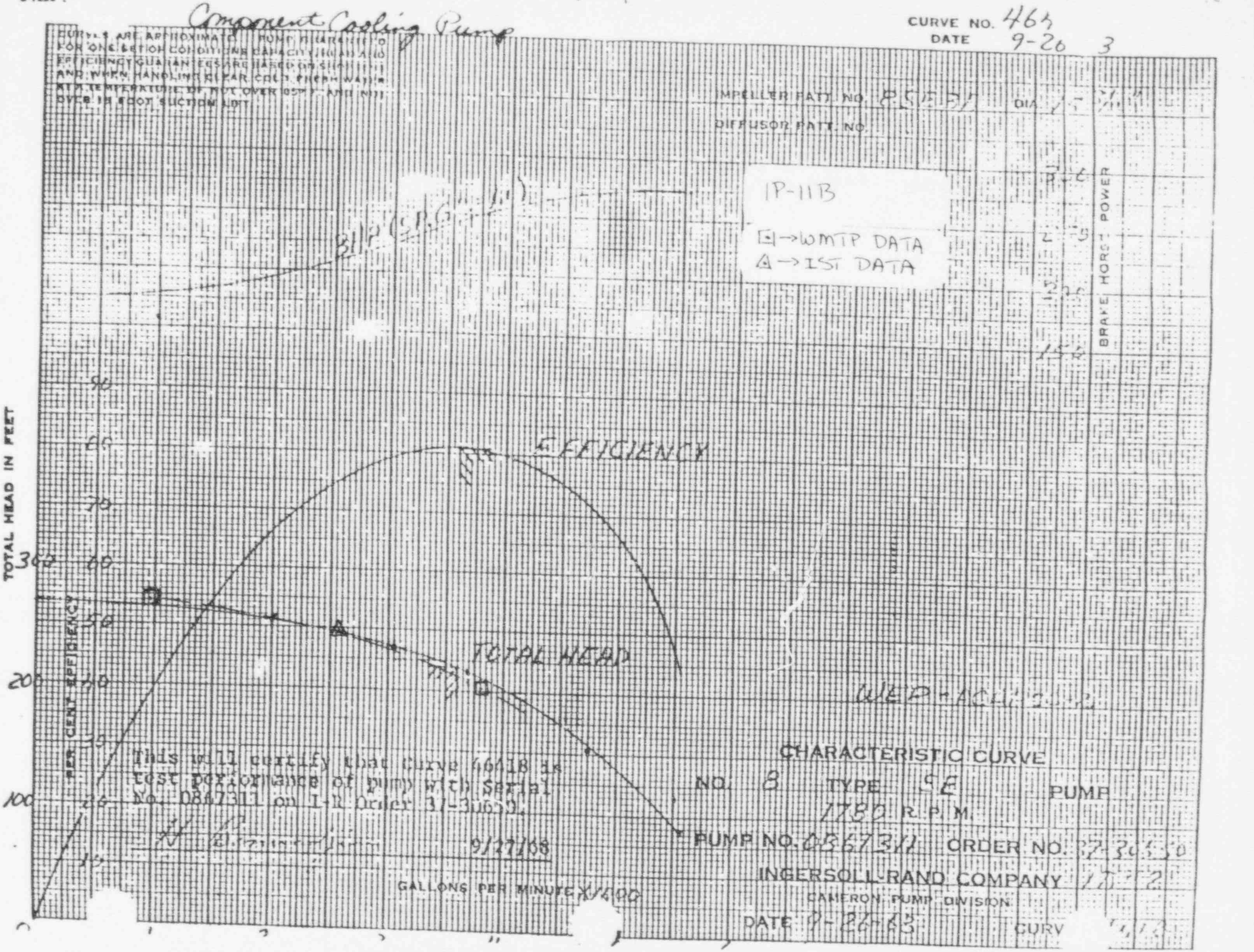
Pump: 2P11B

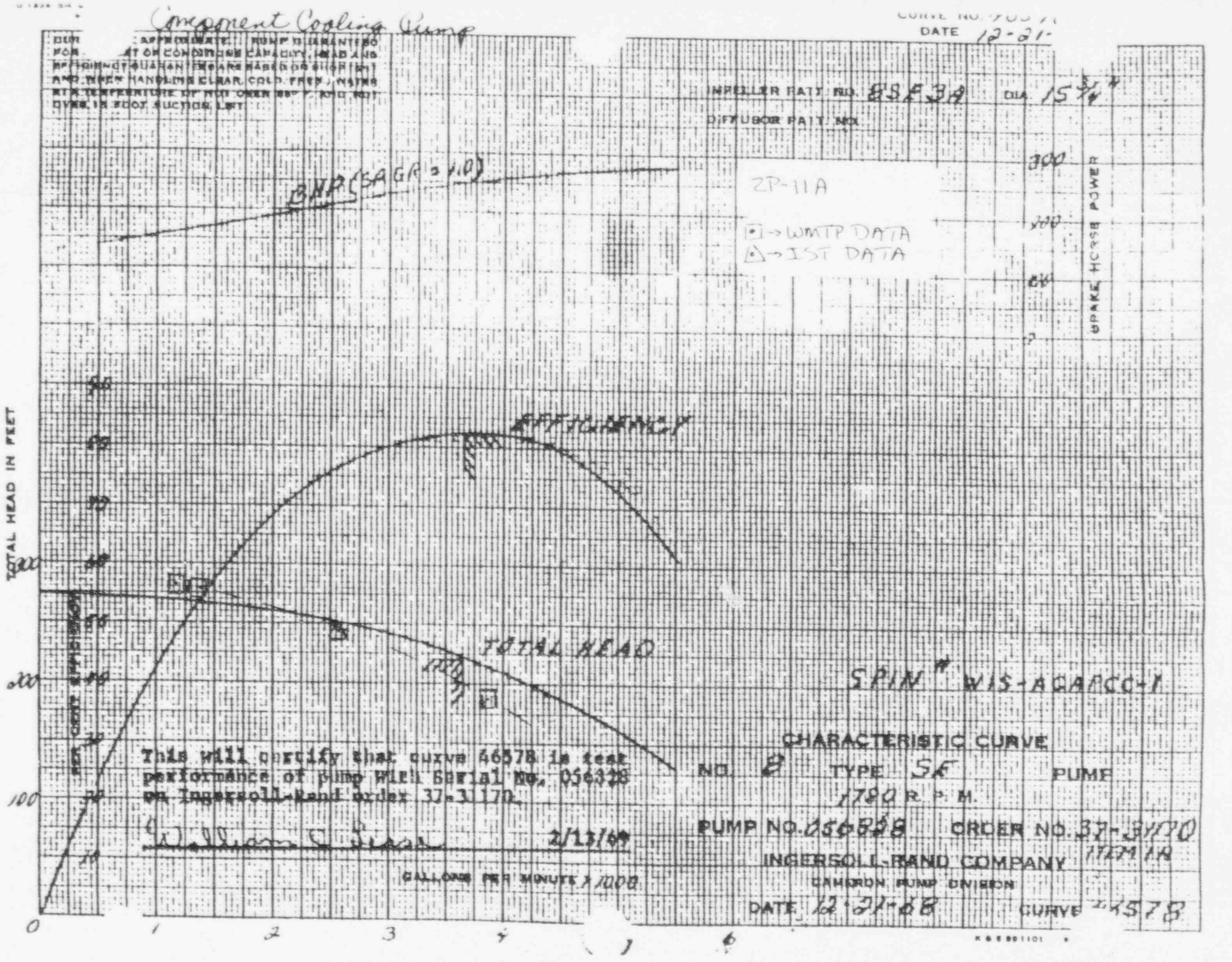
Test: 013

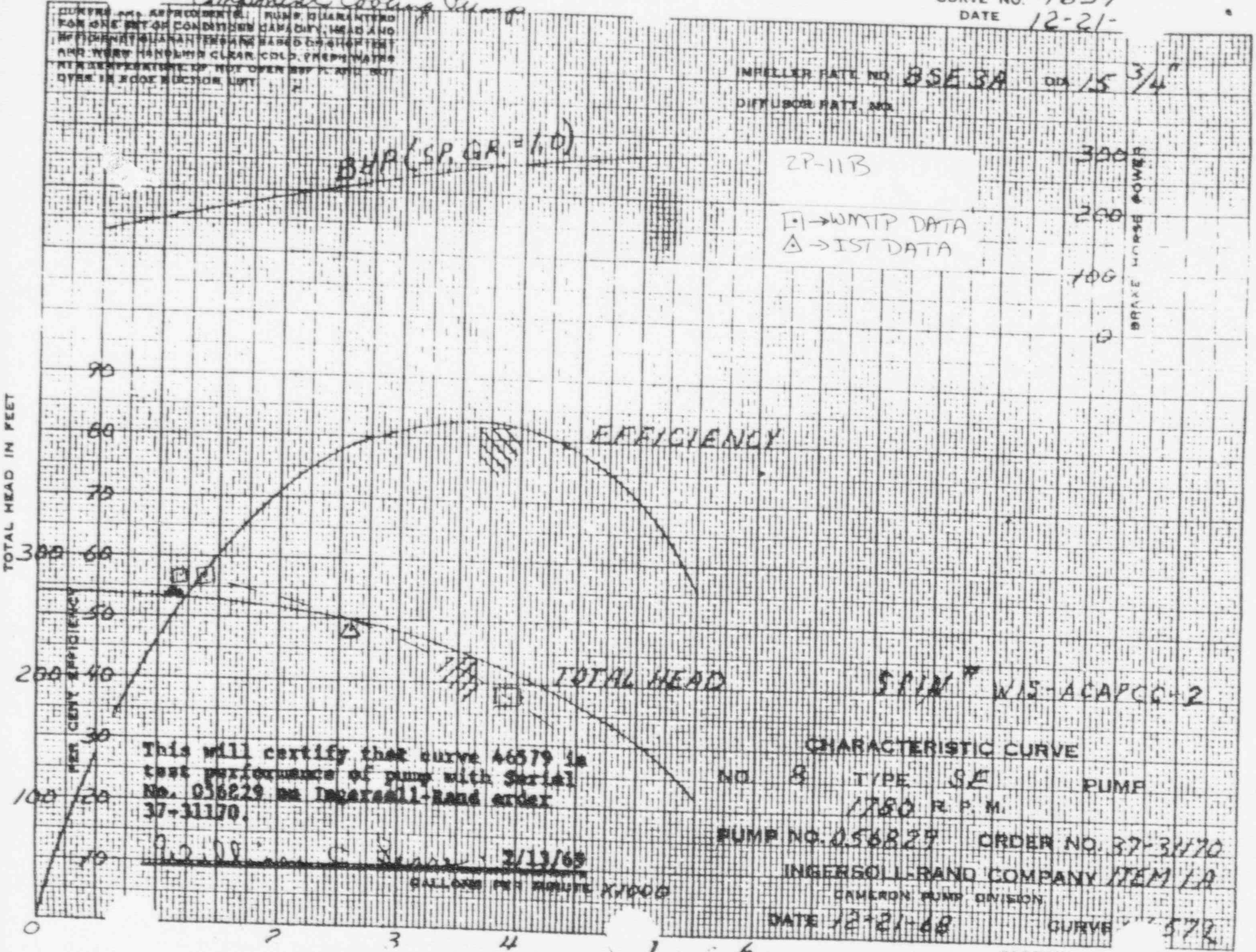
Pressure Test

		Vibrations (ips)						
Test Date	Diff P	Vert Inbd	Horz Inbd	Axial	Vert Outbd	Horz Outbd	Int	Remarks
8/14/91	107	.190	.160	.170	.150	.180	LEH	INITIAL ROUTINE SURV
9/15/91	103	.190	.150	.310	.170	.130	BAT	ROUTINE SURVEILLANCE
9/25/91	106	.200	.170	.290	.210	.150	BAT	INCREASED FREQUENCY
12/15/91	102	.210	.160	.280	.180	.160	LEH	ROUTINE SURVEILLANCE
3/05/92	104	.170	.140	.250	.160	.140	LEH	ROUTINE SURVEILLANCE
6/01/92	101	.170	.130	.290	.170	.150	JH	ROUTINE SURVEILLANCE
6/01/92	101	.170	.130	.290	.170	.150	JH	ROUTINE SURVEILLANCE
9/02/92	102	.178	.135	.262	.182	.134		
9/02/92	102	.180	.130	.260	.180	.130	LEH	ROUTINE SURVEILLANCE
9/04/92	103	.187	.173	.287	.156	.145		
9/04/92	103	.190	.170	.290	.160	.150	LEH	ROUTINE SURVEILLANCE
