ENCLOSURE 1

PROPOSED TECHNICAL SPECIFICATION CHANGE

SEQUOYAH NUCLEAR PLANT UNIT 2

DOCKET NO. 50-328

(TVA-SQN-TS-88-02)

LIST OF AFFECTED PAGES

Unit 2

3/4 7-5
B 3/4 7-2

AUXILIARY FEEDWATER SYSTEM

LIMITING CONDITION FOR OPERATION

3.7.1.2 At least three independent steam generator auxiliary feedwater pumps and associated flow paths shall be OPERABLE with:

a. Two motor-driven auxiliary feedwater pumps, each capable of being powered from separate shutdown boards, and

b. One turbine-driven auxiliary feedwater pump capable of being powered from an OPERABLE steam supply system.

APPLICABILITY: MODES 1, 2 and 3.

ACTION:

a. With one auxiliary feedwater pump inoperable, restore the required auxiliary feedwater pumps to OPERABLE status within 72 hours or be in at least HOT STANDBY within the next 6 hours and in HOT SHUTDOWN within the following 6 hours.

b. With two auxiliary feedwater pumps inoperable, be in at least HOT STANDBY within 6 hours and in HOT SHUTDOWN within the following 6 hours.

c. With three auxiliary feedwater pumps inoperable, immediately initiate corrective action to restore at least one auxiliary feedwater pump to OPERABLE status as soon as possible.

SURVEILLANCE REQUIREMENTS

4.7.1.2 In addition to the requirements of Specification 4.0.5 each auxiliary feedwater pump shall be demonstrated OPERABLE by:

a. Verifying that:

1. each motor-driven pump develops a differential pressure of greater than or equal ~~to 1397 psid~~ the values indicated below on recirculation flow.

2. the steam-turbine driven pump develops a differential pressure of greater than or equal to ~~1183~~ 1165 psid on recirculation flow when the secondary steam supply pressure is greater than 842 psig. The provisions of Specification 4.0.4 are not applicable for entry into MODE 3. R2

2A-A greater than or equal to 1490 psid
2B-B greater than or equal to 1432 psid

SAFETY VALUES (Continued)

109 = Power Range Neutron Flux-High Trip Setpoint for 4 loop operation

76 = Maximum percent of RATED THERMAL POWER permissible by P-8 Setpoint for 3 loop operation.

X = Total relieving capacity of all safety valves per steam line in lbs/hour, 4.75×10^6 lbs/hr at 1170 psig

Y = Maximum relieving capacity of any one safety valve in lbs/hour, 9.5×10^5 lbs/hr at 1170 psig.

3/4.7.1.2 AUXILIARY FEEDWATER SYSTEM

The OPERABILITY of the auxiliary feedwater system ensures that the Reactor Coolant System can be cooled down to less than 350°F from normal operating conditions in the event of a total loss of off-site power.

The steam driven auxiliary feedwater pump is capable of delivering 880 gpm (total feedwater flow) and each of the electric driven auxiliary feedwater pumps are capable of delivering 440 gpm (total feedwater flow) to the entrance of the steam generators at steam generator pressures less than 1133 psia. At 1133 psia the open steam generator safety valve(s) are capable of relieving at least 11% nominal steam flow. A total feedwater flow of 440 gpm at pressures less than 1133 psia is sufficient to ensure that adequate feedwater flow is available to remove decay heat and reduce the Reactor Coolant System temperature to less than 350°F where the Residual Heat Removal System may be placed into operation. The surveillance differential pressure test values ensure that each pump will provide at least 440 gpm plus pump recirculation flow against a steam generator pressure of 1100 psia.

3/4.7.1.3 CONDENSATE STORAGE TANK

The OPERABILITY of the condensate storage tank with the minimum water volume ensures that sufficient water is available to maintain the RCS at HOT STANDBY conditions for 2 hours with steam discharge to the atmosphere concurrent with total loss of off-site power. The contained water volume limit includes an allowance for water not usable because of tank discharge line location or other physical characteristics.

3/4.7.1.4 ACTIVITY

The limitations on secondary system specific activity ensure that the resultant off-site radiation dose will be limited to a small fraction of 10 CFR Part 100 limits in the event of a steam line rupture. This dose also includes the effects of a coincident 1.0 GPM primary to secondary tube leak in the steam generator of the affected steam line. These values are consistent with the assumptions used in the accident analyses.

ENCLOSURE 2

PROPOSED TECHNICAL SPECIFICATION CHANGE

SEQUOYAH NUCLEAR PLANT UNIT 2

DOCKET NO. 50-328

(TVA-SQN-TS-88-02)

DESCRIPTION AND JUSTIFICATION FOR

REVISING SURVEILLANCE REQUIREMENT 4.7.1.2.a

ENCLOSURE 2

Description of Change

TVA proposes to modify the Sequoyah Nuclear Plant unit 2 technical specifications to revise SR 4.7.1.2.a to add pump-specific, differential pressure test values for each auxiliary feedwater (AFW) pump. The associated bases section is revised to clarify the AFW technical specification requirements.

Reason for Change

By letter dated June 26, 1987, TVA provided information to NRC that detailed the need for a revision to the differential pressure test values specified in SR 4.7.1.2.a. The revision to the motor-driven (MD) AFW pump differential pressure test values is necessary because of the replacement of MD pump discharge pressure control valves (PCVs) with cavitating venturis. This modification increased the system resistance of the MDAFW flow paths and thus increased the differential pressure developed by the MDAFW pumps necessary to provide adequate flow to the steam generators. In this letter, TVA indicated that testing would be performed during unit 2 heatup to regenerate as necessary the system resistance curves.

In a September 24, 1987 letter to NRC, additional information was provided on the issue of MDAFW pump operability. This letter indicated that the element of the 2A-A MDAFW pump had been replaced to increase available margin. Because of the replacement of the pump's element, a new pump curve was required for the 2A-A MDAFW pump. This letter detailed how the new pump curve would be used in conjunction with the system resistance curves to establish the new SR differential pressure test values. A safety evaluation report (SER) dated November 2, 1987, was received from NRC that provided NRC concurrence with TVA's methodology for developing the new SR test values. The revisions to the MDAFW pump differential pressure test values are made based on calculations generated from the test data accumulated during unit 2 heatup. This is in accordance with the commitments made in the two TVA letters and recognized in the NRC SER.

As the result of a revised pump curve and more conservative assumptions in calculating the necessary head to ensure adequate flow to the steam generator, a revision is being made to the differential pressure test value of the turbine-driven (TD) AFW pump.

To provide clarification of the AFW technical specification requirements, a revision to the bases is being made and is included for information.

Justification for Change

The Division of Nuclear Engineering (DNE) calculation B25 880430 807 (attachment 1) determines the new AFW pump differential pressure test values. A summary of the calculation results is provided on page 1 of the calculation package. The differential test pressures are determined by two methods. Method one is based on the calculated system resistances generated by DNE calculation B25 880430 806 (attachment 2), whereas method two utilizes system resistances developed from plant test data. The differential pressure test values that are added to SR 4.7.1.2.a for the MDAFW pumps are those calculated by method two to avoid being overly conservative.

The required head to produce 465 gallons per minute (gal/min) (440 gal/min to the steam generators and 25 gal/min recirculation flow) against a steam generator pressure of 1,100 pounds per square inch absolute (psia) is calculated on sheet 5 of attachment 1 for the MDAFW pumps. The available pump head is obtained from pump-specific head curves. The difference in these two values is the allowable degradation of the pumps, assuming uniform degradation of the pumps. The allowable values are found on page 9 of attachment 1.

Because the pumps are tested on recirculation, a minimum head value at recirculation must be calculated. The allowable degradation value is subtracted from the available pump head at recirculation flow. The remaining value is the minimum acceptable head at recirculation flow. These results are also found on page 9 of attachment 1. As shown on page 9 and the summary sheet, the minimum acceptable differential pressure test value of the 2A-A MDAFW pump is 3,439.8 feet (1,490 pounds per square inch differential [psid]). For the 2B-B MDAFW pump, the test value is 3,305.9 feet (1,432 psid).

The same methodology was used to calculate the minimum acceptable head for the TDAFW pump. As shown on page 12 of attachment 1, a differential pressure test value of 2,689.3 feet (1,165 psid) ensures the TDAFW pump's ability to deliver 490 gal/min (440 gal/min to the steam generators and 50 gal/min recirculation flow) against a steam generator pressure of 1,100 psia.

The pump-specific, differential pressure values added to SR 4.7.1.2.a contain no allowance for test instrument error. This is consistent with other safety-related pump flow and pressure test values contained in the technical specifications.

In summary, the proposed revision to SR 4.7.1.2.a provides specific differential pressure test values. The individual pump values merely reflect the different pump curves and different flow paths associated with the individual pumps. The values added to SR 4.7.1.2.a ensure that the pumps will deliver at least 440 gal/min plus recirculation flow at steam generator pressures of 1,100 psia. This ensures that plant operation is bounded by the assumptions for AFW flow in the various Final Safety Analysis Report (FSAR) analyses described in FSAR section 10.4.7.2.

The revision made to section 3/4.7.1.2 of the bases is made to clarify the technical specification requirements for AFW. The change is an enhancement and is included for information.

TS 88 02 Enclosure 2
Attachment 1

TVA 10697 (DNE 6-86)

DNE CALCULATIONS

QA Record

TITLE Minimum Head Required for the Turbine - Driven and Motor-Driven Auxiliary Feedwater (AFW) Pumps

PLANT/UNIT Sequoyah / Units 1&2

PREPARING ORGANIZATION DNE - MEB

KEY NOUNS (Consult RIMS DESCRIPTORS LIST) Pumps, Head, Feedwater

BRANCH/PROJECT IDENTIFIERS 2219280000

Each time these calculations are issued, preparers must ensure that the original (RO) RIMS accession number is filled in.

Rev	(for RIMS' use)	RIMS accession number
R0	830603E0074	MEB 830527 301
R3	871229F0009 (39)	B25 871222 800
R4	INFORMATION ONLY	B25 880430 807
R_		(Not Original Copy)

APPLICABLE DESIGN DOCUMENT(S) Design Criteria SQN-DC-V-13.9.8

SAR SECTION(S) 10.4.7.2

UNID SYSTEM(S) 03B

Revision 0 JPB	R~~1~~3	R~~2~~4	R~~3~~5
ECN No. (or indicate Not Applicable) N/A	N/A	N/A	
Prepared J. W. Warren	J. Bartleman	J. Bartleman	
Checked J. W. Aderholdt	J. Wehrman	J. Wehrman	
Reviewed J. W. Warren	J. Wehrman	J. Wehrman	
Approved L. W. Boyd	G. E. Pelgrin	G. E. Pelgrin	
Date 5-25-83	21Dec'87	30April'88	
List all pages added by this revision.	3, 3a, 4, 4a, 5a - 5h, D1	1, 6	
List all pages deleted by this revision.	2, 3, 3a - 3e, 4	5a, 5c - 5f, 6 - 12, 5h	
List all pages changed by this revision.	i, 1, 1a, 5, 6a	2 - 5, 7 - 9, 11, 12	

Use form TVA 10534 if more space required

Safety-related? Yes ☒ No ☐

Statement of Problem

Tech. Spec. requires that the Motor and Turbine Driven Aux. FW Pumps be periodically tested to determine if the head developed by the pump is adequate to perform its safety function. Determine this minimum developed head for the Motor-Driven and Turbine-Driven AFW Pumps.

Abstract

These calculations contain an unverified assumption(s) that must be verified later. Yes ☐ No ☒

A calculation was performed to determine the Minimum Total Developed Head (TDH) that the Motor-Driven and Turbine-Driven AFW Pumps must develop at recirculation (Test) conditions to assure that the pumps will develop adequate TDH at design flow conditions. The results of the calculations were:

		Minimum TDH
Motor - Driven AFW Pumps -	1A-A :	(later) psid
	1B-B :	(later) psid
	2A-A :	1511 psid
	2B-B :	1450 psid
Turbine - Driven AFW Pumps -	1A-S TDAFWPs :	1201 psid
	2A-S TDAFWP :	1165 psid

R4

☐ Microfilm and store calculations in RIMS Service Center.

☒ Microfilm and return calculations to: J. P. Bartleman

Microfilm and destroy. ☐

Address: DSC-C7, Sequoyah

cc: RIMS, SL 26 C-K

EN DES CALCULATIONS

QA Record ②

TITLE MINIMUM HEAD REQUIRED FOR TURBINE DRIVEN AND MOTOR DRIVEN AUX. FW PUMPS

UNID SYSTEM(S) –

PLANT/UNIT SQN-1 & 2

SAR SECTION(S)

PREPARING ORGANIZATION ICG-1

APPLICABLE DESIGN DOCUMENTS

BRANCH/PROJECT IDENTIFIERS 2219280000

KEY NOUNS PUMPS; HEAD, FEEDWATER

REV	(FOR MEDS USE)	MEDS ACCESSION NUMBER
R0	830603E0074 ⑬	MEB '830527 301
R1	850627F0021 ㉘	B44 '850620 013
R2	870420F0008 ㉚	B44 '870409 006
~~R3~~	JPB	See New Cover Sheet

REV	R0	R1	R2	R3
DATE	5-25-83		4/8/87	10-17-87
PREPARED	J.W. WARREN	L.C. Smith	R.K. Freeman	R.C. Carbonell
CHECKED	J.W. Adenholdt	J.D. Hubble JPB	JPB B. York JPB	J.P. Bartleman
SUBMITTED	J.W. Warren	C.F. Bowman	J.W. Boyd	
APPROVED	J.W. Boyd	H.K. Corbett	H.K. Corbett	R.C. Daniels
ATTACHMENTS MICROFILMED:				
LIST ALL PAGES* ADDED BY THIS REV:	1, 2a, 2b, 3a, 3b, 3c, 3d, A1, A2, B1-B3, C1, C2	12, 6a	5a TO 5h, 3a 3e ~~2 TO 4~~ D1 TO D5
LIST ALL PAGES* DELETED BY THIS REV:			2, 3b, 3d, 3e
LIST ALL PAGES* CHANGED BY THIS REV:	1, 2, 4, 12	1, 2a, 5, 6, 7, 9, 11	5, 2a, 2b, 3, 3b, 2, 1a, 6a

STATEMENT OF PROBLEM

TECH. SPEC. REQUIRES THAT M-D AND T-D AUX. FW PUMPS BE PERIODICALLY TESTED TO DETERMINE IF THE HEAD DEVELOPED BY THE PUMP IS ADEQUATE TO PERFORM ITS SAFETY FUNCTION. DETERMINE THIS MINIMUM DEVELOPED HEAD FOR THE M-D AND T-D AUX. FW PUMPS.

ABSTRACT

A CALCULATION WAS DONE TO DETERMINE THE MINIMUM TOTAL DEVELOPED HEAD (TDH) THAT THE T-D AND M-D AUX. FW PUMPS MUST DEVELOP AT RECIRC. CONDITIONS (TEST CONDITIONS) TO ASSURE THAT THE PUMPS WILL DEVELOP ADEQUATE TDH AT DESIGN FLOW CONDITIONS. THE RESULTS OF THE CALCULATIONS WERE:

MINIMUM TDH - M-D PUMP - see sheet i ~~1399~~ PSID | R1

MINIMUM TDH - T-D PUMP - * ~~1183~~ 1187.5 PSID | R3

* @ TURBINE STEAM SUPPLY PRESSURE ≥ 842 PSIG

There are no unverified assumptions in this calculation | R2

TVA 10697 (ENDES-7-78) *Use revision log (form TVA 10534) if more room is required

Please return originals to ~~C.F. Bowman W7A32 C~~

J.P. BARTLEMAN DSC-C7 SEQUOYAH

NEP-3.1
Attachment 6
Page 1 of 1

CALCULATION INDEPENDENT REVIEW VERIFICATION FORM

2219280000
Calculation No.

R4
Revision

Method of independent review used (check one or more):

1. Alternate calculation method ________
2. Testing method ________
3. Other method X

Justification (explain below):

Method 1: Identify the pages where the alternate calculation has been included in the calculation package and explain why this method is adequate.

Method 2: Identify the QA documented source(s) where testing adequately demonstrates the adequacy of this calculation and explain.

Method 3: Justify the technical adequacy of the calculation and explain how the adequacy was verified (calculation is similar to another, based on accepted handbook methods, appropriate sensitivity studies included for confidence, etc.).

THE DESIGN APPROACH USED IN THIS CALCULATION IS TECHNICALLY ADEQUATE BECAUSE IT IS SIMILAR TO PREVIOUS REVISIONS OF THE CALCULATION AS WELL AS OTHER CALCULATIONS AND IS, IN PART, BASED ON ACCEPTED TEXT BOOK METHODS. REFERENCED IN THE CALCULATION

Robert V. Sauett
Design Verifier
(Independent Reviewer)

4/30/88
Date

CALCULATION DESIGN VERIFICATION (INDEPENDENT REVIEW) FORM

2219280000 Calculation No.

R3 Revision

Method of design verification (independent review) used (check method used):

1. Design Review ✓
2. Alternate Calculation ____
3. Qualification Test ____

Justification (explain below):

Method 1: In the design review method, justify the technical adequacy of the calculation and explain how the adequacy was verified (calculation is similar to another, based on accepted handbook methods, appropriate sensitivity studies included for confidence, etc.).

Method 2: In the alternate calculation method, identify the pages where the alternate calculation has been included in the calculation package and explain why this method is adequate.

Method 3: In the qualification test method, identify the QA documented source(s) where testing adequately demonstrates the adequacy of this calculation and explain.

The calculation was performed based on accepted methods for determining Minimum Total Developed Head - Previous Calcs + Field ~~[illegible]~~ test data ([illegible]) were utilized to generate this calc. See references, Section A, page 1 of 12. Review has determined this calc. is technically adequate.