11/30/92	102	.180	.180	.280	.170	.150	LEH	ROUTINE SURVEILLANCE
3/03/93	104	.194	.237	.329	.275	.161		
3/03/93	104	.194	.237	.329	.275	.161		
4/14/93	104	.192	.136	.334	.171	.143		
6/11/93	104	.224	.227	.282	.191	.161		
7/09/93	103	.197	.360	.280	.206	.229		
9/01/93	104	.304	.205	.274	.150	.187		
12/03/93	103	.264	.173	.261	.157	.176		
3/02/94	103	.201	.151	.279	.153	.142		
6/03/94	104	.200	.156	.283	.158	.161		
9/08/94	104	.210	.156	.158	.180	[illegible]	LEH	ROUTINE SURVEILLANCE
12/09/94	105	.179	.139	.139	.139	[illegible]	BAT	ROUTINE SURVEILLANCE
6/01/95	105	.170	.144	.260	.158	[illegible]	LRD	ROUTINE SURVEILLANCE
9/02/95	105	.186	.144	.268	.171	[illegible]	BAT	ROUTINE SURVEILLANCE
12/04/95	105	.226	.318	.220	.138	.229	BAT	ROUTINE SURVEILLANCE
2/14/96	102	.173	.217	.174	.168	.151	LEH	ROUTINE SURVEILLANCE
6/02/96	102	.255	.233	.095	.120	.158	LRD	ROUTINE SURVEILLANCE