R. M. Callegari 12/20/87
Design Verifier (Independent Reviewer) Date

2219280000

TVA

Title: SQN - "Minimum Head Required For Turbine Driven And Motor Driven Aux. Feedwater Pumps

REVISION LOG

Revision No.	DESCRIPTION OF REVISION	Date Approved
1	This revision incorporates the increase in system resistance due to the removal of the pressure control valves and the installation of cavitating venturis in their place. The increased system resistance reduces the allowable pump degradation and thus raises the minimum acceptable pump head during surveillance testing. This revision also takes credit for the USQD written during the performance of PMT-53 on unit 2, which justifies a reduction in required flow for the 2A-A pump from 440 gpm to the steam generators to 400 gpm. Accordingly, min. acceptable pump head is determined on an individual pump basis to account for the different requirements.	
2	Added references to the Mainsteam and AFW Design Criteria Explained the differences between the DC's and the data used in this Calc. This revision completes part of the corrective action for PIR MEB 9786. ALSO ADDED BRANCH ID # TO ALL PAGES.	

TVA 10534 (EN DES-4-78)

TVA 2219280000

SQN

Title: MINIMUM HEAD REQUIRED FOR TURBINE DRIVEN & MOTOR DRIVEN AUX. FEEDWATER PUMPS

REVISION LOG

Revision No.	DESCRIPTION OF REVISION	Date Approved
3	REVISED CALCULATION FOR DETERMINING THE MINIMUM TOTAL DYNAMIC HEAD OF THE TURBINE DRIVEN AUXILIARY FEED WATER PUMP IN SECTIONS C.2.a and C.2.b. ALSO REVISED CALCULATION FOR DETERMINING THE MINIMUM TOTAL DYNAMIC HEAD OF THE MOTOR DRIVEN AUXILIARY FEEDWATER PUMPS IN SECTIONS C.1.a THRU C.1.c. INCORPORATED FIELD PUMP DATA FOR 2A-A AND 2B-B, AND REVISED CALCULATIONS TO REFLECT NEW PUMP CURVES GENERATED FROM DATA. ADDED REFERENCE OF TVA MECHANICAL DESIGN STANDARD. INCORPORATED TEST INSTRUMENT ERROR / INACCURACY FOR THE MOTOR-DRIVEN AUX. FEEDWATER PUMPS. ALSO TO ACCOUNT FOR THE APPENDIXES: APPENDIX A - 2 SHEETS, APPENDIX B - 3 SHEETS, APPENDIX C - 2 SHEETS, AND APPENDIX D - 1 SHEET.	12/21/87
4	Incorporated pump data for 2A-S (TDAFWP) and revised calc. to reflect new pump curve generated from data. Incorporated new system resistance values for AFW system. Calculated new minimum required head(s) for the AFW pumps. Revised TDAFWP (c.2) section for calculating minimum head required. Added, deleted, and changed references. Added "Purpose" section and relettered other sections. Renumbered pages of calc. and added Appendixes E, F, + G.	

TVA 10534 (EN DES-4-78)

CALCULATION ID 221928000	Sheet 1 of 12
SQN - AFW System	Prepared by JPB Date 4/30/88
PROJECT SEQUOYAH NUCLEAR PLANT	Checked by Jw Date 4/30/88
SUBJECT Minimum Head Required for Motor-Driven and Turbine-Driven Auxiliary Feedwater Pumps	

SUMMARY OF RESULTS

Equation used to find minimum acceptable head at recirc. flow for surveillance test on Motor-Driven AFW Pumps : Minimum acceptable head at recirc. flow for the Motor Driven AFW Pumps = Pump head at recirc. flow (based on pump curves) - Pump head at 465 gpm - Required TDH at 465 gpm + Allowance for Testing Instrument Error (TIE)

MOTOR-DRIVEN AUXILIARY FEEDWATER PUMPS

Pump No. Serial No.	1A-A 117168	1B-B 117169	2A-A 117171	2B-B 117170	
Head at 465 gpm per pump curve (ref.10)	(later) ft.	(later) ft.	3029.4 ft.	2883.8 ft.	R4
Required head at 465 gpm (see sheet 5)	- 2678.7 ft.	- 2691.6 ft.	- 2686.1 ft.	- 2681.6 ft.	
Allowable degradation	(later) ft	(later) ft.	343.3 ft.	202.2 ft.	
Available head at recirc. flow (75 gpm) per pump curve (ref.10)	(later) ft.	(later) ft.	3783.1 ft.	3508.1 ft.	
Minimum pump head at recirc. flow	(later) ft.	(later) ft.	3439.8 ft.	3305.9 ft.	R4
Allowance for TIE (see sheet 7)	+ (later) ft.	+ (later) ft.	+ 48.7 ft.	+ 42.3 ft.	
Minimum acceptable pump head at recirc. - or - Minimum acceptable pump head for SI	(later) ft. or (later) psid	(later) ft. or (later) psid	3488.5 ft. or 1511 psid	3348.2 ft. or 1450 psid	R4

Equation used to find minimum acceptable head at recirc. flow for surveilance test on Turbine-Driven AFW Pumps : Minimum acceptable head at recirc. flow for the T-D AFW Pumps = Pump head at recirc. flow (from pump curves) - Pump head at 490 gpm - Required TDH at 490 gpm

TURBINE-DRIVEN AUXILIARY FEEDWATER PUMPS

Pump No. Serial No.	1A-S 127182	2A-S 127183
Head at 490 gpm per pump curve (ref. 3 + 10)	2800.0 ft.	2766.1 ft.
Required head at 490 gpm (see sheet 12)	- 2600.6 ft.	- 2600.6 ft.
Allowable degradation	199.4 ft.	165.5 ft.
Available head at recirc. flow (50 gpm) per pump curve (ref 3 + 10)	2972.0 ft.	2854.8 ft.
Minimum acceptable pump head at recirc. - or - Minimum acceptable pump head for SI	2772.6 ft. or 1201 psid	2689.3 ft. or 1165 psid

NOTE :

No Testing Instrument Error was added to the minimum acceptable pump head for the Turbine-Driven AFW Pumps (see sheet 8).

MINIMUM HEAD REQUIRED FOR THE TURBINE - DRIVEN AND MOTOR - DRIVEN AFW PUMPS

SHEET 1 OF 12

2219280000

COMPUTED JPB DATE 4/27/88
CHECKED Jw DATE 4/30/88

A) PURPOSE

R1

This calculation determines the minimum required head that the AFW pumps must develop to assure that the pumps can meet their minimum flow design requirement. The minimum head that is determined in this calculation is used in Technical Specification Requirements 4.7.1.2 for the AFW pumps.

B) ASSUMPTIONS - listed in body of calculation.

R4

MINIMUM HEAD REQUIRED FOR THE TURBINE - DRIVEN AND MOTOR - DRIVEN AFW PUMPS 2219280000

SHEET 2 OF 12

R4 JPB 4/30/88
jw 4/30/88

COMPUTED JPB DATE 12/19/87
CHECKED JW DATE 12/19/87

R4

C) REFERENCES

1) AFW System Pressure Drop Calculation - SNP1-2-CA-D053 0-HCG-JWW-082274 (B25 880430 806)

2) JWW's Calc. 1/9/87 (attached)

3) Pump Test Curve Data (See AFW Pump Calc. Book)
Contract 72C30 - 72610 N2M-10
Pump Test Curves 1A-A
for Motor - 1B-B
Driven Pumps 2A-A see reference 10
2B-B see reference 10
Pump Test Curves for N-530 for pump # 127182 (1A-S)
Turbine - Driven Pumps 2A-S see reference 10.

R4

4) Bingham Wilhamette test of 1st Venturi (NEB 83 1017 639).

R4

5) SQN AFW Flowrates During MSLB Calc. no. SQN-CA-D053 0-HCG-LCS-031285 (B44 850606 006)

6) Design Criteria for the Main Steam System SQN-DC-V-4.1.1 R0

7) Design Criteria for the AFW System SQN-DC-V-13.9.8 R0 & DIMS 1,2,3

R4

8) Post Modification Test (PMT) - 53 for Units 1 & 2 AFW Cavitating Venturi (see Appendix G)

9)

10) Analysis of AFW Pump Head Test Data Calculation no. SQN-CSS-021 Rev. 1 (B25 88 0429 331)

11) Letter from H.L. Jones to R.E. Daniels dated 12/8/87 (B25 871208 016)

12) Work Plan (WP) 12195 for 2A-A Motor - Driven AFW Pump Cavitating Venturi (see Appendix F)

MINIMUM HEAD REQUIRED FOR THE TURBINE - DRIVEN AND MOTOR - DRIVEN AFW PUMPS

SHEET 3 OF 12

2219230000

COMPUTED GRB DATE 4/29/88

CHECKED Jw DATE 4/30/88

RH

13) Bingham - Willamette (Rocky Mountain Nuclear Cavitating Venturi Test P0638-3) test of 2A-A MDAFWP Cavitating Venturi (S/N 02) - Contract No. 85P-JG-453044 (see Appendix D)

14) TVA Mechanical Piping Drawings:

Drawing No.	Rev.	Unit	Description
47W401-4	D	0	Feedwater Piping
47W420-10	R	0	Condensate Piping
47W427-1	E	1+2	AFW Piping
47W427-7	I/I	1/2	AFW Piping

15) FSAR Section 10.4.7.2 - Auxiliary Feedwater System - Amendment 4

TVA 11030 (WM-7-75)

R4

D) CALCULATIONS

1) MOTOR - DRIVEN AFW PUMPS (MDAFWP)

R4

d.1.a With the cavitating venturis installed and the Steam Generator (SG) pressure at 1085 psig (ref. 6+7) find the required pump Total Developed Head (TDH_r) at the required flow of 465 gpm (440 gpm to the SGs + 25 gpm recirc. flow) (ref. 7) by two methods:

R4

- i) Calculate the TDH_r by using the SG pressure, static head, calculated system resistance (ref. 1), and the cavitating venturis ΔP's. Use PMT - 53 (ref. 8) and manufacture lab test values (ref. 4 + 13) for venturi ΔP losses.
- ii) Use the actual field measured system resistance values from PMT - 53 (ref. 8) and WP 12195 (ref. 12).

Method 1 - Find required TDH using calculated system resistance at a MDAFWP flow of 465 gpm.

Required TDH (TDH_r) = SG Pressure + Static Head + Calculated System Resistance (SR_c) + Cavitating Venturi ΔP

$$\text{SG Pressure} + \text{Static Head} + \Sigma R_c = K = \overset{(\text{ref. }7)}{\frac{1085}{0.433}} + \overset{(\text{sheet }11)}{\underbrace{(\text{El. }742.34' - 705.5')}} + \overset{(\text{ref. }1)}{\frac{23.74}{0.433}}$$

K = 2597.44 ft. ∴ $TDH_r = K$ + Cavitating Venturi ΔP

Now add the venturi ΔP's and calculate the TDH_r for each MDAFWP..

Loop	1A-A	1B-B	2A-A	2B-B
Venturi ΔP's :	70 psid	78 psid	48 psid	55 psid
	(ref. 4)	PMT - 53 (ref. 8) data and ref. 5, sheet 14.	Appendix D (ref. 13)	PMT - 53 (ref. 8) retest # 2 Appendix A

Note: Scott Long (test engr.) confirmed that venturi S/N 1 with insert, which was tested by the vendor, is installed in loop 1A-A.

$$48\left(\frac{440}{410.4}\right)^2 = 55.2$$

MINIMUM HEAD REQUIRED FOR THE TURBINE - DRIVEN AND MOTOR - DRIVEN AFW PUMPS 2219280000

COMPUTED gPC DATE 4/28/88
CHECKED jw DATE 4/30/88

Method 1 Results

	Loop 1A-A	1B-B	2A-A	2B-B
TDH$_r$ with venturis installed (based on tested venturi losses & calculated losses for the rest of system)	K = 2597.44 ft $\longrightarrow$			R4
	$+\left(70/0.433\right)$	$+\left(78/0.433\right)$	$+\left(48/0.433\right)$	$+\left(55/0.433\right)$
	2759.1 ft	2777.6 ft	2708.3 ft	2724.5 ft

Note: Actual Pump Flow = 465 gpm (440 gpm to SG + 25 gpm recirc.)

Method 2 - Find TDH$_r$ using system resistance from PMT - 53 (ref. 8) and WP12195 (ref. 12) at a pump flow = 465 gpm (440 gpm to SG + 25 gpm recirc.)

Required TDH (TDH$_r$) = SG Pressure + Static Head + Measured System Resistance (SR$_m$)

$$TDH_r = \overset{(ref.1)}{\frac{1085}{0.433}} + \overset{\{sheet\ 11\}}{(El.\ 742.34' - 705.5')} + SR_m = 2542.6\ ft + SR_m$$

$$SR_m = \left[\left(\begin{matrix}\text{Pump discharge pressure}\\ \text{(w/ LCV's full open)}\end{matrix} - \text{SG pressure}\right) - \underbrace{\begin{matrix}\text{Static Head from pump}\\ \text{discharge to SG inlet}\end{matrix}}_{(742.34' - 692.08') = 50.26'\ \{sheet\ 11\}}\right]\left(\frac{Q_{440}}{Q_{PMT-53}}\right)^2$$

Loop — TDH$_r$

* 1A-A $$TDH_r = 2542.6\ ft + \left[\left(\frac{1128-1005}{0.433} - 50.26\right)\left(\frac{440}{576.6}\right)^2\right] ft = 2678.7\ ft$$

** 1B-B $$TDH_r = 2542.6\ ft + \left[\left(\frac{1128-1005}{0.433} - 50.26\right)\left(\frac{440}{551.2}\right)^2\right] ft = 2691.6\ ft$$

Δ 2A-A $$TDH_r = 2542.6\ ft + \left[\left(\frac{1112.4-990}{0.433} - 50.26\right)\left(\frac{440}{560}\right)^2\right] ft = 2686.1\ ft$$

ΔΔ 2B-B $$TDH_r = 2542.6\ ft + \left[\left(\frac{1117-1002}{0.433} - 50.26\right)\left(\frac{440}{547.6}\right)^2\right] ft = 2681.6\ ft$$

* See page x-d-18 of PMT - 53 (ref. 8)

** See page x-d-21 of PMT - 53 (ref. 8)

Δ See page x-a-36 & 37 of WP 12195 (ref. 12)

ΔΔ See page x-a-51 of PMT - 53 (ref. 8)

MINIMUM HEAD REQUIRED FOR THE TURBINE - DRIVEN AND
MOTOR - DRIVEN AFW PUMPS 2219280000

COMPUTED JEB DATE 4/29/88
CHECKED JW DATE 4/30/88

R4

The SG pressure used in determining the SR_m for 2A-A and 2B-B Motor-Driven AFW Pumps was derived from taking the average of the appropriate SG pressure just before starting the pump and just after stopping the pump.

Method 2 will be used in determining the minimum required head for the motor-driven AFW pumps for the following reasons:

1) The values used in determining the TDHr are based on actual field/plant test data which truely represents the system resistance for each particular pump.

2) There is some conservatism factored into determining the minimum required head, and they are as follows:

   a) The 440 gpm AFW flow requirement comes from a maximum reactor power of 102% of the ESD rating and no AFW (cooling) flow to the SG for 10 minutes (ref. 15), and

   b) Testing Instrument Error (TIE), which accounts for instrument inaccuracies, is also being added to the minimum required head for extra assurance that the minimum head calculated is conservative.

Method 2 does not account for the actual friction loss/dP for the MDAFWP suction piping because its value is negligible when compared to the conservatism that is factored into the minimum required head value. The difference between the suction pressure measured and actual head from a CST level of 23.5 ft (ref. 12) is 0.08 psi for a flow rate of 465 gpm.

MINIMUM HEAD REQUIRED FOR THE TURBINE - DRIVEN AND MOTOR - DRIVEN AFW PUMPS 2219280000

SHEET 7 OF 12

R4 JPB 4/30/88 COMPUTED JPB DATE 12/19/87
Jw 4/30/88 CHECKED Jw DATE 12/19/87

R4

d.1.b Testing Instrument Error (TIE) is calculated using ref. 10

Reference 10 uses actual field tested pump data and then develops a computer generated pump curve by means of curve fit equation / program. The ref. 10 calc. incorporates instrument inaccuracy data and a min. / max. pump curve based on the +/- of instrument inaccuracies applied to the nominal pump curve (generated from actual field test data).

The TIE used in this calc. is the average of differences, in head, between the min. & nominal and max. & nominal pump curves (generated in ref. 10) at a flow of 465 gpm.

Pump		2981.3	Min. Head Expected	48.1 ft	
2A-A	⟹	3029.4	Nominal Head Expected		Differences
@ 465 gpm		3078.6	Max. Head Expected	49.2 ft	

$$2A\text{-}A \ TIE = \frac{48.1 + 49.2}{2} = 48.65 \text{ ft} \quad \text{or } \underline{48.7 \text{ ft.}}$$

Pump		2841.9	Min. Head Expected	41.9 ft	
2B-B	⟹	2883.8	Nominal Head Expected		Differences
@ 465 gpm		2926.5	Max. Head Expected	42.7 ft	

$$2B\text{-}B \ TIE = \frac{41.9 + 42.7}{2} = \underline{42.3 \text{ ft}}$$

Pump		(later)	Min. Head Expected	(later)	
1A-A	⟹	↓	Nominal Head Expected		Differences
@ 465 gpm			Max. Head Expected	(later)	

$$1A\text{-}A \ TIE = \frac{(\text{later})}{2} = -$$

MINIMUM HEAD REQUIRED FOR THE TURBINE - DRIVEN AND MOTOR - DRIVEN AFW PUMPS

SHEET 3 OF 12

2219280000

R4 JPB 4/30/88 COMPUTED JPB DATE 12/19/87

Jw 4/30/88 CHECKED Jw DATE 12/19/87

Pump 1B - B @ 465 gpm ⟹ (later) ↓

Min. Head Expected > (later)

Nominal Head Expected

Max. Head Expected > (later)

Differences

$$1B-B \ \text{TIE} = \frac{(\text{later})}{2} =$$

The TIE for the Motor - Driven AFW Pumps incorporates instrument error from both flow and pressure (head) instrumentation inaccuracies. The total error is determined by using the "Square Root of the Sum of the Squares" $[\sqrt{(\ )^2 + (\ )^2 + \cdots}]$ of all the inaccuracies.

The TIE term based only on pressure / head was 10 psig (or 23.1 ft). Therefore, if the Surveillance Instruction (SI) which tests the M-D AFW Pumps (satisfying Tech Spec requirements) can measure the pump head with an error of less than or equal to 10 psi, (i.e. the 10 psi error can be met by using a 2000 psig discharge pressure gauge which has an accuracy of $\frac{1}{2}$ %, and a 60 psig suction pressure gauge which has an accuracy of $\frac{1}{2}$ %) then no further inaccuracies need to be accounted for. ICF 87 - 2419 will incorporate the use of the specified gauges above in SI - 130.2.

There is no TIE applied to the Turbine - Driven AFW Pumps since the pump is only required to supply a minimum of 440 gpm to the Steam Generators and the pump is capable of a nominal flow of 880 gpm. Since this provides approximately 100 % reserve margin for the pump, the instrument inaccuracies are negligible when compared to the excess pump capacity. (See ref. 11) R4

MINIMUM HEAD REQUIRED FOR THE TURBINE - DRIVEN AND MOTOR - DRIVEN AFW PUMPS 2219280000

COMPUTED JPB DATE 4/28/88
CHECKED Jw DATE 4/30/88

R4

d.1.c

Since method 2 (sheet 5) yields the actual system resistance per AFW pump, the allowable pump degradation will be based on method 2.

Using the same technique as R0 of this calc., the minimum acceptable head when testing at recirc. flow is given by:

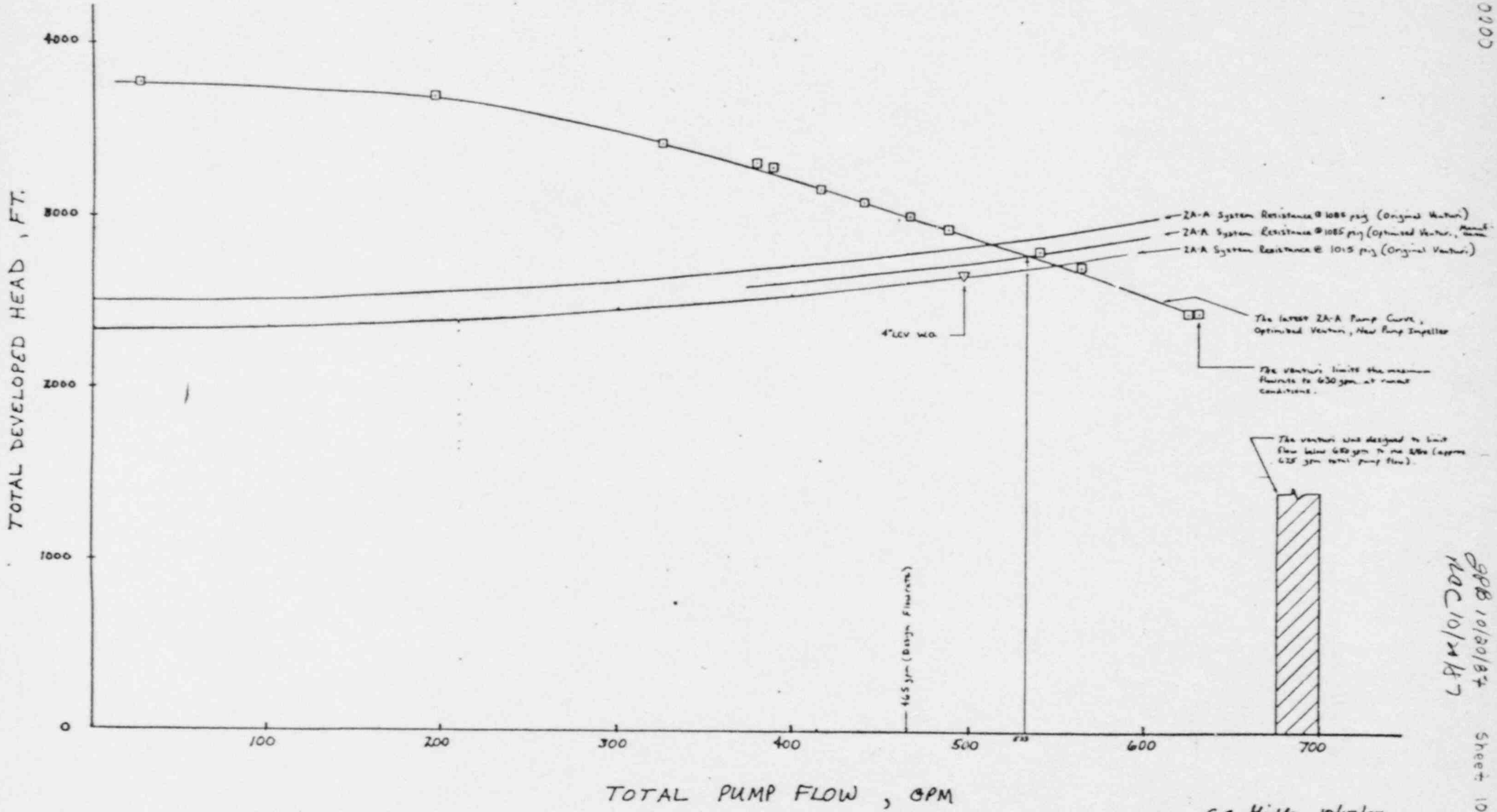
Min. acceptable head at recirc. flow = Pump head @ recirc. flow (based on pump curves) − (Pump head @ 465 gpm (based on pump curves) − Required TDH @ 465 gpm) + Allowance for Testing Instrument Error

AFW Motor - Driven Pumps
Minimum Acceptable Head @ Recirc. (≈ 25 gpm)

Pump	1A-A	1B-B	2A-A	2B-B
(ref. 10) Head @ 465 gpm per pump curve	(later) ft	(later) ft	3029.4 ft	2883.8 ft
Required Head @ 465 gpm (from sheet 2b)	2678.7 ft	2691.6 ft	2686.1 ft	2681.6 ft
Allowable degradation	(later) ft	(later) ft	343.3 ft	202.2 ft
(ref. 10) Head @ Recirc. flow per pump curve	(later) ft	(later) ft	3783.1 ft	3508.1 ft
Min. Acceptable Head @ Recirc. flow (w/o TIE)	(later) ft	(later) ft	3439.8 ft	3305.9 ft
Allowance for Testing Instrument Error (from sheet 3)	(later) ft	(later) ft	48.7 ft	42.3 ft
Min. Acceptable Head w/ TIE @ Recirc flow	(later) ft or (later) psid	(later) ft or (later) psid	3488.5 ft or 1511 psid	3348.2 ft or 1450 psid
Maximum Allowable Degradation, %	(later) %	(later) %	7.8 %	4.6 %

Degradation % = [Pump Recirc Head (H_r) − Min. Acceptable Head at Recirc. w/ TIE] Divided by H_r × 100%

POST MAINTENANCE TEST - WP 12195
SEQUOYAH NUCLEAR PLANT
UNIT 2
MOTOR-DRIVEN AFW PUMP 2A-A SYSTEM DATA ANALYSIS



C.a. Gidley 10/15/87

SPB 10/20/87

RDC 10/20/87

Sheet 10 of 18

MINIMUM HEAD REQUIRED FOR TURBINE AND MOTOR DRIVEN AUXILIARY FEED-WATER PUMPS

SHEET 11 OF 12

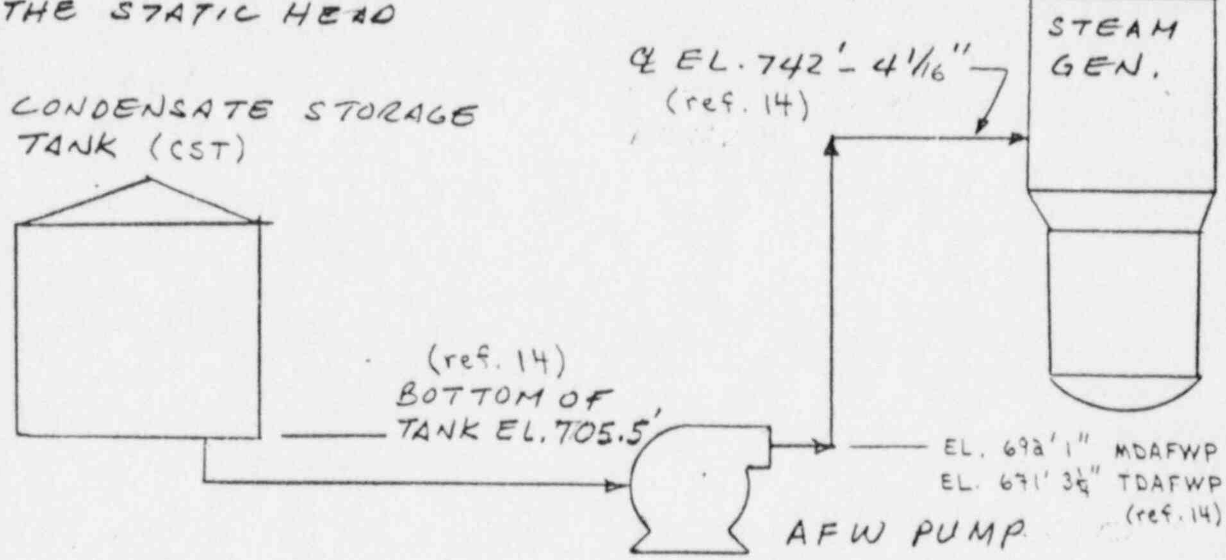
R4 JRB 4/30/88
JW 4/30/88

COMPUTED RCC DATE 10-17-87
CHECKED JDW DATE 10-17-87

R4

D) CALCULATIONS

ASSUME BOTTOM OF THE TANK = THE MINIMUM WATER LEVEL FOR DETERMINING THE STATIC HEAD



R4

R4

SH = ELEVATION (POINT OF CONNECTION AT THE SG) MINUS MINIMUM WATER LEVEL (CONDENSATE STORAGE TANK)

$$= (742' - 4\tfrac{1}{16}'') - 705.5' = 36.84'$$

REV. 3

R4

MINIMUM REQUIRED HEAD FOR THE TURBINE - DRIVEN AND MOTOR - DRIVEN AFW PUMPS 2219280000 SHEET 12 OF 12

R4 JPB 4/30/88 COMPUTED JPB DATE 12/19/87
JW 4/30/88 CHECKED JW DATE 12/19/87

2) T-D Pumps

R4

2.2 **Assumptions** According to Westinghouse and refs. 6, 7, +11; only 440 gpm (+50 gpm recirc. flow) is required to the SGs at a pressure of 1085 psig in order to meet its safety function. Use this as the basis to estimate the tech specs requirement.

Find minimum required TDH (TDH_r) for the Turbine - Driven AFW Pump (TDAFWP) at the minimum required AFW flow of 440 gpm to the SGs.

TDH_r = SG Pressure + Static Head + System Resistance (calculated)

$$TDH_r = \overset{(\text{ref. }7)}{\frac{1085}{0.433}} + (\text{El. } 742.34' - 705.5') + \overset{(\text{ref. }1)}{\frac{25.12}{0.433}} = 2600.6$$

TDAFWP Data

Pump No.	H_{TC} Head from pump curve at 490 gpm	H_S Recirc Head (ft) from pump curve (50 gpm)	Minimum Acceptable Head @ Recirc	Degradation Percentage
1A-S	(in feet) 2800 (note 1)	2972 (note 1)	1200.5 psi	93.3 %
2A-S	2766.1 (ref. 10)	2854.8 (ref. 10)	1164.5 psi	94.2 %

Note 1 - Pump test curve from Ingersoll - Rand at 3970 rpm (dated 4-11-73), Pump no. 127182 (Serial No. N-530) (ref. 3)

Degradation % = Recirc. / Shutoff Head (H_S) - [Head from pump test curve at 490 gpm (H_{TC}) - TDH_r] Divided by H_S × 100 %

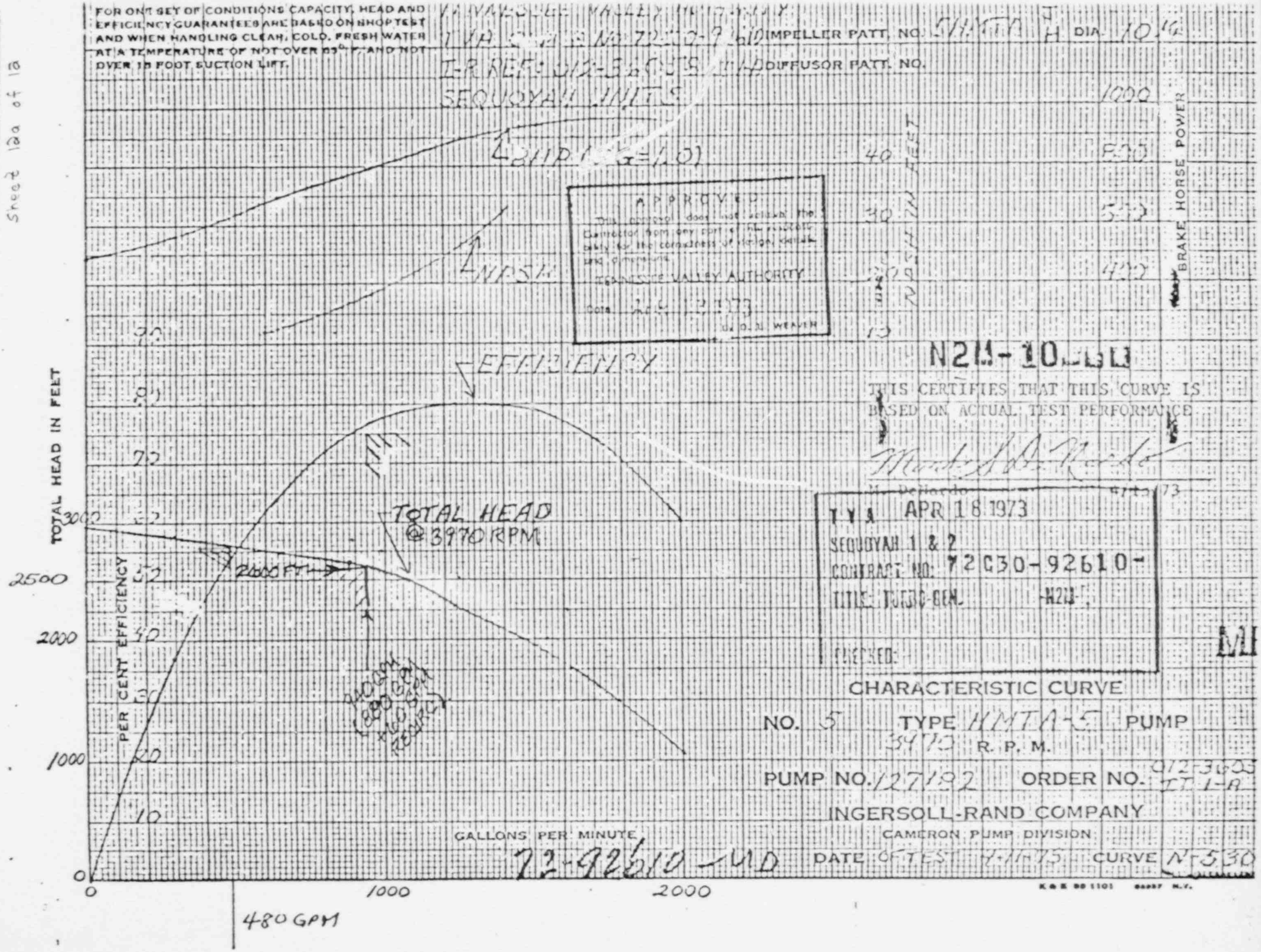
$$\text{Minimum Acceptable Head @ Recirc} = \left[H_S - (H_{TC} - TDH_r)\right] \times 0.433 \ (\text{psi})$$

2019280000

REV. 3

RCC 10/20/87
JRB 10/20/87

Sheet 12a of 12



FOR ONE SET OF CONDITIONS CAPACITY, HEAD AND EFFICIENCY GUARANTEES ARE BASED ON SHOP TEST AND WHEN HANDLING CLEAN, COLD, FRESH WATER AT A TEMPERATURE OF NOT OVER 85° F. AND NOT OVER 15 FOOT SUCTION LIFT.

TENNESSEE VALLEY AUTHORITY
TVA CONTRACT No 72C30-92610 IMPELLER PATT. NO. 5HMTA J H DIA. 10 1/4
I-R REF 012-3603 IT 1-A DIFFUSOR PATT. NO.
SEQUOYAH UNITS

APPROVED
This approval does not relieve the Contractor from any part of his responsibility for the correctness of design, details and dimensions.
TENNESSEE VALLEY AUTHORITY
Date JUN 12 1973
by O. N. WEAVER

N2M-10-[illegible]

THIS CERTIFIES THAT THIS CURVE IS BASED ON ACTUAL TEST PERFORMANCE

M. Dellacdo [illegible] 73

T V A APR 18 1973
SEQUOYAH 1 & 2
CONTRACT NO. 72C30-92610-
TITLE: TURBO-GEN. -N2M-
CHECKED:

CHARACTERISTIC CURVE

NO. 5 TYPE HMTA-5 PUMP
3970 R. P. M.