6/29/96	104	.171	.151	.147	.132	.149	LEH	ROUTINE SURVEILLANCE
12/11/96	104	.205	.171	.131	.165	[illegible]	LEH	ROUTINE SURVEILLANCE


Component Cooling Pump
CURVE NO. 46.
DATE 9-2. 3
CURVES ARE APPROXIMATE. PUMP IS GUARANTEED FOR ONE SET OF CONDITIONS CAPACITY, HEAD AND EFFICIENCY GUARANTEES ARE BASED ON SHOP TEST AND WHEN HANDLING CLEAR COLD FRESH WATER AT A TEMPERATURE OF NOT OVER 85° F. AND NOT OVER 15 FOOT SUCTION LIFT
IMPELLER PATT. NO. 35E3A
DIA
DIFFUSOR PATT. NO.
IP-11A
▣ -> WMTP DATA
△ -> IST DATA
BRAKE HORSE POWER
BHP (SPG GR-1.0)
EFFICIENCY
TOTAL HEAD
TOTAL HEAD IN FEET
PER CENT EFFICIENCY
This will certify that Curve 40417 is test performance of pump with Serial No. 0867310 on I-R Order 37-30650.
9/26/68
GALLONS PER MINUTE X1400
CHARACTERISTIC CURVE
NO. 8 TYPE 5E PUMP
1780 R. P. M.
PUMP NO. 0867310 ORDER NO.
INGERSOLL-RAND COMPANY
CAMERON PUMP DIVISION
DATE 7-24-55
CURVE