PUMP NO. 127192 ORDER NO. 012-3603 IT 1-A

INGERSOLL-RAND COMPANY
CAMERON PUMP DIVISION

72-92610-MD DATE OF TEST 4-11-73 CURVE N-530

K&E 90 1101

SUBJECT MUAFP 2AA & KCIRST PROJECT PMT-53 Retest #2

SG ce @ 845 PSIS ~ 5/17/85

COMPUTED BY DATE CHECKED BY DATE

TIA INT	SUCTION PRESSURE	DISCHARGE PRESSURE (PLANT)	DISCHARGE PRESSURE (TEMP)	VENTURI HIGH	VENTURI LOW	SYSTEM PRESSURE LOOP 1	SYSTEM PRESSURE LOOP 2	CHECK VALVE ΔP	VENTURI ΔP	VENTURI √ΔP	PIPING ΔP LOOP 1	PIPING ΔP LOOP 2	TOTAL HEAD	FLOW TO SG #1	FLOW TO SG #2	TOTAL FLOW TO SG's
1	17.3	1450	–	1426	1399	1389.4	1387	24	27	5,20	9.6	12	3305	120.0	125,5	245.5
2	17.25	1375	–	1351	1307	1296.8	1295	24	44	6.63	10.2	12	3132	154.3	154.1	313.4
3	17.1	1260	–	1237	1162	1152.9	1150	23	75	8.66	9.1	12	2867	209.1	199.7	408.8
4	17.0	1150	–	1133	1028	1017.0	1014	17	105	10.25	11.0	14	2614	241.7	242.5	484.2
5	16.8	1070	–	1053	911	900.1	898	17	142	11.92	10.9	13	2390 2430	244.5	236.6	531.1
6	17.25	1345	1322	1321	1269	1259.3	–	24 (1)	52	7.21	9.7	–	3010 3063	171.4	167.7	339.1
7	17.1	1210	1190	1192	1104	1094.1	–	18 (-2)	88	9.38	9.9	–	2706 2752	221.3	219.0	440.3
8	17.0	1160	1140	1136	1032	1021.0	–	24 (4)	104	10.20	11.0	–	2591 2637	242.1	235.4	480.5

APPENDIX A 2219280000

A1

INFORMATION ONLY

INFORMATION ONLY

TENNESSEE VALLEY AUTHORITY

SHEET OF

SUBJECT Mc 3B-B PROJECT PMT-52 st #2

SG PRESSURE @ 855 PSIG 7/17/05

COMPUTED BY DATE CHECKED BY DATE

DATA POINT	SUCTION PRESSURE	DISCHARGE PRESSURE (PLANT)	VENTURI HIGH	VENTURI LOW	SYSTEM PRESSURE LOOP 3	SYSTEM PRESSURE LOOP 4	CHECK VALVE ΔP	VENTURI ΔP	VENTURI √ΔP	PIPING ΔP LOOP 3	PIPING ΔP LOOP 4	TOTAL HEAD	FLOW TO SG #3	FLOW TO SG #4	TOTAL FLOW TO SG's	PUMP OUTPUT
1	17.5	1440	1437.	1417	1423.9	1414.5	3	20.	4.47	-6.9	2.5	3282	132.2	122.6	254.8	
2	17.5	1380	1377	1346	1351.1	1343.6	3	31	5.57	-5.1	2.4	3143	154	161.5	315.5	
3	17.5	1260	1272	1224	1227.4	1221.6	8	48	6.93	-3.4	2.4	2913	201.7	208.7	410.4	
								~53 psid			~5.0				~440 gpm	
4	17.2	1170	1174	1111	1109.4	1104.3	-4	63	7.94	1.6	6.7	2660	245.1	246.5	491.6	
5	17.1	1070	106.2	904	894.2	889.6	8	158	12.57	8	14.4	2429	250.2	322.6	572.8	

2219280000

A2

INFORMATION ONLY

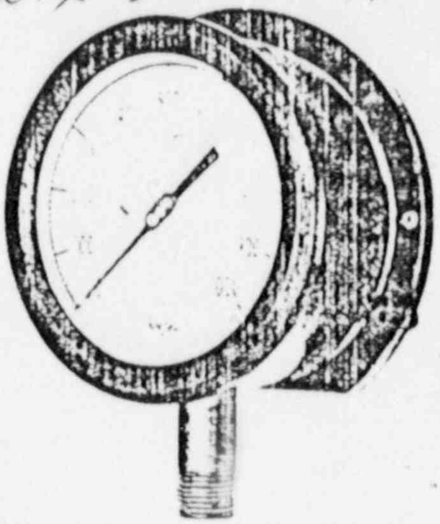
2219280000
Appendix B
B1

600 SERIES/700 SERIES

STAINLESS STEEL BOURDON TUBE
ALLOY STEEL/STAINLESS STEEL SOCKET

ACRAGAGE®
SOLID FRONT GAGES

INFORMATION ONLY



For use on any media not corrosive to gage system materials. (See pages 12-13.)

Standard – AISI 316-L stainless steel, ranges 0-15 thru 0-5000 psi. Type 403 stainless steel, ranges 0-7500 thru 0-20,000 psi.

4½" and 6": Available with Aluminum case, styles 13, 14 and 67; and Phenol case, style 75. See Catalog No. tabulation, this page, and case descriptions, page 11.

Standard: White with black figures. *Optional:* 'ack with white figures.

600 Series: Carbon steel. *700 Series:* AISI 316 stainless steel.

Pressures up to 1000 psi: 1/4" and 1/2" NPT male. *Pressures over 1000 psi:* 1/2" NPT male.

NOTE: Custom connections available.

Acrapointer, balanced adjustable design.

Standard: Double-strength glass. *Optional:* Safety glass or plastic.

Suffix B: Geared stainless steel. Stainless pinion, gear and bushings.

Suffix D: Delrin bushed and geared. Delrin sector and bushings; stainless pinion.

Within 1/2 of 1% of full range.

See pages 36-37.

See page 38.

See pages 32-35.

Gages on this page available with special features iown on pages 7 and 8.

Models 675/775 only also available with fluid fill. See Page 19.

NOTE: 600 Series: Alloy steel socket; 700 Series: 316 Stainless Steel socket.

MOVEMENTS: Add suffix letter to catalog number to designate movement. (B: stainless steel; D: Delrin.) Complete description of movements on page 6.

For ordering information, see page 39.

CATALOG NO.	CASE	RING	MOUNTING
613/713	Aluminum	Screwed	Wall, Flush or Stem
614/714	Aluminum	Screwed	Stem only
667/767	Aluminum	Hinged	Flush only
675/775	Phenol	Polypropylene	Wall or Stem

PRESSURE RANGES – PSI

TOTAL GRADUATIONS	FIGURE INTERVALS	MINOR SUBDIVISIONS
0-15	1	.1
0-30	3	.2
0-60	5	.5
0-100	10	1
0-160	20	2
0-200	20	2
0-250	50	2
0-300	30	2
0-400	50	5
0-500	50	5
0-600	50	5
0-800	100	10
0-1000	100	10
0-1500	200	10
0-2000	200	20
0-2500	500	20
0-3000	500	20
0-5000	500	50
0-7500	1000	50
0-10,000	1000	100
0-15,000	2000	100
0-20,000	2000	200

COMPOUND RANGES
(Inches HG. VAC. and PSI)

TOTAL GRADUATIONS	FIGURE INTERVALS	MINOR SUBDIVISIONS
30"-0- 15	5" & 3	.5" & .2
30"-0- 30	10" & 5	1" & .5
30"-0- 60	10" & 10	1" & 1
30"-0-100	30" & 10	2" & 1
30"-0-150	30" & 30	5" & 2
30"-0-200	30" & 20	5" & 2
30"-0-300	30" & 50	5" & 2

VACUUM RANGE

0-30" Vac.	3"	.2"

Also available in equivalent metric ranges.

2219280000

TENNESSEE VALLEY AUTHORITY

Purchase Requisition B2

B2

Commodity code

Requisition number 337850

Requisition Date Oct. 4, 1982

Account Number	Location	Subpro.	Org.	Activity	
	6000	056	12	80	

Acctg. Office Power 02

Location Sequoyah NuclearPlant

Project Power Stores

Organization Power 5040800000

Requisitioner Ref. No.

Ship To Tennessee Valley Authority 5800
ATTN: C. E. Brannon, Power Stores
Sequoyah Nuclear Plant near Daisy,

Shipping Notice To: P.O. Box 2000, Daisy, TN 3

Ship By UPS 02 Date Wanted 10/20

ITEM NO.	ARTICLES OR SERVICES Give Complete Description or Catalog Number	QUANTITY	UNIT	UNIT PRICE*	AMO
10-5-8	INITIAL STOCK				
1..	Gauge, pressure, Robertshaw catalog 0767-B-4½", 0-2000 psi, ½" NPT back connection	5	EA	100.00	50

Seq

Tiic # Aym 438K

Bin 10318-2

NO QA

FOR: Various Non-CSSC Systems
(3-PI-3-122B & 3-PI-3-132B)

REF: Robertshaw Controls Co.
2318 Kingston Pike, S.W.
Knoxville, TN 37901

INFORMATION ONLY

THIS CONTRACT WILL BE PAID WITH: (REFER TO ACCOUNTING MEMORANDUM 144)

ajm

POWER FUNDS 100 % APPROPRIATED FUNDS % OTHER FUNDS %

Quality Assurance Requirements ☐ are required and included ☒ are not required

Is 10 CFR Part 21 notice required? Yes ☐ No ☒ QA-VS 10-5-82

*If not estimated price, price used on previous Contract No.

C E Brannon
C. E. Brannon
751-6224

E. W. Mansfield

Validated by

Approved

WP 11010
PAGE IX-1 OF

DIVISION OF PURCHASING
POWER REQUISITION FILES
ORIGINATING OFFICE

I/B's 0 Contracts 2

989C00 | 450 | 1102C | KNOX | - | 80
2601A - WASH. - 20
(T) (2)

4

2219280000 B3

ROBERTSHAW CONTROLS COMPANY
FULTON SYLPHON DIVISION
P. O. BOX 400 - KNOXVILLE, TENNESSEE 37901

INVOICE
D.U.N.S. 00-337-4683

CHANGE #1
1/26/73

PAGE #8 OF 26

OUR ORDER NO.	DATE	CUSTOMER'S ORDER NO. AND/OR DATE
39301	9/18/72	73C-38-83530-3 SCHEDULE I

INVOICE NUMBER: 19904
DATE: 5-18-73

WHEN REMITTING PLEASE ENCLOSE THE YELLOW COPY OF THIS INVOICE, OR REFER TO YOUR "CUSTOMER ACCOUNT NUMBER" OR YOUR REMITTANCE ADVICE.

SHIP TO:
WOLFE & MANN MFG. CO.
28TH AND SISSON STREETS
BALTIMORE, MD 21211
MARK: FOR SHOP ORDER 16285

CUSTOMER'S REQUISITION:
CASE NO.:

SHIPPING INSTRUCTIONS: ROADWAY - PPD. & CHG.
SHIPMENT REQUESTED: ASAP
SHIPPED VIA:

865 ← CUSTOMER ACCOUNT NO.

SOLD TO:
TENNESSEE VALLEY AUTHORITY
CONSTRUCTION ACCOUNTING BRANCH
KNOXVILLE, TENNESSEE

TRAFFIC CONTROL:
BRANCH ORDER NO.:

NO. OF
_______ CARTONS
_______ BOXES
_______ CRATES
SHIPPING WT. _______
CASE NOS.

COMPLETE OR PARTIAL	TERMS OF SALE:	PRIORITY RATING	MTL. CERT. REQUIRED	RENEGOTIABLE	GOVERNMENT INSPECTION
P	NET 30 DAYS F. O. B. KNOXVILLE, TENN.				

QUANTITY THIS SHIPMENT	QUAN ORDERED OR BALANCE DUE	PART NO. SIZE AND DESCRIPTION	PART CODE NUMBER	UNIT PRICE	GROSS AMOUNT	NET AMOUNT PAY LAST AMOUNT IN THIS COLUMN
		FACTORY	Brt fwd		6691.86	
10	10	ITEM #8 80164-A31 (767-B) ACRAGAGE 4½" 0-30 PSI ¼" NPT BACK CONN.		23.73 NET EA.	237.30	
		AL. TAG (1 EA.) 1-PI-3-127, 1-PI-3-117, 1-PI-6-188, 1-PI-6-189 0-PI-78-23, 0-PI-78-24 2-PI-3-127, 2-PI-3-117, 2-PI-6-188, 2-PI-6-189			6929.16 Fwd	
		CHANGE TAGGING				
		system 78				✓
		QA				

INFORMATION ONLY

Appendix C 2219280000 C1

ENNESSEE VALLEY AUTHORITY
DIVISION OF PURCHASING
Chattanooga, Tennessee 37401
Telephone -- Area Code 615/265-3651
TWX No. 810 575 5274

INVITATION, BID, AND ACCEPTANCE

To be completed by TVA

State or Country Code {(29) - 148,~~2~~; (34) - 38,635; ~~(05) - 110,014.~~}
Vendor Code
Buying Code L A
Commodity Code
Account Number 1N2 139
N2M 10

Bidder No. 1

CONTRACT

TVA Reference No. 72C 30-926
Contract Date July 9, 1971
Total Amount $ 296,931
Performance Date May 1, 1972

INVITATION

Date May 4, 1971

A quotation IN DUPLICATE is requested on the items listed, subject to the conditions herein. Quotations will be received at this office until 10 a.m. EST, June 3, 1971* and will be opened and read in public. Bids not physically received by the time stated will be returned unopened to the bidder.

TENNESSEE VALLEY AUTHORITY, By M. W. Thomas
Purchasing Agent

ARTICLES OR SERVICES AND 1r ATTACHMENTS WHICH FORM PART OF CONTRACT

*Local Time at Chattanooga, Tennessee

STEAM-TURBINE-DRIVEN AND ELECTRIC-MOTOR-DRIVEN AUXILIARY FEED WATER PUMPING UNITS

APPROVED:
James L. Williams, Jr.
7/9/71

Schedule of Prices
Delivery and Shipping Data
Guaranteed Data
Equipment Data
Experience Data
~~Foreign Bidder Conditions (forms 9699 and~~ 9699A)
Special Conditions
General Conditions (form 5052)
Walsh-Healey Act
Equal Opportunity (forms 9923 and 9925)
TVA Specification No. 9955
System Tabulation 3-47-112090
Flow Diagram No. 47A5R

TVA USE ONLY. DO NOT USE THIS SPACE.

CS 3		Spec.	1
Bonine 4		Sisk	
CAB		Contr.	1
TB			
PAB			
Sherrod			

RECD JUL 19 1971 MECHANICAL DESIGN

N	H	Name	N	H	Name	N	H	Name
		RHD			BSM			
	1	DRP						
	/	RMS			REL			
					JIC			MHW

Requisitioner Ref. No. ______ Project Sequoyah Nuclear Project

BID --

Date 6/9/71 Bidder's Reference Number ATL-2099

In compliance with the invitation for bids, and subject to all the conditions thereof, the undersigned offers, and agrees if this bid be accepted within ______ days (30 days unless otherwise specified) from the date of the opening, to furnish the services and or sell and deliver the articles, any or all of the items at the price quoted opposite each. Bids may not be withdrawn after opening without the consent of the Contracting Officer.

Discounts will be allowed for payments as follows: None

Unless otherwise qualified by the bidder on this form: (1) discounts will be computed from contract price; and (2) time in connection with discounts offered will be computed from delivery of the supplies at destination, or from date of receipt of correct bill, whichever later.

The bidder represents:

That he is __, is not X a small business concern as defined in Code of Federal Regulations, Title 13, Chapter I, Part 121, Section 121.3-8. In connection with supply contracts, if he is a nonmanufacturer, he also represents that the products to be furnished hereunder will not X, be produced by a small business concern. In construction and construction-type nonpersonal service contracts, the preceding sentence is not applicable.

(Complete only when the aggregate amount of bid is $10,000 or more.)
That he is X a manufacturer of the articles, equipment, material or supplies quoted upon.
That he is __ a regular dealer in, and maintains a stock for sale to the general public of, equipment, materials, or supplies of the general character of that or those upon which herein.

(Complete only when (a) the aggregate amount of bid in response to advertising is $ or more, or (b) the aggregate amount of bid on a negotiated purchase is more than $
That (a) he has __, has not X employed or retained any company or person (other than full-time employees or bona fide established commercial or selling agencies maintained by the bidder [illegible] contractor) for purposes of securing business) to solicit or secure this contract, and (b) he has not X, paid or agreed to pay any company or person (other than bona fide employees or bona fide established commercial or selling agencies maintained by the bidder for purposes of securing business) any fee, commission, percentage, or brokerage fee, contingent upon or resulting from the award of this contract, and agrees to furnish information relating thereto as requested by the Contracting Officer.

INGERSOLL-RAND COMPANY

Street
211 Ingersoll-Rand Drive

City, State, and Zip Code
Chamblee, Georgia 30341

P. O. Box
Number | Zip

Telephone No.
(404) 458-4

TWX No.

Person authorized to sign bid -- Name and title (print or type) and signature
S. R. Unkles, Jr. Dist. Mgr. SRUnkles Jr

ACCEPTANCE -- Accepted only as to: Items 1 and 2, and if required by TVA, item 3, including overtime rates when applicable. F.O.B. Cars, Daisy, Tennessee (CNO & TP Railway), for switch delivery to Sequoyah Plant Site.

PAGE 1A IS MADE A PART OF THIS CONTRACT.

(*See note on page 1A).

INFORMATION ONLY

TENNESSEE VALLEY AUTHORITY, By M. W. Thomas
M. W. Thomas, Purchasing Agent

CONSIGN TO -- TENNESSEE VALLEY AUTHORITY
Daisy, Tennessee (CNO & TP Ry.), for switch delivery to Sequoyah Nuclear Plant Site

MARK: Contract 72C30-92610
For: Sequoyah Units 1 and 2
Attn: Chief Storekeeper

MAIL INVOICE in DUPLICATE to --
TENNESSEE VALLEY AUTHORITY
Construction Accounting Branch
400 Northshore Building
Knoxville, TN 37902

Invoices must show contract number, discount or terms of payment applicable, number, description of article or service, quantity, unit price, and total amount

TVA USE ONLY

I certify that the articles or services listed above have been received in quantity and quality specified except as noted.

TVA 5050 ([illegible])

Person receiving material

Approved as reported above

Date Material Received

Truck: Vendor | TVA

Common Carrier: Express | Freight | Par.

G.B.L. No.