Component Cooling Pump
CURVE NO. 463
DATE 9-20 3
CURVES ARE APPROXIMATE. PUMP IS GUARANTEED FOR ONE RATING CONDITION, CAPACITY, HEAD AND EFFICIENCY GUARANTEES ARE BASED ON SHOP TESTS AND WHEN HANDLING CLEAR COLD FRESH WATER AT A TEMPERATURE OF NOT OVER 85° F. AND NOT OVER 10 FOOT SUCTION LIFT
IMPELLER PATT. NO.
DIA.
DIFFUSOR PATT. NO.
1P-11B
□→WMTP DATA
△→IST DATA
BHP
BRAKE HORSE POWER
EFFICIENCY
TOTAL HEAD
TOTAL HEAD IN FEET
PER CENT EFFICIENCY
This will certify that Curve 46418 is test performance of pump with Serial No. 0867311 on I-R Order 37-30650.
9/27/68
GALLONS PER MINUTE X 1000
CHARACTERISTIC CURVE
NO. 8 TYPE SE PUMP
1780 R.P.M.
PUMP NO. 0867311 ORDER NO. 37-30650
INGERSOLL-RAND COMPANY
CAMERON PUMP DIVISION
DATE 9-26-63
CURV


Component Cooling Pump
CURVE NO.
DATE 12-21-
IMPELLER PATT. NO. 85F3A
DIA 15 3/4
DIFFUSER PATT. NO.
BHP (SP. GR. = 1.0)
2P-11A
→ WMTP DATA
→ IST DATA
BRAKE HORSE POWER
EFFICIENCY
TOTAL HEAD
TOTAL HEAD IN FEET
PER CENT EFFICIENCY
SPIN # WIS-ACAPCC-1
This will certify that curve 46578 is test performance of pump With Serial No. 056328 on Ingersoll-Rand order 37-31170.
2/13/69
GALLONS PER MINUTE x 1000
CHARACTERISTIC CURVE
NO. 8 TYPE SF PUMP
1780 R. P. M.
PUMP NO. 056328 ORDER NO. 37-31170
ITEM 1A
INGERSOLL-RAND COMPANY
CAMERON PUMP DIVISION
DATE 12-21-68
CURVE 46578


Component Cooling Pump
CURVE NO. 4657
DATE 12-21-
IMPELLER PATT. NO. BSE3A
DIA. 15 3/4"
DIFFUSOR PATT. NO.
BHP (SP. GR. = 1.0)
2P-11B
[·] → WMTP DATA
△ → IST DATA
BRAKE HORSE POWER
300
200
100
0
EFFICIENCY
TOTAL HEAD
TOTAL HEAD IN FEET
PER CENT EFFICIENCY
300
200
100
90
80
70
60
50
40
30
20
10
S/N # W15-ACAPCC-2
This will certify that curve 46579 is test performance of pump with Serial No. 056229 on Ingersoll-Rand order 37-31170.
2/13/69
GALLONS PER MINUTE X1000
0
2
3
4
6
CHARACTERISTIC CURVE
NO. 8 TYPE SE PUMP
1780 R.P.M.
PUMP NO. 056829 ORDER NO. 37-31170
INGERSOLL-RAND COMPANY ITEM 1A
CAMERON PUMP DIVISION
DATE 12-21-68
CURVE 572

NUCLEAR POWER BUSINESS UNIT
CALCULATION REVIEW AND APPROVAL

Calculation # 96-0284

Number of Pages
7 + 1 attachment page

Title of Calculation:
Uncertainty Associated with Instrumentation used in IT-12 & IT-13 for CCW pumps

☒ Original Calculation ☒ QA-Scope

☐ Revised Calculation. Revision # ________

☐ Superseding Calculation. Supersedes Calculation # ________

Modification #	Description:

Other References:

Prepared By:	Date: 12/23/96

This Calculation has been reviewed in accordance with NP 7.2.4. The review was accomplished by one or a combination of the following (as checked):

____ A review of a representative sample of repetitive calculations.

✓ A detailed review of the original calculation.

____ A review of the calculation against a similar calculation previously performed.

____ A review by an alternate, simplified, or approximate method of calculation.

Comments:

Reviewed By:	Date:	Approved By:	Date:
	12/26/96		12/27/96

A. Purpose

The purpose of this calculation is to determine the uncertainty associated with the instrumentation used in inservice test procedures IT-12 & 13, for the component cooling water pumps, (reference 2). The final uncertainty value must include a combination of the uncertainties (by a square root sum of the squares [SRSS] method) for all the instrumentation used in the test that will have an impact on the ability to measure the IST acceptance value during the test performance for comparison to the design basis acceptance value.

B. Method

Instrument uncertainties will be calculated for the instruments used in the component cooling water (CCW) pump Inservice Test procedures IT-12 and IT-13, (reference 2). These inservice tests determine the developed head across the CCW pumps (1&2P-11A&B) by adjusting the pump flow to approximately 2600 gpm within approximately ± 30 gpm by throttling valves 1CC-824A and 1CC-748A. Once the correct flow value is achieved, the suction pressure instrument is valved in and the suction and discharge pressures are measured and the total developed head across the pump is determined. This value is compared to the CCW pump acceptance criteria.

A change to the IST test will be made to open up these throttle valves further to establish a flowrate that is greater than the design basis required CCW flow, plus instrument uncertainties. Based on this calculation, and reference 1, this value is expected to fall between 3400 gpm and 4000 gpm. This calculation is supporting this additional flow criteria that is being added to the IST test. These uncertainties do not apply to the portion of the IST test that is only verifying that ASME Section XI criteria are being satisfied.

While the IST procedures recommend using the computer point for total CCW flow (FT619), this calculation evaluated the control room indication, FI-619. Due to the readability error of FI-619, the overall loop error should exceed that of the computer point (FT619), and thus this calculation would be conservative.

This calculation is written referencing Unit 1 train A instrumentation. The results are also applicable to Unit 1 B train, and Unit 2 trains A and B.

C. References

1. Component Cooling Water Pump operability determination, 10/3/1996.
2. PBNP Inservice Test, IT 12 and IT-13, "Component Cooling Water Pumps and Valves"; Unit 1, Revision 11, August 29, 1996; and Unit 2, Revision 12, August 29, 1996.
3. Foxboro Component Instruction Manual for E13DM Series Differential Pressure Transmitter, Section 10, June 1979.

4. Ashcroft Pressure Gauge Ordering Manual, I&C library
5. PBNP Instrumentation and Control Procedures, ICP-06.15, "Auxiliary Coolant System (Non-Outage)", Rev 19, August 20, 1996.
6. PBNP Instrumentation and Control Procedures, 1ICP-06.068, "Component Cooling Water Flow Calibration", Rev 1, October 24, 1995.
7. DG-I01 "Instrument Setpoint Methodology", Revision 1, September 12, 1995.
8. Perma-Cal direct drive test and process gauge, component manual, dated 2/94.
9. VECTRA Calc No. PBNP-IC-07, "Westinghouse 252 Indicator Drift Calculation", Rev 0, 6/9/1995
10. Duke Engineering & Services letter to WE, "SI Pump IST Flow Test Uncertainty Evaluation", September 25, 1996.
11. WE Calculation 96-0191, "Minimum Allowable IST Acceptance Criteria for SI Pump Performance", dated 9/25/1996.
12. Process Measurement and Analysis, Instrument Engineers' Handbook, Third Edition, Chilton Book Company.
13. Flowmeters, a basic guide and sourcebook for users, Alan T.J. Hayward, John Wiley & Sons, 1979.
14. Ingersoll-Rand Component Instruction Manual #76, Component Cooling Water Pumps, rev 12, dated 10/15/96.

D. Assumptions

✓1. The temperature effect on the instrumentation will be assumed to be negligible as the transmitters are calibrated and used in essentially the same temperature environment.

✓2. The CCW pump flowrate used in the IST test will be changed to a value that ensures the IST design basis criteria, plus instrument uncertainties, is satisfied. This value is expected to be between 3400 gpm and 4000 gpm. The method to convert an error from psi to gpm, as accepted by Duke Engineering (reference 10), requires determining the slope of the pump curve at the point of interest. The pump curve for the CCW pump (from reference 14) is attached. As can be seen from the curve, the slope of the pump curve is more negative at higher flowrates, and using the slope at the lower end of this band, 3400 gpm, will ensure a maximum gallon per minute change for a given head change. In addition, when using the transfer function for calculating the error of a square root converter, (see Eq. 1.) the lower the representative flowrate, the greater the resulting error. For this case a flowrate of 3400 gpm will also be used. This calculation will be accurate for all CCW IST test revisions in which the pump flowrate that is used to satisfy the design basis requirement is greater than 3400 gpm. This calculation does not apply to the IST criteria that ensures that ASME Section XI criteria are satisfied, and that CCW test criteria could be done at any flowrate desired by the IST engineer and system engineer.

✓3. The pressure indicators, 1&2 PI-692 A&B and 1&2 PI-617 A&B were verified to be at the same elevation, 54" above the 8' elevation of the PAB,

and there is no need to consider the effects of elevation differences between the instruments and pipe centerlines

✓4. The velocity head developed by the pump is ignored.

✓5. The delta pressure measurement for FI-619 is taken off a 90 degree elbow in the pipe. It is assumed that this device has an inaccuracy of ±10% based on references 12 & 13, which both state an accuracy of between ±5.0% and ±10% for this type of flow measuring device.