Carrier's Charges: Paid $ Collect $

Purchase Cost

Cash Discount

Carrier's Charges

2219280000 -
CZ

EQUIPMENT DATA (Continued)

INFORMATION ONLY

Impellers

a. Type and material Same as turbine unit

b. Diameter 9-5/8

c.. Number of stages 9

7. Wearing rings

a. Type, method of fastening, and material of rings Casing Rings Type 410 SS, Set Screwed

8. Shaft and sleeves

a. Material and method of fastening 316 SS Coated, Keyed to Shaft

P/B b. Diameter at impellers, bearings, and stuffing boxes 2½", 2.12", & 3·

c. Brinell hardness number of shaft sleeves 578 Min. (Coating)

9. Stuffing boxes

P/B a. Type, size, and materials Packed 4 1/8" OD 13% Chrome

10. Base plate

a. Material and construction Fabricated Carbon Steel

11. Couplings

a. Make, type, and size Fast B Flexible, #2

12. Flanges

P/B a. Size and length of suction and discharge nozzles from centerline
Std of shaft Suction 300# RF 16"
Discharge 900# RF 16"

b. Materials Same as Casing

c. Limiting allowable pump nozzle forces and moments

13. Minimum flow

a. Minimum recommended flow from pump discharge to prevent overheating and/or provide for operational stability 25 GPM

~~V~~VENTURI S/N 03 D#1 gPB
TVA REF 85P-JG453044
15 of 3 gPB

Bingham-Willamette Company

APPENDIX D
~~221902~~ gPB 10/19/87
2219280000

ROCKY MOUNTAIN NUCLEAR

CAVITATING VENTURI TEST--P0638-3

RUN NO.	CAPACITY GPM	INLET PRESSURE PSI	OUTLET PRESSURE PSI	DIFFERENTIAL PRESSURE PSI	LOOP TEMPERATURE °F
1	603	983	802	181	93
2	500	763	702	61	98
3	440	877	829	$\boxed{48}$	97
4	400	731	692	39	99
5	300	737	715	22	97
6	203	847	837	10	94
7	606	987	21	966	95
8	566	863	735	128	94
9	529	840	768	72	93

****

RUMENTATION USED:

CAPACITY...............4" VENTURI METER
INLET PRESSURE........0-1500 PSI GAGE
OUTLET PRESSURE.......0-60 PSI GAGE
0-1000 PSI GAGE

INFORMATION ONLY

WITNESS TESTED @ PORTLAND, OREGON 8/1/85

Jack L Poe FOR ROCKY MOUNTAIN NUCLEAR
Steven Scott Long FOR TENNESSEE VALLEY AUTH.

CERTIFIED CORRECT BY:
O.C. Smith FOR BINGHAM-WILLAMETTE CO.

Bingham-Willamette Company
A DIVISION OF GUY F. ATKINSON COMPANY

CHRIS A. WRIGHT
MANAGER
PORTLAND SERVICE CENTER

2 00 NORTHWEST FRONT AVENUE
P. O. BOX 10247
TLAND, OREGON 97210

(503) 226-5203
(24 HOURS)

ROCKY MOUNTAIN NUCLEAR
Q.A. APPROVED
By Jack L Poe
Date 8-8-85

7800 N.W. Front Avenue • Post Office Box 10247 • Portland, Oregon 97210 U.S.A. • (503) 226-5200 • Telex: 360-510 • TWX: 910-464-5031

TVA 489 (EN DES 11-76)

SQN Tech Spec's

SHEET E1 OF 8

Aux FW Requirements and Test Points

APPENDIX E

R2 RKJ 3/25/87
Bey 3/27/87

COMPUTED JWW DATE 1/9/79
CHECKED [illegible] DATE 1-29-79

2219280000

BACKGROUND / MISC. INFO.

1) ADDITIONAL REFERENCES

1) W written comments (see Spike Dothard's 6/22/77 "45 and notes on 7/12/77 telecon.

2) Crosby letter dated 1/12/72 on S.G. safety valves for Sequoyah

3) Crosby Catalog 402, pg 19.

4) Safety Valve (Contract) Setpoint tolerance for popping is ±1 percent of setpoint per PG-72.3 (1968 Ed. of Section I).

5) TVA-1918 letter from W NSSS (SQN), dated 8/11/71

2) ADDITIONAL ASSUMPTIONS AND GIVEN INFO.

1) 1st S.V. setpoint is 1064 psig. ✓ ref 6
2nd S.V. setpoint is 1077 psig ✓ ref 6 | R2

2) From Reference #1, W states that 440 gpm per M-D aux. feedpump is satisfactory ✓ at least than 1133 psia if the open safety valves can relieve at least 11 percent of nominal steam flow at that pressure.
In Ref. 5, W states that the max. flow that the NSSS can delivered @ 1100 psia is assumed to be max. calculated load flow times 1.02. Max. Calc. load flow is 15,481,500 #/hr per TVA IIB 17K1110-1.

3) Assume 11 percent of nominal flow is
0.11 × 1.02 × 15,481,500 = 1,737,024.3 #/HR total
or 434,256.075 #/HR. per S.G. ✓

4) Select 1085 ✓ psig (≈1100 psia) (Ref 6) as the min. pressure for M.D. aux. feedwater pumps per B(2) above. | R2
Verify below by calculation that S.V. relieving capacity is sufficient.

APPENDIX E

SHEET E2 OF 8

Minimum Head Required for Turbine-driven and Motor-driven Aux FW Pumps

R3 JPB 10/20/87
Rec 10/20/87

2219280000

(THIS PAGE ADDED IN REV. 2)

COMPUTED RKJ DATE 3-25-87

CHECKED Bey DATE 3/27/87

ADDITIONAL REFERENCES (Continued)

6. Design Criteria for Main Steam System
   SQN-DC-V-4.1.1 R0

7. Design Criteria for Auxillary Feedwater System
   SQN-DC-V-13.9.8 R0 & DIMs 1, 2, 3

8. AFW Pump Contract 72C30-72610 N2M-10

Pumptest Curves for Motor-driven Pumps	Curve No. N-509	for pump # 117169
	N-510	117171
	N-511	117771
	N-524	117168
Pumptest Curves for Turbine driven Pumps	N-530	127182
	N-531	127183

Note

The current steam design flow is 3.73 X10^6 lb/hr per SG or 14.92 lb/hr $\times 10^6$ total (ref 6). The maximum capacity of a safety valve is 890,000 lb/hr (ref 6). Since this calculation used 15,481,500 lb/hr steam flow rate and 617,848.9 lb/hr for safety valve capacity, the result are still within the current plant design. The steam flow used is greater than the design point and the safety valve capacity less than the design point are both conservative. The greater flow means the need for more steam relieving capability. The lower safety valve capacity means the current design has greater relieving margin than that used in this calc. Since the results of this calc was acceptable the current design is also acceptable.

There is no need to revise this calc since these difference do not change the results of this calculation.

APPENDIX E

SHEET E3 OF 8

Min Required Head for AFW Pumps

R2: RKF 3-25-87

Bcy 3/27/87

COMPUTED ____ DATE ____

2219280000

CHECKED ___ DATE 1-29-79

3) ADDITIONAL CALCULATIONS

✓ $A = 16$ sq. in.

✓ $P = 1085 + 14.7$ psia

✓ $W = 51.45\,A \cdot P \cdot K$ (100% rated capacity)

✓ $K = 0.975$

$W = 51.45 \cdot 16 \cdot 1099.7 \cdot 0.975$ ✓

$\boxed{= 882{,}641.2\ \#/HR}$ ✓ (100% theoretical capacity)

$(\quad " \quad) \times .9$

$\boxed{= 794{,}377.09}$ ✓ (90% theoretical capacity)

$\left[\left(\quad\downarrow\quad\right)/0.9\right] \times (0.7)$ (see pg 19 of Ref 3 for typical capacities @ pressures 1 to 2 percent above set pressure)

$\boxed{= 617\,848.9\ \#/HR}$ ✓ (70% theoretical capacity)

Since 617 848.9 ✓ is greater than 434 256.1 #/HR 1st Safety Valves can relieve greater than 11 percent of nominal steam flow. Thus okay to have 1085 psig ✓ as minimum test pressure requirement for aux. feedwater pumps in Tech. Spec's.

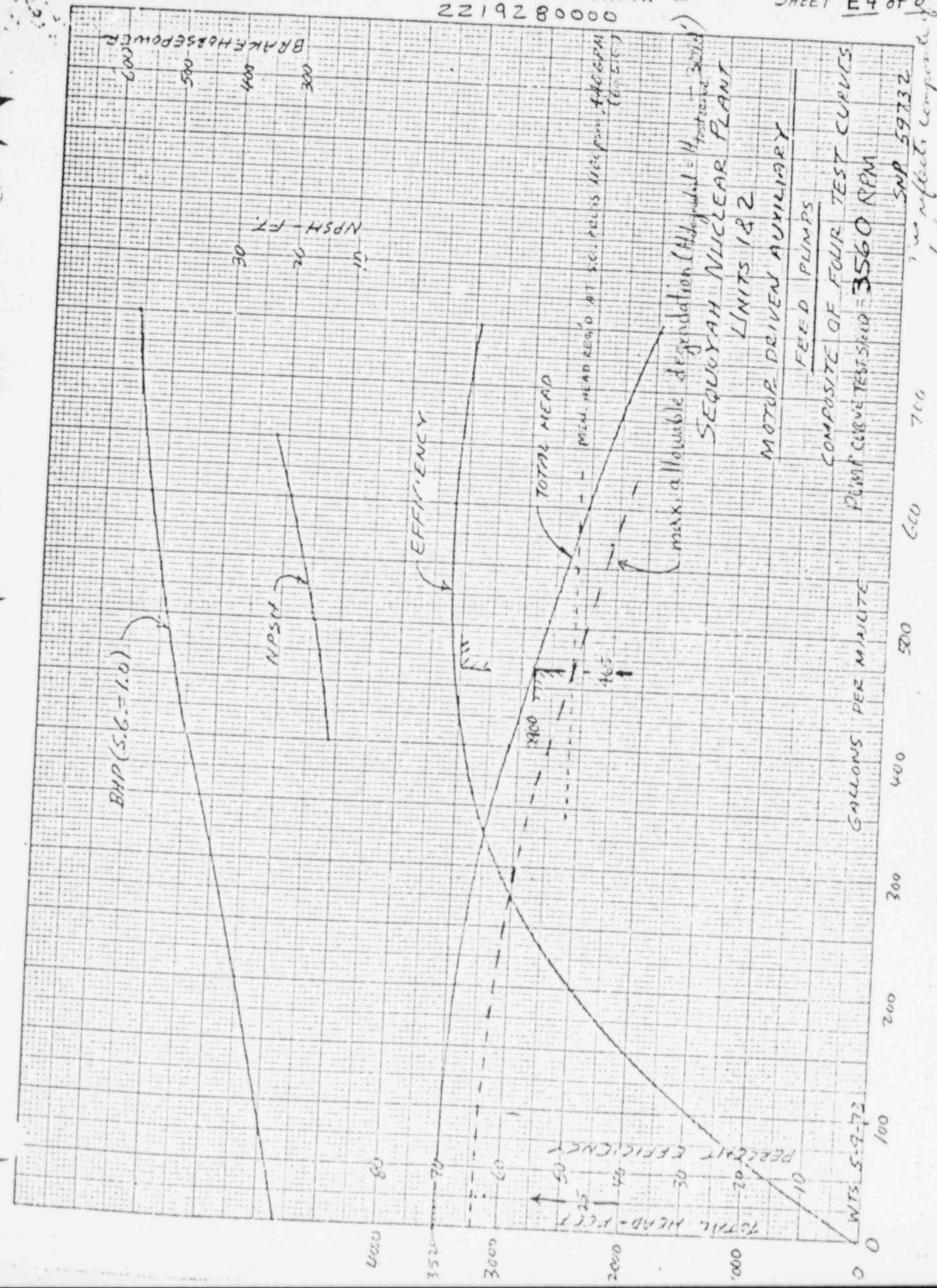
See Note pg 6A

|R2

APPENDIX E

SHEET E4 of 8

2219280000



TVA 489 (REV-8 47)

SHEET E5 OF 8

MOTOR DRIVEN — TEST

APPENDIX E

Min Required Head for AFW Pumps.

RZ RKJ 3/25/87 COMPUTED ____ DATE ____

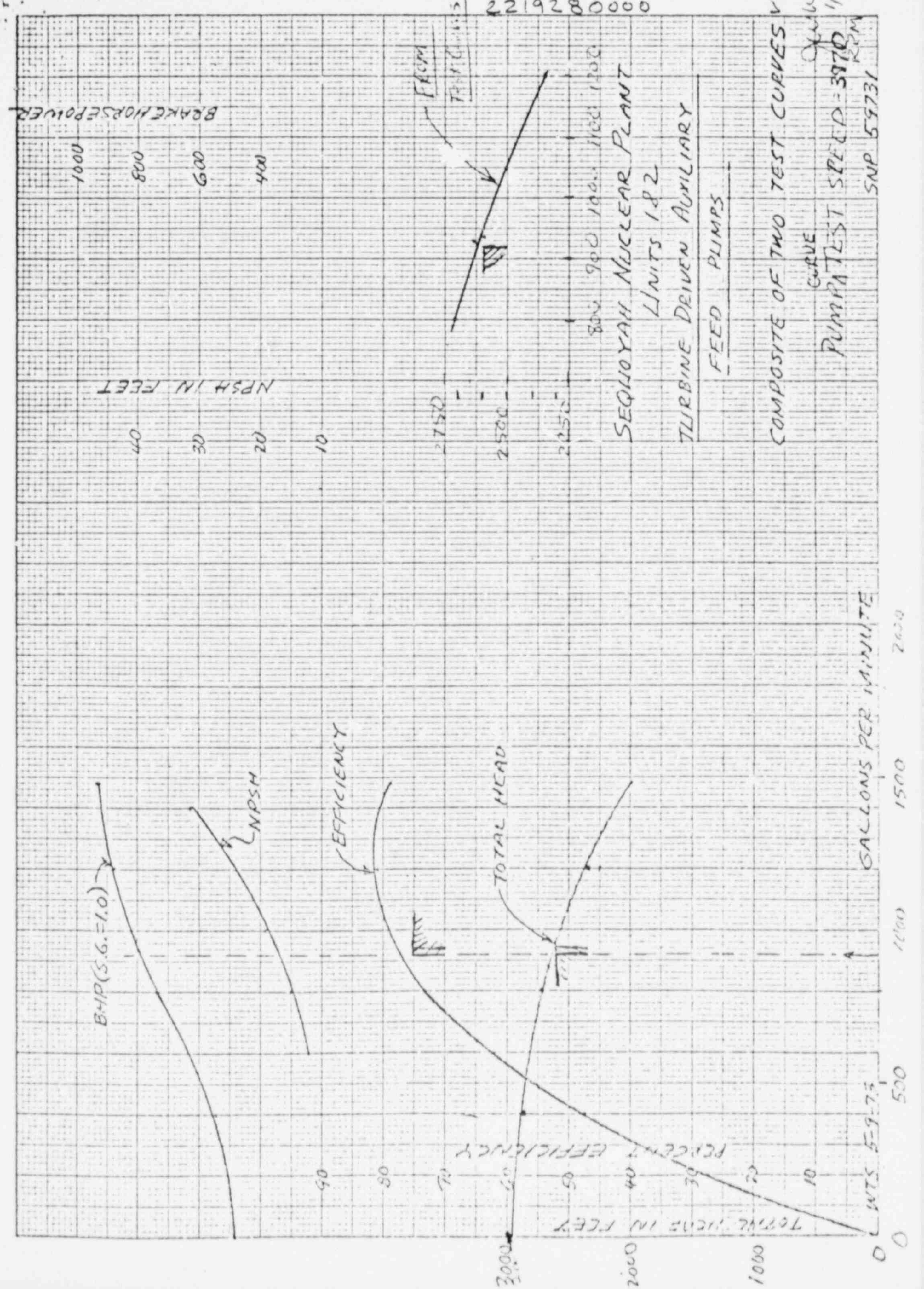
Bcy 3/27/87 CHECKED ____ DATE ____

221928D000

	BHP					N?			NPSH				
					AVG								AVG
0	310	195	288	270	266		400		11	11.5	11.0	11.0	11.1
200	355	345	349	350	350		520		14.5	14.5	14.5	14.5	14.5
400	446	450	452	450	450		600		19.1	19.0	19.0	19.0	19.0
600	521	527	524	526	525		650		22.0	21.6	22.0	21.9	21.9
750	551	560	560	560	558								
	EFF								HEAD				
					AVG							AVG	
0	0	0	0	0	0			3500	3530	3550	3500	3520	
200	47.5	51.2	48.8	49.0	49.1			3390	3430	3450	3440	3428	
400	68.9	68.8	69.3	68.0	68.8			3060	3100	3100	3050	3078	
600	72.0	73.0	72.0	71.0	72.0			2480	2570	2520	2465	2509	
750	68.0	71.0	68.4	—	69.1			1900	2080	1980	—	1985	

APPENDIX E

SHEET E6 of 8



SHEET E7 of 8

APPENDIX E

TURBINE DRIVEN – TEST

Min. Required Head For AFW Pumps

RZ RKJ 3/25/87

Bcy 3/27/87

COMPUTED ______ DATE ______

CHECKED ______ DATE ______

2219280000

BHP			AVG		NPSH		
0	480	485	483	600	12	12	12
400	590	500	545	800	15	15	15
800	732	745	738	1000	19	19	19
1200	870	875	873	1200	24.5	23.3	23.9
1480	930	935	933	1400	32	30.7	31.3

EFF			AVG.
0	0	0	0
400	47.0	48.0	47.5
800	72.0	74.3	73.2
1200	80.0	81.5	80.8
1480 ~~1600~~	77.8 ~~77.3~~	81.0	78.9
200	60.0		

(from Ref 9)

HEAD		
3000	2960 ~~2930~~	2980 ~~2965~~
2910	2830 ~~2800~~	2890 ~~[illegible]~~ ~~2850~~
2730	2690 ~~2680~~	2770 ~~2705~~
2340	2340	2340 ✓
2000	1975	1988 ✓

RZ

JCW 1/12/79

10% a[illegible]

	.8x above	.9x above
0-GPM	2664 (296)	2682 (298)
400-GPM	2830-296=2534	2865-298=2567

need to [illegible] 440+40

SQN Tech Spec's

SHEET ~~42~~ E8 OF ~~42~~ 8

APPENDIX E

Min Required Head for AFW Pumps

2219280000

COMPUTED JWW DATE 1/29/79

CHECKED WHA DATE 1/...