✓6. If manufacturer's data was not located, uncertainties associated with drift of an instrument have been assumed to be the smaller of either 0.5% of full scale, or the instrument calibration tolerance. This value (0.5%) is based on engineering judgment of the maximum expected drift between calibrations for the instrumentation involved. Alternatively, the calibration accuracy is used if smaller, because instrumentation found regularly out of calibration are typically either repaired or replaced.

✓7. The M&TE error is assumed to be the smaller of either 0.5% of the instrument range, or the calibration tolerance, for all IST instruments. This value (0.5%) is conservative based on the research performed for Calculation 96-0191, "Minimum Allowable IST Acceptance Criteria for SI Pump Performance" (reference 11). The calibration accuracy is used if smaller because it is the practice of I&C to use a calibration instrument which is at least as accurate as the instrument being calibrated.

E. Inputs

For this calculation, the total uncertainty associated with the instrumentation used to perform the IST test must be considered. Contributors to this total uncertainty include:

- Instrument (transmitter & indicator) accuracy
- Indicator readability
- Tolerance
- Drift

F. Instrument Uncertainty Determinations

1. Instrument uncertainties for 1-FT-619, HX-12A/B CC HX Outlet Flow Transmitt[illegible] xboro model N-E13DM, input range 0.0 to 94.33 in H_2O, output range 10.0 to 50.0 mAdc. The calibrated range is 0.0 to 94 in H_2O (reference 6)

a. Instrument accuracy: ±0.5% of range (reference 3)

$$\text{Accuracy} = \frac{\pm 0.5\% * 94.33"}{(94.0" - 0.0")} = \pm 0.502\%$$ ✓

b. Calibration Setting Tolerance: The calibration setting tolerance is 0.2 mAdc. This represents ±0.5% of the range, or an error of ±0.502% (see a. above) (reference 6)

c. Drift (transmitter stability); Assumed to be ±0.5% (Assumption 6)

d. M&TE (Instrumentation uncertainty due to calibration); M&TE tolerance must be ±0.47 in H_2O, which represents ±0.5% of the calibrated input range (±0.47 in H_2O /94 in H_2O) (reference 6)

e. Flow Element: This flow measurement is done using a delta P measurement off an elbow flow element. It is assumed that this type of device is about 10% accurate (Assumption 5). This accuracy is assumed to be as a function of the flowrate. Since the flow value for the test is always less than 4000 gpm (Assumption 2), and the calibrated range is 1131.4 gpm to 7838.4.0 gpm, the assumed accuracy as a function of the calibrated range is:

$$U_{FE619} = \pm 10\% * \frac{4000 \text{ gpm}}{(7838.4 - 1131.4) \text{ gpm}} = \pm 5.96\%$$

$$U_{FT619} = \sqrt{(0.00502)^2 + (0.00502)^2 + (0.005)^2 + (0.005)^2 + (0.0596)^2}$$

$$U_{FT619} = \pm 0.0604 = \pm 6.04\%$$

2. Instrument Uncertainties for 1-FI-619, HC-12A/B CC HX return Flow Indicator, Westinghouse Model 252 indicator.

a. Indicator readability: This is a log scale. Minor divisions at 200 gpm. Assuming the instrument can be read to 1/2 a division, the readability as a function of calibrated range would represent an error of:

$$U_{readability} = \pm \frac{100 \text{ gpm}}{(7838.4 - 1131.4) \text{ gpm}} = \pm 1.49\%$$

b. Instrument accuracy: ±1.028% (reference 9)
This error also includes M&TE error and drift, based on telecon on 12/17/1996 with Karen Depodesta, Duke Engineering & Services.

c. Calibration Tolerance; 2% of 8000 gpm = 160 gpm. (reference 6)
Since the calibrated span is 1131.4 gpm to 7838.4 gpm:

$$\text{Calibration Tolerance} = \frac{160 \text{ gpm}}{(7838.4 - 1131.4) \text{ gpm}} = .0239 = \pm 2.39\%$$

Since the bellows in the indicator effectively acts as the square root converter, it is necessary to treat this instrument as a square root converter. All the above errors with the exception of the indicator readability, are treated as input errors.

Input errors:

$$a = \sqrt{(U_{FT619})^2 + (U_{FI619})^2}$$

$$a = \sqrt{(0.0604)^2 + (0.01028)^2 + (0.0239)^2}$$ ✓

$a = \pm 0.0658 = \pm 6.58\%$ ✓

Using the transfer function from reference 7 for a square root converter:

Eq. 1 $b = \sqrt{(a / 2B)^2 + e^2}$

Where
- b = Output error from non - linear device
- a = Input error to non - linear device
- B = Point of Interest (0 - 100% of span = 0 to 1)
- e = Device Uncertainty from non - linear device

By reviewing Equation 1 it can be seen that the smaller the value of B, the point of interest the greater the error. Based on this, and assumption #2, a point of interest of 3400 gpm will be used.

$$B = \frac{\text{Point of interest}}{\text{Instrument range}} = \frac{3400 \text{ gpm}}{8000 \text{ gpm}} = .425$$ ✓

Evaluating Equation 1.

$$b = \sqrt{(.0658 / 2*0.425)^2 + (0.0149)^2}$$ ✓

$b = 0.0788 = \pm 7.88\%$ of calibrated span ✓

$b = \pm 7.88\% * (7838.4 \text{ gpm} - 1131.4 \text{ gpm}) = \pm 529$ gpm ✓

3. Instrument Uncertainties for 1-PI-692A, P-11A CCW Pump Suction Pressure Indicator, Perma-Cal model #101TTM03A21, range 0-60 psig. (reference 5)
   a. Indicator readability; minor divisions at 0.2 psi. Assuming the meter can be read to half a division, the meter can be read to ±0.1 psi. This represents 0.1 gpm/60 gpm or ±0.17% uncertainty. Indicator readability was determined by plant walkdown by Ed Mercier 12/21/96. ✓
   b. Instrument accuracy, ±0.25% of full scale, (reference 8) ✓

c. Calibration Tolerance: The as-left tolerance for the instrument is ±1.0 psi. This represents an uncertainty of 1psi/60psi, or ± 1.67%(reference 5) ✓
d. Drift: assumed to be ±0.5%. (assumption 6) ✓
e. M&TE (Instrumentation uncertainty due to calibration); assumed to be ±0.5%, (assumption 7) ✓

Total Uncertainty associated with PI-692:

$$U692 = \pm\sqrt{(0.0017)^2 + (0.0025)^2 + (0.0167)^2 + (0.005)^2 + (0.005)^2}$$ ✓

$$U692 = \pm\ 0.0184 = \pm 1.84\%$$ ✓

$$U692 = \pm 1.84\% * 60\ psi = \pm 1.10\ psi$$ ✓

4. Instrument Uncertainties for 1-PI-617A, 1P-11A CCW Pump Discharge Pressure Indicator, Ashcroft model #1379SS, range 0-200 psig (reference 5).

a. Indicator readability: Based on plant walkdown, the smallest division is 2 psi. Assuming the meter can be read to half a division, the indicator readability would be ± 1.0 psi, which represents an uncertainty of 1/200 or ±0.5% ✓
b. Instrument accuracy, ±0.5% of full scale, (reference 4) ✓
c. Calibration Tolerance: The as left tolerance for the instrument is ±1.0 psi, which represents an uncertainty of ±0.5% (reference 5) ✓
d. Drift; assumed to be ±0.5%, (assumption 6) ✓
e. M&TE (Instrumentation uncertainty due to calibration); assumed to be ±0.5%, (assumption 7) ✓

Total uncertainty associated with PI-617A:

$$U617 = \pm\sqrt{(0.005)^2 + (0.005)^2 + (0.005)^2 + (0.005)^2 + (0.005)^2}$$ ✓

$$U617 = \pm\ 0.0112 = \pm\ 1.12\%$$ ✓

$$U617 = \pm\ 1.12\% \cdot 200\ psi = \pm 2.24\ psi$$ ✓

G. Calculation

The uncertainties of the Inservice test instrumentation have been determined above, and will be combined using a systematic method established in reference 7 and reference 10. This best estimate or realistic approach combines uncertainties using the statistical square root sum of squares (SRSS) method. This uncertainty value will be added to the design basis CCW pump flow requirement and this will become the IST design basis limit, and will be used as an acceptance value for the CCW pumps.

a. Uncertainty associated with FI-619 (see Section F.1 & F.2)

$$U619 = \pm\ 529\ gpm$$ ✓

b. Uncertainty associated with PI-692A (see Section F.3)

U692 = ± 1.10 psi ✓

c. Uncertainty associated with PI-617A (see Section F.4)

U617 = ± 2.24 psi ✓

The uncertainties associated with 1-PI-692A and 1-PI-617A, in psi, must be converted to an equivalent uncertainty in gpm in order to combine the pressure uncertainty with the uncertainty associated with the flow instrument. Therefore, the pump curve at the test point (3400 gpm) was used to approximate an associated change in gallons per minute due to an uncertainty in psi. Selecting this point to take the slope maximizes the error contribution of the pressure indicators. (assumption 2) A tangential line to the pump curve was drawn at the testing point from which a slope (ft/gpm) was obtained to convert the uncertainty in psi to an uncertainty in gpm. This method has been determined to be an acceptable approach and has been evaluated independently by Duke Engineering Services. (reference 10)

The two points taken off the tangential line to develop the slope were 275 feet at 1900 gpm, and 150 feet at 5950 gpm. The conversion factor used to convert ft to psi (2.336) assumes a water temperature of 125 °F which is the upper temperature for the CCW system from the draft CCW Design Basis Document.

$$m = \left| \frac{275\ \text{ft} - 150\ \text{ft}}{1900\ \text{gpm} - 5950\ \text{gpm}} \right| = 3.09E-2\ \text{ft/gpm} \times \frac{\text{psi}}{2.336\ \text{ft}} = 1.32E-2\ \text{psi/gpm}$$ ✓

$$U692 = \pm 1.10\ \text{psi} \times \frac{\text{gpm}}{1.32E-2\ \text{psi}} = \pm 83\ \text{gpm}$$ ✓

$$U617 = \pm 2.24\ \text{psi} \times \frac{\text{gpm}}{1.32E-2\ \text{psi}} = \pm 170\ \text{gpm}$$ ✓