JWW 2/21/79

SLL 6/13/85

JOH 6/14/85

Revise ¶ 4.7.1.2.a (1.) and (2.) as follows:

(1.) Verifying that each motor driven pump develops a differential pressure greater than or equal to ~~1377 psid~~ ✓ that shown in the summary of results (sh. i) on recirculation flow.... R1

R3 (2.) Verifying that the steam turbine driven pump develops a differential pressure greater than or equal to 1183.5 ~~1183~~ psid ✓ on recirculation flow with the secondary steam supply pressure greater than or equal to 842 psig.

APPENDIX F

F1

Calc. ID. No. 2219280000

WP12195
Data Sheet 3
Page 1 of 2
12/03/86

DATA SHEET 3

AFW SYSTEM
MDAFW 2A-A Pump Test
S/G Pressure At Approximately 1,005 psig
Unit 2

WCN 12195-262
HFK
2/9/88

PARAMETER	INSTRUMENT	STEP 5.4.16 DATA	STEP 5.4.24 DATA	SUGGESTED VALUE
S/G No. 1 Level	~~LR-3-43*~~ ~~or~~ LI-3-164	26 %	34 %	~~Info~~ 25-30%
S/G No. 2 Level	~~LR-3-43*~~ ~~or~~ LI-3-156	28 %	34 %	~~Info~~ 25-30%
S/G No. 1 Pressure	[✓ PI-1-2A] OR ~~RTDTS~~	1005 psig	990 psig	apprx. 1,005 psig
S/G No. 2 Pressure	[✓ PI-1-9A] OR RTDTS	985 psig	970 psig	apprx. 1,005 psig
CST Level	LI-2-230D or LI-2-233D	28 1/2 ft	28 1/2 ft	>15.8 ft

CAY 4/6/87

Recorded By 3-17-88

STEP NO.	PARAMETER	INSTRUMENT	DATA	SUGGESTED VALUE
5.4.21	Pump Motor Current	2-EI-3-119XB	40 amps	<40 amps
5.4.21	Pump speed	Strobotac	3568 rpm	Info
5.4.21	AFW temperature to S/G No. 1	Log T2425A [✓ or Contact Pyrometer]	57.6 °F	Info
5.4.21	AFW temperature to S/G No. 2	Log T2426A [✓ or Contact Pyrometer]	57.6 °F	Info

ICF 87-1621
CAY 9-18-87

~~*Indicate narrow (NR) or wide range (WR)~~

* APPLIES ONLY TO STEP 5.4.16

WCN 12195-262
HFK
2/9/88

Recorded by 3-17-88

WP 12195

PAGE X-a-36 OF

2.040

Calc. ID. No. 2219280000

WP12195
Data Sheet 3
Page 2 of 2
12/29/86

DATA SHEET 3

AFW SYSTEM
MDAFP 2A-A Pump Test
S/G Pressure at Approximately 1,005 psig
Unit 2

STEP NO.	MEASUREMENT	INSTRUMENT	DATA WITH UNITS
5.4.20	Flow Rate to S/G No. 1	2-FT-3-163 (Auto Data 10)	299.98
5.4.20	Flow Rate to S/G No. 2	2-FT-3-155 (Auto Data 10)	260.05
5.4.20	MDAFP 2A-A Recirculation Flow Rate	Ultrasonic Meter	23.7 gpm
5.4.20	Suction Pressure (Corrected for Water Leg)	Temporary PT at 2-PI-3-117 (Auto Data 10)	18.26
5.4.20	Discharge Pressure (Corected for Water Leg)	2-PT-3-122A (Auto Data 10)	1112.39
5.4.25	* Time to Reach 460 gpm from a MDAFW 2A-A Pump Start Signal (Flow to S/G Nos. 1 and 2)	RTDTS See Chron Log 3-17-88, 2355 LCB 3-17-88	3.2 secs 3-17-88 LCB ~~8.0 secs~~ *

DN-1~~2~~ HPK 2/17/88

INITIAL HFL 2/18/88

Recorded by Jean Cabell, 3-17-88

*The allowable time must be less than 21.75 seconds. 60 seconds (response time from BO signal to full flow) minus 28.25 seconds (actual load sequence delay time from the latest SI-247.900 run on December 12, 1984) minus 10 seconds (maximum D/G start and bus reenergization) equals 21.75 seconds.

↑ need to add flow error of 15 gpm time to 475 gpm.

Drawing 45N 603-3 K needs to be revised to chg. 500 to 400 psia

2219280000

PMT-53

ATTACHMENT III

CALCULATION SHEET

Sheet 1 of 3

Test PMT 53 SG Pressure 1005 PSIG Date April 16, 1984
Pump 1A-A Calculated by Rick Grau
Checked by Craig A Gidley

I. Miscellaneous Data Transferred from Data Sheets and the RTDTS Plots

Total flow to SGs from pump 551.6 gpm
Suction pressure 16.08 psig; Discharge pressure 1128 psig
Barometric pressure at M-D pump 29.04 in. Hg
Auxiliary feedwater temperature 69.0 °F

II. Miscellaneous Information

Radius at suction 3.03 in.; Radius at discharge 2.75 in.
Water leg at suction -0.71 ft.
(Elevation difference between gage and pump centerline, position if gage is above ℄ and NEG if gage is below ℄.)
Water leg at discharge 0 ft.
Approximate local air temperature near M-D pumps 78 °F

III. Available Net Positive Suction Head, NPSH

A. Patm = Barometric Pressure, in. Hg x 0.491 psi/in. Hg.
= 29.04 in. Hg x 0.491
= 14.26 psia

B. Pv = Vapor Pressure of Water, psia at AFW Temperature
= 0.35 psia at 69 °F

C. Water Leg at Suction, psi = Water Leg at Suction, ft. x Density of Water, lbm/ft^3 at Local Air Temperature
= 0.71 ft x 62.27 lbm/ft^3
= 0.31 psi

D. Corrected Suction Pressure

= Suction Pressure~~, psig~~ plus or minus the water leg at suction, psi
= 16.08 psig ± 0.31 psi
= 15.77 psig

E. Win = Specific Weight of Water, lb/ft3 ~~at AFW~~ Temperature
= 62.3 lb/ft^3 at 69 °F

F. Total Pump Flow, gpm = flow to SGs, gpm + 25 gpm
= 576.6 gpm

WP 10920

PAGE x-d-16 OF x-d-21

PMT-53

ATTACHMENT III

CALCULATION SHEET

Sheet 2 of 3

Test PMT 53 SG Pressure 1005 PSIG

Date April 16, 1984

Pump 1A-A

Calculated by Rick Shaw

Checked by Craig A Gidley

G. Inlet Velocity, Vin

$$Vin = \frac{(\text{Total Pump Flow, gpm}) \times (144\ in^2/ft^2)}{\pi\,(\text{radius, in})^2 \times 7.48\ gal/ft^3 \times 60\ sec/min}$$

$$= \frac{(\ 576.6\ ) \times 144}{3.1416 \times (3.03)^2 \times 7.48 \times 60}$$

$$= (\ 576.6\ ) \times 0.011124$$

= 6.41 ft/sec

H. Suction Head, Hs

$$Hs,\ ft\ H_2O = \left[(\text{Corrected Suction Pressure, psig}) \times \frac{144}{(Win)}\right] + \frac{Vin^2}{2g}$$

$$= \frac{(\ 15.77\ )}{(\ 62.3\ )} \times 144 + \frac{(\ 6.41\ )^2}{64.348}$$

= 37.09 ft of H_2O

I. Available NPSH $= \left\{\left[(\text{Patm, psia}) - (\text{Pv, psia})\right] \times \frac{144}{Win}\right\} + (\text{Hs, ft of } H_2O)$

$$= \{[(14.26\ ) - (\ 0.35\ )] \times 144/(62.3)\} + (\ 37.09\ )$$

= 69.24 ft of H_2O

IV. Total Head, H

A. Wout = Specific Weight of Water, lb/ft^3 at AFW Temperature
= 62.3 lb/ft^3 at 69 °F

B. Water Leg at Discharge, psi = Water Leg at Discharge, ft x Density of Water lbm/ft^3 at Local Air Temperature
= 0 ft x 62.3 lbm/ft^3
= 0 psi

10920

X-d-17 OF X-d-21

PMT-53

ATTACHMENT III

CALCULATION SHEET

Sheet 3 of 3

Test PMT 53 SG Pressure 1005 PSIG Date April 16, 1984

Pump 1A-A Calculated by Rick Grau

Checked by Craig A Gidley

C. Corrected Discharge Pressure = Discharge Pressure, psig plus or minus the Water Leg at Discharge, psi

= 1128 psig ± 0 psi

= 1128 psig

D. Outlet Velocity, Vout

$$\text{Vout} = \frac{(\text{Total Pump Flow, gpm}) \times (144\ \text{in}^2/\text{ft}^2)}{\pi\,(\text{radius, in})^2 \times 7.48\ \text{gal/ft}^2 \times 60\ \text{sec/min}}$$

$$= \frac{(\ 576.6\ ) \times 144}{3.1416 \times (2.75)^2 \times 7.48 \times 60}$$

= 7.79 ft/sec.

E. Discharge Head, Hd

$$\text{Hd, ft. } H_2O = \left[(\text{Corrected Discharge Pressure, psig}) \times \frac{144}{(\text{Wout})}\right] + \frac{\text{Vout}^2}{2g}$$

$$= \frac{(\ 1128\ )}{(\ 62.3\ )} \times 144 + \frac{(\ 7.79\ )^2}{64.348}$$

= 2608.2 ft of H_2O

F. H = Hd - Hs = 2571.1 ft of H_2O at a total pump flow rate of 576.6 gpm.

CAG:JLR
01/20/84
B5236.MC

2219280000

PMT-53

ATTACHMENT III

CALCULATION SHEET

Sheet 1 of 3

Test PMT-53 SG Pressure 1005 psig Date April 16, 1984

Pump 1B-B Calculated by Rick Moran

Checked by Craig A Gidley

I. Miscellaneous Data Transferred from Data Sheets and the RTDTS Plots

Total flow to SGs from pump 526.2 gpm
Suction pressure 16.05 psig; Discharge pressure 1128 psig
Barometric pressure at M-D pump 29.04 in. Hg
Auxiliary feedwater temperature 75.3 °F

II. Miscellaneous Information

Radius at suction 3.03 in.; Radius at discharge 2.75 in.
Water leg at suction 0.71 ft.
(Elevation difference between gage and pump centerline, position if gage is above ℄ and NEG if gage is below ℄ .)
Water leg at discharge 0 ft.
Approximate local air temperature near M-D pumps 78 °F

III. Available Net Positive Suction Head, NPSH

A. Patm = Barometric Pressure, in. Hg x 0.491 psi/in. Hg.
= 29.04 in. Hg x 0.491
= 14.26 psia

B. Pv = Vapor Pressure of Water, psia at AFW Temperature
= 0.43 psia at 75.3 °F

C. Water Leg at Suction, psi = Water Leg at Suction, ft. x Density of Water, lbm/ft^3 at Local Air Temperature
= .71 ft x 62.27 lbm/ft^3
= 0.31 psi

D. Corrected Suction Pressure

= Suction Pressure, psig plus or minus the water leg at suction, psi
= 16.05 psig ± 0.31 psi
= 15.74 psig

E. Win = Specific Weight of Water, lb/ft3 at AFW Temperature
= 62.3 lb/ft^3 at 75.3 °F

F. Total Pump Flow, gpm = flow to SGs, gpm + 25 gpm
= 551.2 gpm

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PAGE X-d-19 OF X-d-21

PMT-53

ATTACHMENT III

CALCULATION SHEET

Sheet 2 of 3

Test PMT 53 SG Pressure 1005 PSIG Date April 16, 1984

Pump 1B-B Calculated by Rick Gray

Checked by Craig A Gidley

G. Inlet Velocity, Vin

$$Vin = \frac{(\text{Total Pump Flow, gpm}) \times (144\ in^2/ft^2)}{\pi (\text{radius, in})^2 \times 7.48\ gal/ft^3 \times 60\ sec/min}$$

$$= \frac{(\quad 551.2 \quad) \times 144}{3.1416 \times (3.03)^2 \times 7.48 \times 60}$$

$$= (\quad 551.2 \quad) \times 0.011124$$

$$= \underline{\quad 6.13 \quad} \text{ ft/sec}$$

H. Suction Head, Hs

$$Hs, \text{ ft } H_2O = \left[(\text{Corrected Suction Pressure, psig}) \times \frac{144}{(Win)}\right] + \frac{Vin^2}{2g}$$

$$= \left(\frac{15.74}{(\quad 62.3 \quad)}\right) \times 144 + \frac{(\ 6.13\ )^2}{64.348}$$

$$= \underline{\quad 36.96 \quad} \text{ ft of } H_2O$$

I. Available NPSH $= \left\{\left[(\text{Patm, psia}) - (\text{Pv, psia})\right] \times \frac{144}{Win}\right\} + (\text{Hs, ft of } H_2O)$

$$= \{[(\ 14.26\ ) - (\ 0.43\ )] \times 144/(62.3\} + (\ 36.96\ )$$

$$= \underline{\quad 68.93 \quad} \text{ ft of } H_2O$$

IV. Total Head, H

A. Wout = Specific Weight of Water, lb/ft^3 at AFW Temperature
= 62.3 lb/ft^3 at 75.3 °F

B. Water Leg at Discharge, psi = Water Leg at Discharge, ft x Density of Water lbm/ft^3 at Local Air Temperature
= ~~62.3~~ 0 ft x ~~0~~ 62.3 lbm/ft^3
= 0 psi

CAG 4/16/84

Wr 10920

PAGE X-d-20 OF X-d-21

PMT-53

ATTACHMENT III

CALCULATION SHEET

Sheet 3 of 3

Test PmT 53 SG Pressure 1005 psig Date April 16, 1984

Pump 1B-B Calculated by Rick Grau

Checked by Craig A Gidley

C. Corrected Discharge Pressure = Discharge Pressure, psig plus or minus the Water Leg at Discharge, psi

= 1128 psig ± 0 psi

= 1128 psig

D. Outlet Velocity, Vout

$$\text{Vout} = \frac{(\text{Total Pump Flow, gpm}) \times (144\ \text{in}^2/\text{ft}^2)}{\pi\,(\text{radius, in})^2 \times 7.48\ \text{gal/ft}^2 \times 60\ \text{sec/min}}$$

$$= \frac{(\ 551.2\ ) \times 144}{3.1416 \times (2.75)^2 \times 7.48 \times 60}$$

= 7.44 ft/sec.

E. Discharge Head, Hd

$$\text{Hd, ft. } H_2O = \left[(\text{Corrected Discharge Pressure, psig}) \times \frac{144}{(\text{Wout})}\right] + \frac{\text{Vout}^2}{2g}$$

$$= \frac{(\ 1128\ )}{(\ 62.3\ )} \times 144 + \frac{(\ 7.44\ )^2}{64.348}$$

= 2608.1 ft of H_2O

F. H = Hd - Hs = 2571.1 ft of H_2O at a total pump flow rate of 551.2 gpm.

CAG:JLR
01/20/84
B5236.MC

2219280000

PMT-53
AFW System

Data Sheet 8.3.1
Page 1 of 3

Unit 2
Two-Pump Start Test
(2A-A and 2B-B AFWP)

Step	Measurement	Instrument	Data W/Units	Suggested Value	Recorded by/Date
8.3.1.8.2 (Before pump start)	SG No. 1 Pressure	PI-1-2A	1013.3 psig	≈ 1005 psig	
	SG No. 2 Pressure	PI-1-9A	1013.3 psig	≈ 1005 psig	
	SG No. 3 Pressure	PI-1-20A	1015.4 psig	≈ 1005 psig	
	SG No. 4 Pressure	PI-1-27A	1009.6 psig	≈ 1005 psig	
	SG No. 1 Level	LR-3-43	28.5 %	Info	
	SG No. 2 Level	LR-3-43	23.1 %	Info	
	SG No. 3 Level	LR-3-98	27.1 %	Info	
	SG No. 4 Level	LR-3-98	24.9 %	Info	
	CST Levels	LI-2-230D/ LI-2-233D	25.4 ft. 25.8 ft	Info	Scott Long / 12/17/84
8.3.1.11.1 (After pump has stopped)	SG No. 1 Pressure	PI-1-2A	993.5 psig	≈ 1005 psig	
	SG No. 2 Pressure	PI-1-9A	993.5 psig	≈ 1005 psig	
	SG No. 3 Pressure	PI-1-20A	992.8 psig	≈ 1005 psig	
	SG No. 4 Pressure	PI-1-27AB	990.5 psig	≈ 1005 psig	
	SG No. 1 Level	LR-3-43	36.3 %	Info	
	SG No. 2 Level	LR-3-43	29.3 %	Info	
	SG No. 3 Level	LR-3-98	34.1 %	Info	
	SG No. 4 Level	LR-3-98	34.0 %	Info	
	CST Levels	LI-2-230D/ LI-2-233D	25.0 ft. 25.5 ft	Info	Scott Long / 12/17/84
8.3.1.10.1	2 A-S AFWP Suction	PS-3-121A (A.D. ~~10~~)9 SSL 12/19/84	27.7 psig	> 12.9 psig	See log entry on 9/15/86 for clarification SSL 9/15/86
	2A-A M-D AFWP Suction	PS-3-139A (A.D. ~~10~~)9 SSL 12/19/84	16.238 psig	> 1.25 psig	
	2B-B M-D AFW Suction	PS-3-144A (A.D. ~~10~~)9 SSL 12/19/84	16.248 psig	> 1.25 psig	
	T-D AFWP Suction Pressure Below 12.9 psig		<2 sec.	< 5.5 sec.	See log entry of 12/19/85 for explanation SSL 9/7/86
	2A-A AFWP Suction Pressure Below 1.25 psig		<2 sec.	< 4.0 sec.	
	2B-B AFWP Suction Pressure Below 1.25 psig		<2 sec.	< 4.0 sec.	Scott Long / 12/17/84
8.3.1.2	2A-A Discharge Pressure	PT-3-122A (RTDTS)	1168 psig	Info	
	2B-B Discharge Pressure	PT-3-132A (RTDTS)	1117 psig	Info	Scott Long / 12/18/84
8.3.1.10.5	2A-A Recirc. Flowrate		N/A gpm		
	2B-B Recirc. Flowrate		N/A gpm	Info	N/A / —