Now that the units of the individual uncertainties are consistent, the total uncertainty associated with the instruments used to test the CCW pumps can be calculated via the SRSS method.

d. Combining the uncertainties from these three instruments gives the following for total uncertainty:

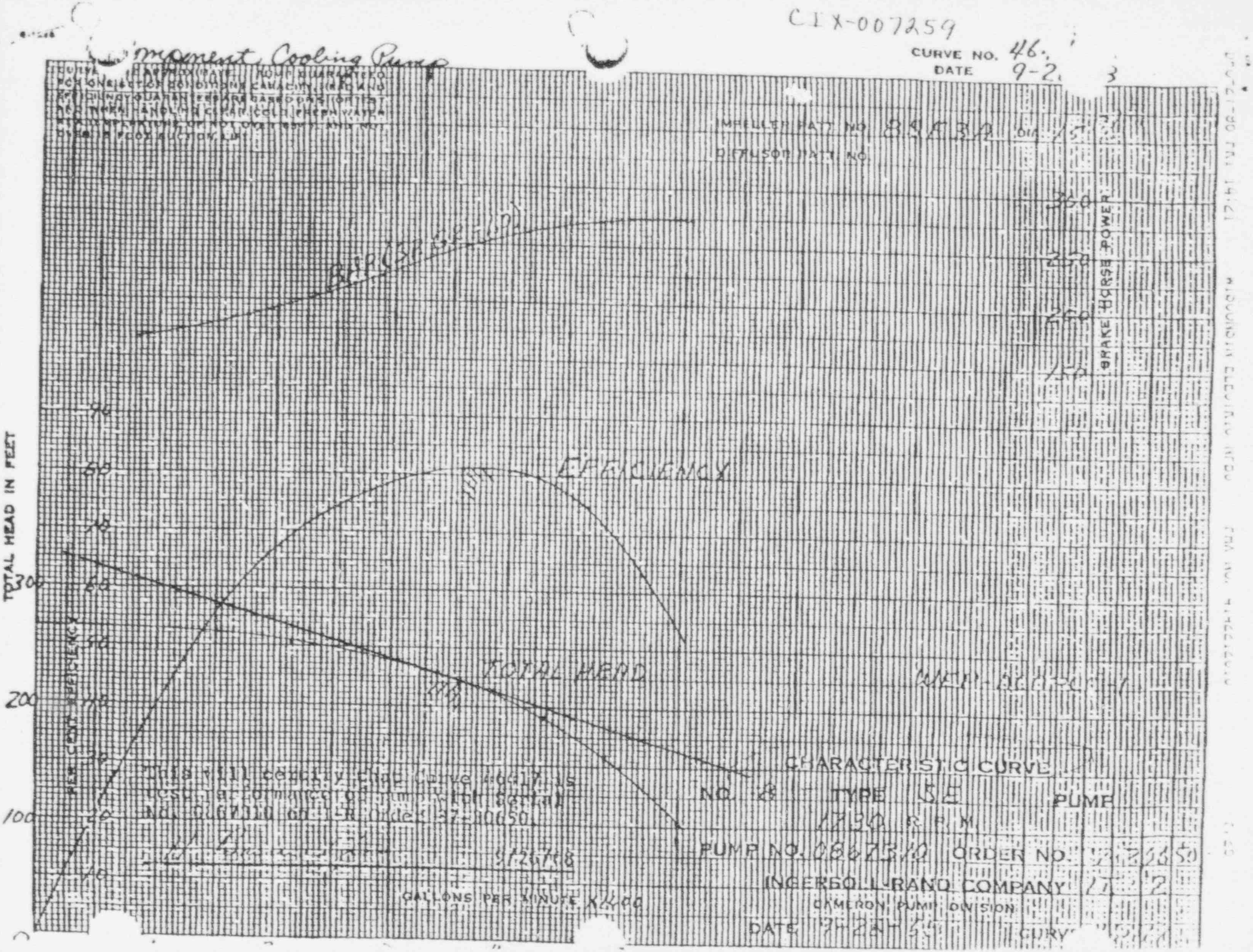
$$U_{total} = \pm\sqrt{(U692)^2 + (U617)^2 + (U619)^2}$$

$$U_{total} = \pm\sqrt{(83\ \text{gpm})^2 + (170\ \text{gpm})^2 + (529\ \text{gpm})^2}$$ ✓

$$U_{total} = \pm\ 562\ \text{gpm}$$ ✓

H. Results

The total instrument uncertainty, expressed in gpm, associated with the inservice test procedure for the component cooling water pumps is ± 562 gpm.


CIX-007259
Component Cooling Pump
CURVE NO. 46
DATE 9-2
BRAKE HORSE POWER
EFFICIENCY
TOTAL HEAD
TOTAL HEAD IN FEET
PER CENT EFFICIENCY
GALLONS PER MINUTE
CHARACTERISTIC CURVE
NO. 8 TYPE 5E PUMP
1750 R.P.M.
PUMP NO.
ORDER NO.
INGERSOLL-RAND COMPANY
CAMERON PUMP DIVISION
DATE