WP 11243

PMT-53
AFW System

2219280000

Data Sheet 8.3.1 (Continued)
Page 2 of 3

Unit 2
Two-Pump Start Test
(2A-A and 2B-B AFWP)

Step	Measurement	Instrument	Data W/Units	Suggested Value	Recorded by/Date
8.3.1.10.2	Flow to SG 1	2-FI-3-163A (A.D. 10)	251.6 gpm	Info	
	Flow to SG 2	2-FI-3-155A (A.D. 10)	220.3 gpm	Info	
DN-5 12/17/84	Total Flow from pump 2A-A to SG 1 and 2		471.9 gpm	> ~~500~~ 460 gpm	TC-86-1109 RMM 9/20/86
	Flow to SG 3	2-FI-3-147A (A.D. 10)	224.6 gpm	Info	
	Flow to SG 4	2-FI-3-170A (A.D. 10)	323.0 gpm	Info	
	Total Flow from pump 2B-B to SG 3 and 4		547.6 gpm	> 500 gpm	① Time for sum of 2loop flow to equal flowrate (i.e. 460 or 500)
DN-5 12/17/84	Time to reach ~~500~~ 460 gpm from pump 2A-A (Flow to SG Nos. 1 and 2) TC-86-1109 9/16/86		4.6 / 6.8 sec. ① ②	< *23.75 sec.	② Time to steady-state flowrates. 9/16/86
	Time to reach 500 gpm from pump 2B-B (Flow to SG Nos. ~~1~~ 3 and ~~2~~ 4)		3.8 / 8.6 sec. ① ②	< *23.75 sec.	Scott Long 9/16/86
8.3.1.10.3	Barometric pressure at M-D pumps	(A.D. 10)	29.48 In. Hg.	Info	12-17-84
8.3.1.3 *	AFW temperature to SG No. 1	log T2425	69.6 °F	Info	* Avg. values during 2 minute data interval
	AFW temperature to SG No. 2	log T2426	66.45 °F	Info	
	AFW temperature to SG No. 3	log T2427	67.25 °F	Info	** AFW temp for Loop 4 did not trend on P250. Value used is that for Loop 3.
	AFW temperature to SG No. 4	log T2428	67.25 °F **	Info	Scott Long 12/17/84
8.3.1.2	2A-A pump speed	Strobe	3490 rpm	Info	
	2B-B pump speed	Strobe	3490 rpm	Info	12-17-84

*This time criteria was calculated as follows:

Sixty seconds (response time from Bo signal to full flow) minus 26.25 seconds (maximum load sequence delay time) minus 10 seconds (maximum diesel generator start and bus regenerization) equals 23.75 seconds.

WP 11243

TS 88-02 , Enclosure 2
Attachment 2

QA Record

TVA 10697 (DNE 6-86)

DNE CALCULATIONS

TITLE: AUXILIARY FEEDWATER SYSTEM PRESSURE DROP CALCULATION

PLANT/UNIT: SEQUOYAH / UNIT 1 & 2

PREPARING ORGANIZATION: MEB - HCG

KEY NOUNS (Consult RIMS DESCRIPTORS LIST): AFW , PRESSURE DROP , SYSTEM RESISTANCE

BRANCH/PROJECT IDENTIFIERS:
SNP 1-2-CA-D053
0-HCG-JWW-082274

Each time these calculations are issued, preparers must ensure that the original (RO) RIMS accession number is filled in.

Rev	(for RIMS' use)	RIMS accession number
R0	830512B0008	MEB '830509 301
R1	870331E0004	B25 870324 804
R2		B25 880430 806
R_		

APPLICABLE DESIGN DOCUMENT(S): DESIGN CRITERIA ,SQN-DC-V-13.9.8

SAR SECTION(S): 10.4.7.2

UNID SYSTEM(S): 03B

INFORMATION ONLY (Not Original Copy)

	Revision 0	R1	R2	R3
ECN No. (or indicate Not Applicable)			N/A	
Prepared	J.W. Aderholdt	J.P. Hahn	John Bartleman	
Checked	E.W. Steinhouser	H.V. Garrett		
Reviewed	for R.K. Sood	R.W. Bond		
Approved	for H.R. Corbett	J.E. Pilgrim	J.E. Pilgrim	
Date	8/23/74	3/23/87	27 April 88	
List all pages added by this revision.		Revision Log	1-16 Attachment A	
List all pages deleted by this revision.			1-20A of previous rev.	
List all pages changed by this revision.		1		

Use form TVA 10534 if more space required

Safety-related? Yes ☒ No ☐

Statement of Problem

Determine the pressure drop (dP) in the Auxiliary Feedwater (AFW) system piping; first in the discharge of the Motor-Driven AFW Pumps (MDAFWP) and Turbine-Driven AFW Pumps (TDAFWP), and then in the suction piping for these pumps.

Abstract

These calculations contain an unverified assumption(s) that must be verified later. Yes ☐ No ☒

An analysis of the pressure drop (dP) in the discharge and suction piping of the AFW pumps is performed to show the total dP for the AFW system. The AFW pump flow path choosen to represent the dP for the pump discharge is the flow path to Steam Generator (S/G) No. 3, and for the pump suction it is the 1A-A MDAFWP and 1A-S TDAFWP. These paths were choosen because the dP results obtained are conservative.

☐ Microfilm and store calculations in RIMS Service Center.

☒ Microfilm and return calculations to: J.E. PILGRIM - SEQUOYAH

Microfilm and destroy. ☐

Address: DSC-C3

cc: RIMS, SL 26 C-K

QA Record EN DES CALCULATIONS ORIGINAL

LE	UNID SYSTEM(S)	PLANT/UNIT
SEGUOYAH NUCLEAR PLANT AUX. FEEDWATER SYSTEM PRESSURE - DROP CALCULATION	CA	SQN 1&2 SAR SECTION(S)

EPARING ORGANIZATION		REV	(FOR MEDS USE)	MEDS ACCESSION NUMBER
MEB -HCG		R0	830512B0008 ㉝	MEB '830509 301
APPLICABLE DESIGN DOCUMENTS	BRANCH/PROJECT IDENTIFIERS SNP1-2-CA-D053 0-HCG-JWW-082274	R1	870331E0004 ㉟	B25 870324 804
KEY NOUNS AFW, PRESSURE DROP		R2		
		R3		

REV	R0	R1	R2	R3
DATE	8/23/74	03/23/87	SEE NEW COVER SHEET	
PREPARED	J W Aderholdt	J. P. Hahn		
CHECKED				
SUBMITTED For R. K. SOOD				
APPROVED For H. R. CORBETT				
ATTACHMENTS MICROFILMED:		—		
LIST ALL PAGES* ADDED BY THIS REV:		REVISION LOG		
UST ALL PAGES* LETED BY THIS REV:		—		
LIST ALL PAGES* CHANGED BY THIS REV:		1		

STATEMENT OF PROBLEM

Determine the pressure drop in the AFW system piping, first in the discharge of the motor driven and turbine driven pumps, and then in the suction piping of those pumps.

ABSTRACT

An analysis of the pressure drop in the discharge pipiping of the AFW system motor driven pump and turbine driven pump is performed. The pressure drop in the pumps suction piping is then determined.

TVA 10697 (ENDES-7-78) *Use revision log (form TVA 10534) if more room is required

Return original to ~~L. C. Smith W7A34 C-K~~ QEP 24 MAR H V Garrett SQN DSC D5

NEP-3.1
Attachment 6
Page 1 of 1

CALCULATION INDEPENDENT REVIEW VERIFICATION FORM

SNP 1-2-CA-D053
0-HCG-JWW-082274
Calculation No.

R2
Revision

Method of independent review used (check one or more):

1. Alternate calculation method ________
2. Testing method ________
3. Other method X

Justification (explain below):

Method 1: Identify the pages where the alternate calculation has been included in the calculation package and explain why this method is adequate.

Method 2: Identify the QA documented source(s) where testing adequately demonstrates the adequacy of this calculation and explain.

Method 3: Justify the technical adequacy of the calculation and explain how the adequacy was verified (calculation is similar to another, based on accepted handbook methods, appropriate sensitivity studies included for confidence, etc.).

CALCULATION IS TECHNICALLY ADEQUATE BECAUSE IT IS BASED ON ACCEPTED HANDBOOK METHODS AND DESIGN GUIDES. THESE REFERANCES ARE IDENTIFIED WITHIN THE CALCULATION.

Gilbert V. Garrett
Design Verifier
(Independent Reviewer)

4/27/88
Date

TVA

Title: AUXILIARY FEEDWATER SYSTEM PRESSURE DROP CALCULATION

REVISION LOG

SNP1-2-CA-D053
0-HCG-JWW-082274

Revision No.	DESCRIPTION OF REVISION	Date Approved
0	INITIAL ISSUE	
1	RESPONSE TO MEMO FROM D.W. WILSON TO G.B. KIRK (RIMS B25 87C109027). EXPLANATION OF ASSUMPTION ADDED. REVISION LOG ADDED. NO ECN IS INVOLVED	
2	REVISED ENTIRE CALCULATION TO DOCUMENT REFERENCES AND ACCEPTABLE METHOD (S) TO DETERMINE PRESSURE DROPS FOR AFW SYSTEM. ADDED APPENDIX A, 7 SHEETS.	

AUXILIARY FEEDWATER SYSTEM PRESSURE DROP CALCULATIONS

SHEET 1 OF 16
SNP 1-2-CA-D053
0-HCG-JWW-082274
COMPUTED JPB DATE 4-21-88
CHECKED DATE 4-26-88

A) PURPOSE

This calculation determines the pressure drop (dP) across the AFW system piping, fittings, valves, etc. The total calculated dP for the AFW system can be used to determine the total required head that an AFW pump must develop in order to assure that the pump can meet its design function.

B) ASSUMPTIONS - listed in body of calculation.

AUX. FEEDWATER SYSTEM PRESSURE DROP CALCULATION

SHEET 2 OF 16
SNP 1-2-CA-D053
0-HCG-JWW-082274
COMPUTED SPB DATE 4-21-88
CHECKED DATE 4-26-88

c) REFERENCES -

1) TVA Mechanical Design Guide DG-M2.8.5 Rev. 3

2) CRANE Technical Paper No. 410 - Flow of Fluids Through Valves, Fittings, and Pipe. 1986

3) AFW Bill of Materials - 47BM427 Series

4) AFW System Design Criteria SQN-DC-V-13.9.8 Rev. R0

5) Mechanical AFW Piping Drawings :

DRAWING	REVISION	UNIT
47W420-5	H/G	1/2
47W427-1	E	1+2
47W427-2	F	1+2
47W427-3	B/B	1/2
47W427-4	F/G	1/2
47W427-5	B	1
47W427-6	A/C	1/2
47W427-7	I/I	1/2
47W427-8	E	1+2
47W420-10	R	0

6) Condensate Bill of Materials - 47BM420 Series

7) AFW Pumps Minimum Head Required Calc. - 221923000 Rev. R4 (B25 880430 807)

8) Vendor Drawings :

DRAWING	CONTRACT	REVISION	UNIT	EQUIPMENT ID
A-32500-134	83520-1	1	1+2	FE-3-142
A-32500-135	83520-1	1	1+2	FE-3-147

9) Contract file #73C34 83577 for AFW Level Control Valves. (see Attachment A)

AUX. FEEDWATER SYSTEM PRESSURE DROP CALCULATION

SHEET 3 OF 16

SNP 1-2-CA-D053

0-HCG-JWW-082274

COMPUTED JPB DATE 4-21-88

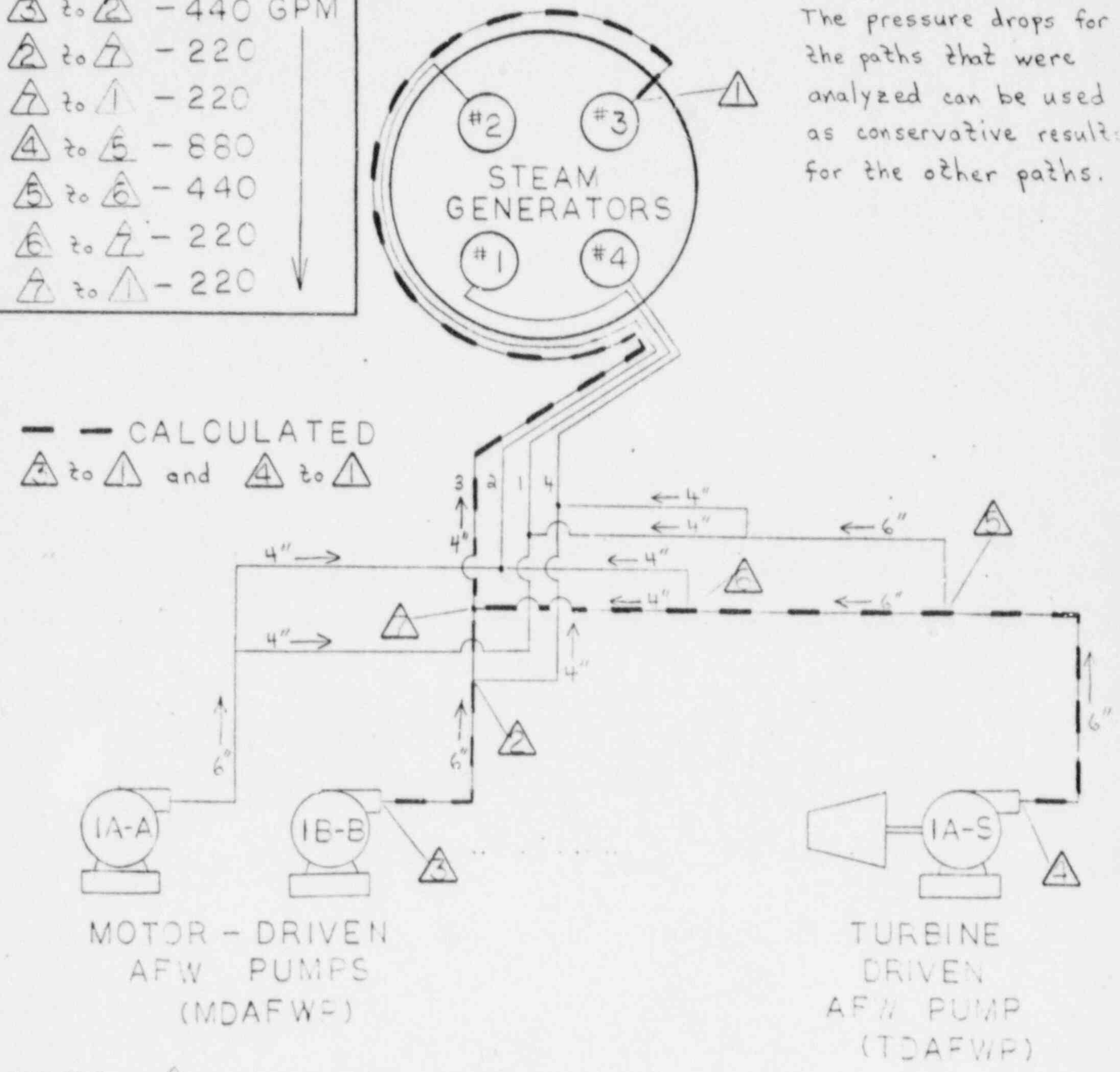
CHECKED Mdf DATE 4-26-88

FLOW RATES

△3 to △2 – 440 GPM
△2 to △7 – 220
△7 to △1 – 220
△4 to △5 – 880
△5 to △6 – 440
△6 to △7 – 220
△7 to △1 – 220

D. CALCULATIONS

ASSUMPTION: The pressure drops for the paths that were analyzed can be used as conservative results for the other paths.



NOTE: △ – PIPING JUNCTION LOCATION SYMBOL

DESIGN CRITERIA DIAGRAM OF AUX. FEEDWATER SYSTEM PUMP DISCHARGE PIPING – UNIT 1 (UNIT 2 SIMILAR)

AUXILIARY FEEDWATER SYSTEM PRESSURE DROP CALCULATION

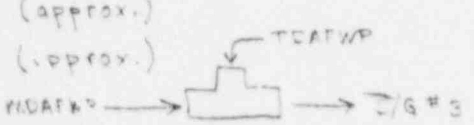
SHEET 4 OF 16
SNP 1-2-CA-DC53
0-HCG-JWW-082274
COMPUTED JPB DATE 4-21-88
CHECKED MLH DATE 4-26-88

PIPING LENGTHS AND COMPONENTS BETWEEN NODAL POINTS ON DESIGN CRITERIA DIAGRAM (Sheet) FOR AFW PUMPS DISCHARGE PIPING.

Longest Piping run is to Steam Generator (S/G) #3. Connection to Main Feedwater line is at el. 714'-4". Working from this point back, tabulate pipe lengths and fittings to calculate a pipe friction loss. All components are the same size as the pipe, unless otherwise noted. (see reference 5)

4" PIPE SIZE

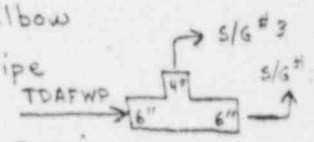
△1 1' - Pipe el. 714'-4"
1 - 90° Elbow
12' - Pipe
2 - Check Valves
1 - 90° Elbow
4' - Pipe el. 718'-3"
1 - 90° Elbow
50.25' Radius for 275.15° = 241.5'
1 - 90° Elbow
1.5' - Pipe el. 719'-9"
1 - 90° Elbow
4.5' - Pipe el. 725'-3"
1 - 90° Elbow
5.5' - Pipe
1 - 90° Elbow
11.5' - Pipe
1 - 90° Elbow
3.2' - Pipe el. 723'-0"
1 - 45° Elbow
1 - Orifice (FE-3-147)
66.21' Radius for 10.5° minus 2.25' = 44.6'
1 - 90° Elbow (approx.)
4.5' - Pipe (approx.)
△7 1 - Standard Tee



2.3' - Pipe el. 725'-3"
1 - 90° Elbow
1 - Gate Valve
1 - Check Valve
1 - Enlarger (3" x 4")

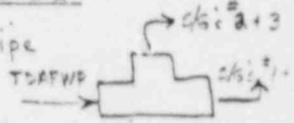
UNIT 1 - AS SHOWN
UNIT 2 - SIMILAR

1 - 3" Valve (LCV-3-172)
1 - Reducer (4" x 3")
1 - Gate Valve
1 - 90° Elbow
el. 722'-5" 2.8' - Pipe
△6 1 - Tee (6" x 4" x 6")



6" PIPE SIZE

6.25' - Pipe
△5 1 - Standard Tee

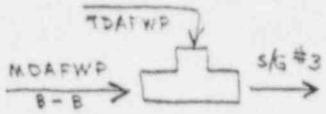


6.35' - Pipe
1 - 90° Elbow
28.25' - Pipe el. 694'-2"
1 - 90° Elbow
12.5' - Pipe
1 - 90° Elbow
17.5' - Pipe el. 676'-9"
1 - 90° Elbow
5.75' - Pipe
1 - Orifice (FE-3-142)
12.1' - Pipe
1 - 90° Elbow
1 - Check Valve
1 - 90° Elbow
5.5' - Pipe el. 671'-3 1/4"
1 - 90° Elbow
1.25' - Pipe
△4 Discharge Flange of TDAFWP (1A-S)

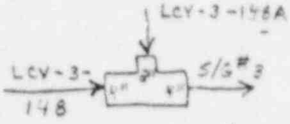
Start at the intersection point (△7) of the MDAFWP and TDAFWP and work back to the discharge of the B MDAFWP (point △3). (see reference 5)

4" PIPE SIZE

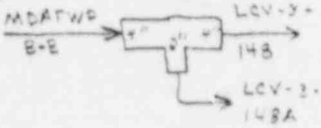
△7 1- Standard Tee



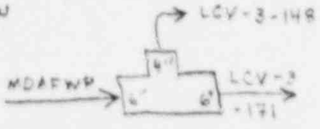
10.4' - Pipe el. 723'-0"
1-45° Elbow
1-90° Elbow
2.25' - Pipe el. 725'-3"
1-90° Elbow
1- Gate Valve
1- Check Valve
1-90° Elbow
5.5' - Pipe el. 730'-9"
1-90° Elbow
8.25' - Pipe
1-90° Elbow
15.8' - Pipe
1-90° Elbow
34.1' - Pipe
1-90° Elbow
1- Tee (4"x2"x4")



7.75' - Pipe el. 723'-0"
1-90° Elbow
1.4' - Pipe
1- 4" Valve (LCV-3-148)
1- Tee (4"x2"x4")

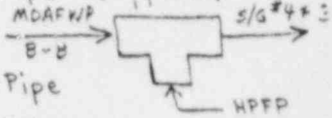


1.6' - Pipe
1- Gate Valve
0.5' - Pipe (approx.)
1-90° Elbow
2.5' - Pipe
△2 1- Tee (6"x4"x6")



6" PIPE SIZE

1.5' - Pipe (approx.)
1- Standard Tee



5.35' - Pipe
1-90° Elbow
21.25' - Pipe el. 701'-9"
1-90° Elbow
13.6' - Pipe (approx.)
1-90° Elbow
8' - Pipe (approx.)
1-90° Elbow
1- Cavitating Venturi
4.9' - Pipe el. 692'-1"
1-90° Elbow
1- Enlarger (4"x6")
1.5' - Pipe
1- Reducer (6"x4")
1- Check Valve
1-90° Elbow

△3 Discharge Flange of MDAFWP (1B-B)

UNIT 1 - AS SHOWN
UNIT 2 - SIMILAR

PRESSURE DROP CALCULATION SHEET

Sheet 6 of 16

SYSTEM Auxiliary Feedwater (#03B)

CALC ID SNP 1-2-CA-D053

2-HCG-JWW-082274

Computed by JRB Date 4-21-88

Checked by [illegible] Date [illegible]

Line Identification			4 to 5	5 to 6	6 to 7	7 to 1	3 to 2	2 to 7	
Nominal Dia, In.	(ref. 5)	D	6	6	4	4	6	4	
Schedule	(ref. 3)		120	120	120	120	120	120	
Internal Dia, In.	(ref. 2)	d	5.501	5.501	3.624	3.624	5.501	3.624	
Pressure, psia	(ref. 4)	P	1100	1100	1100	1100	1100	1100	
Temperature, °F	(ref. 4)	T	40	40	40	40	40	40	
Spec Volume, Ft^3/Lb	(ref. 2)	v	0.01602	0.01602	0.01602	0.01602	0.01602	0.01602	
Viscosity, Centipoise	(ref. 1)	u	1.6	1.6	1.6	1.6	1.6	1.6	
Flow, gpm	(ref. 4)	Q	880	440	220	220	440	220	
Flow, Lb/Hr (8.02Q/v)		W	440,549	220,275	110,137	110,137	220,275	110,137	
Velocity, Ft/Sec ($0.0509Wv/d^2$)		V	11.87	5.94	6.84	6.84	5.94	6.84	
Reynolds No. (6.31W/du)		Re	315,836	157,918	119,855	119,855	157,918	119,855	
Friction Factor	(ref. 1)	f	0.0172	0.0185	0.0204	0.0204	0.0185	0.0204	
dP/100' ($0.000336W^2vf/d^5$)			3.57	0.96	2.13	2.13	0.96	2.13	
L/D 90° Welding Elbow	(ref. 5)	13	91(7)	—	26(2)	117(9)	78(6)	117(9)	
L/D 45° Welding Elbow	(ref. 5)	8.5	—	—	—	8.5(1)	—	8.5(1)	
L/D Tee (Thru run)	(ref. 5)	20	—	—	—	—	20(1)	60(3)	
L/D Tee (Thru branch)	(ref. 5)	60	60(1)	60(1)	60(1)	—	60(1)	—	
L/D 45° Lateral (Thru branch)		30	—	—	—	—	—	—	
L/D Reducer/Enlarger	(ref. 1+5)		—	9.9(1)	7.0(1) 7.7(1)	—	12.7(1) 19.8(2)	—	
L/D Gate Valve*	(ref. 5)	10	—	—	20(2)	—	—	20(2)	
L/D Globe Valve*		340	—	—	—	—	—	—	
L/D Swing Check Valve*	(ref. 5)	80	80(1)	—	80(1)	160(2)	80(1)	80(1)	
Total Fitting L/D			231	69.9	200.8	285.5	270.5	285.5	
Fitting Equiv. Length, Ft (L/D)(d/12)			105.9	32.0	60.6	86.2	124.0	86.2	
Piping Length, Ft	(ref. 5)		89.2	6.25	5.1	333.3	56.1	90.1	
Total Equiv. Length, Ft		L	195.1	38.3	65.7	420.0	180.1	176.3	
Orifice Plate dP, psi	(see c.1)		3.72	—	—	2.84	—	—	
Pressure Drop, psi (dP/100')(L/100)			6.97	0.37	1.40	8.95	1.73	3.76	

*L/D for valves are in the fully open position.

AUXILIARY FEEDWATER SYSTEM PRESSURE DROP CALCULATION

SHEET 7 OF 16

SNP 1-2-CA-D053

0-HCG-JWW-082274

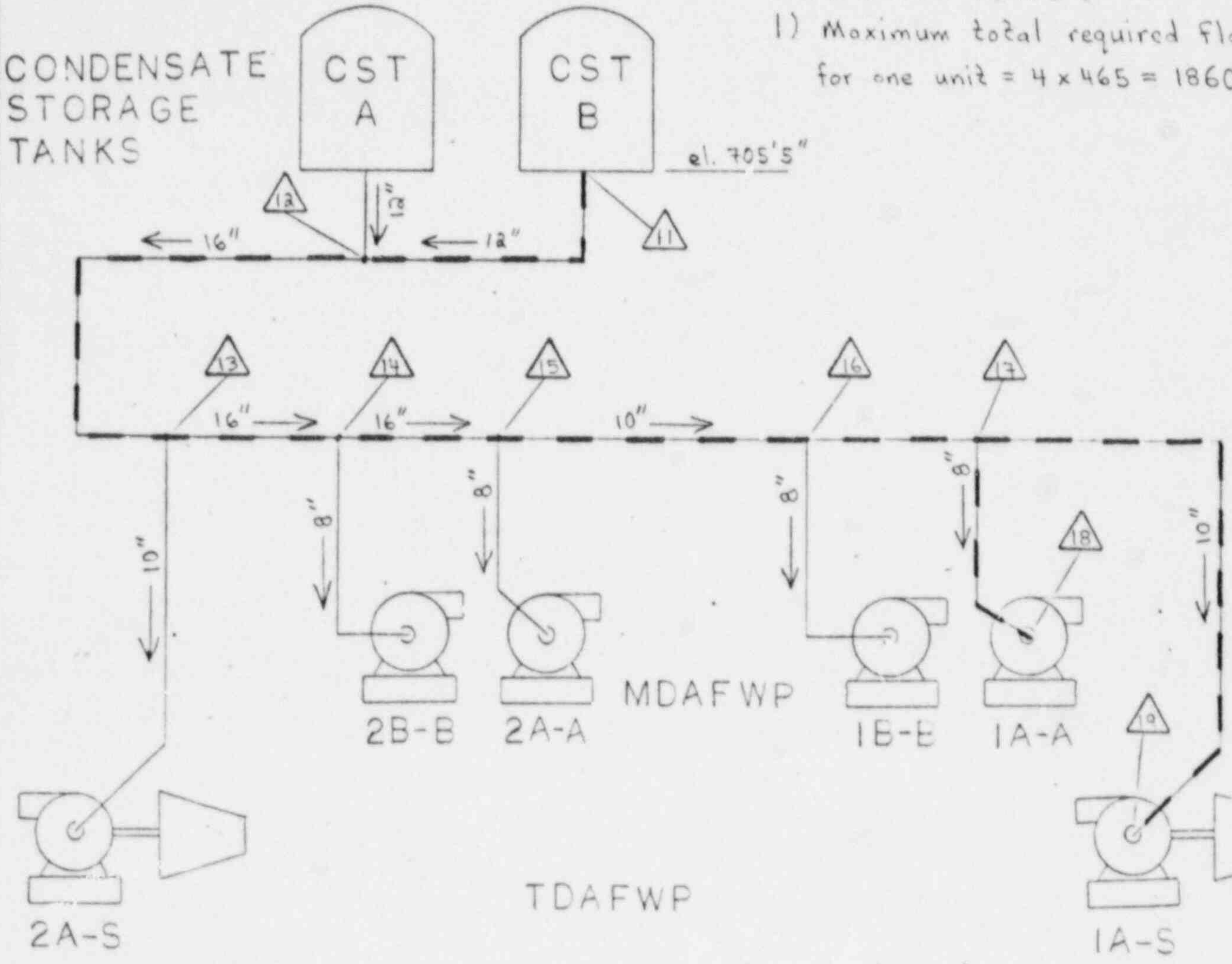
COMPUTED JPB DATE 4-21-88

CHECKED MJF DATE 4-26-88

D. CALCULATIONS

ASSUMPTIONS:

1) Maximum total required flow for one unit = 4 x 465 = 1860 gpm



— — CALCULATED △11 to △18 and △11 to △19

NOTE: △ – PIPING JUNCTION LOCATION SYMBOL

DESIGN CRITERIA DIAGRAM OF AUX. FEEDWATER SYSTEM PUMP SUCTION PIPING – UNIT 1&2

TVA 11030 (WM-7-75)

AUXILIARY FEEDWATER SYSTEM PRESSURE DROP CALCULATION

SHEET 8 OF 16
SNP 1-2-CA-D052
0-HCG-JWW-082274
COMPUTED JPB DATE 4-21-88
CHECKED MYJ DATE 4-26-88

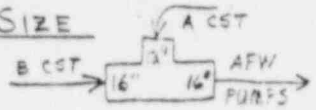
PIPING LENGTHS AND COMPONENTS BETWEEN NODAL POINTS ON DESIGN CRITERIA DIAGRAM (Sheet) FOR AFW PUMPS SUCTION PIPING.

Longest Piping run is to 1A-A MDAFWP and 1A-S TDAFWP from the B CST. Tabulate pipe lengths and fittings from CST to AFW Pumps in order to calculate a pipe friction loss. All components are the same size as the pipe, unless otherwise noted. (see reference 5)

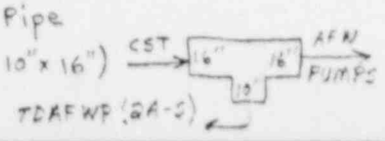
12" PIPE SIZE

△11 2.9' - Pipe el. 702'-7$\frac{1}{2}$"
1- 90° Elbow
14.5' - Pipe
1- 90° Elbow
80' - Pipe
1- 90° Elbow
21.25' - Pipe
1- 90° Elbow
15.3' - Pipe
1- Gate Valve
1- Enlarger (12" x 16")

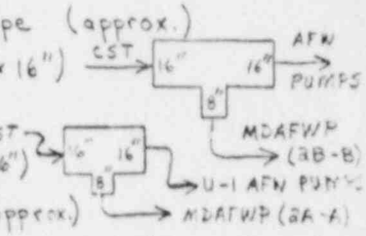
△12 16" PIPE SIZE
2.2' - Pipe
1- Tee (16" x 12" x 16")



8.25' - Pipe
1- 90° Elbow
1- 45° Elbow (approx.)
9.25' - Pipe el. 700'-9"
1- 90° Elbow
53.5' - Pipe
1- 45° Elbow
14.15' - Pipe
1- 45° Elbow
15' - Pipe
1- Gate Valve
30.5' - Pipe
1- 90° Elbow
4.25' - Pipe
△13 1- Tee (16" x 10" x 16")



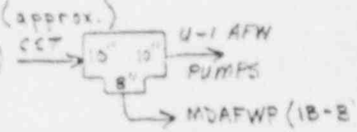
40.3' - Pipe (approx.)
△14 1- Tee (16" x 8" x 16")
12' - Pipe
△15 1- Tee (16" x 8" x 16")



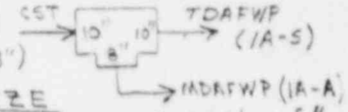
3'- Pipe (approx.)
1- Reducer (16" x 10")

10" PIPE SIZE

66.5' - Pipe (approx.)
1- 90° Elbow
8' - Pipe
1- 90° Elbow
8' - Pipe
1- 90° Elbow
8' - Pipe
1- 90° Elbow
63' - Pipe (approx.)
△16 1- Tee (10" x 8" x 10")



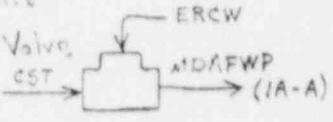
12' - Pipe
△17 1- Tee (10" x 8" x 10")



1- Reducer (10" x 8")

8" PIPE SIZE

el. 700'-11$\frac{5}{8}$"
4'- Pipe (approx.)
1- 90° Elbow
8.9' - Pipe el. 692'-0$\frac{15}{16}$"
1- 90° Elbow
1- Gate Valve
1- Check Valve
1- Standard Tee



5' - Pipe
1- 90° Elbow
△18 Suction Flange of MDAFWP (1A-A)

TVA 11030 (WM-7-75)

AUXILIARY FEEDWATER SYSTEM PRESSURE DROP CALCULATION

SHEET 9 OF 16

SNP 1-2-CA-D053

0-HCG-JWW-082274

COMPUTED JPB DATE 4-21-88

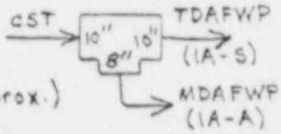
CHECKED DATE 4-26-88

Start at the intersection point (△17) of the CST supply to the MDAFWP (1A-A) and TDAFWP (1A-S) and work to the suction of the TDAFWP (1A-S).

(see reference 5)

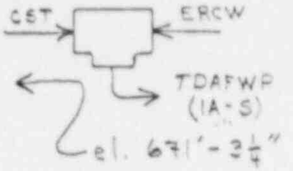
10" PIPE SIZE

△17 1- Tee (10"×8"×10")



43.5' - Pipe (approx.)
1-90° Elbow
6' - Pipe el. 700' - 11 5/8"
1-90° Elbow
4' - Pipe el. 687' - 0"
1-90° Elbow
3.9' - Pipe
1-90° Elbow
25' - Pipe
1-90° Elbow
10' - Pipe el. 677' - 0"
1-90° Elbow
1- Gate Valve
1-90° Elbow
1- Check Valve

1- Standard Tee



5.75' - Pipe
1-90° Elbow
6.8' - Pipe
1- Reducer (10"×8")
1-90° Elbow

△19 Suction Flange of TDAFWP (1A-S)

PRESSURE DROP CALCULATION SHEET

Sheet 10 of 16

SYSTEM Auxiliary Feedwater (#03B)

CALC ID SNP 1-2-CA-D053

0-HCG-JWW-082274

Computed by SRB Date 4-21-88

Checked by MHH Date 4-26-88

Line Identification			11 to 12	12 to 13	13 to 14	14 to 15	15 to 16	16 to 17	
Nominal Dia, In.	(ref. 5)	D	12	16	16	16	10/16	10	
Schedule	(ref. 3+6)		STD	30	30	30	40/30	40	
Internal Dia, In.	(ref. 2)	d	12.00	15.25	15.25	15.25	10.02/15.25	10.02	
Pressure, psia	(ref. 3+6)	P	65	65	65	65	65	65	
Temperature, °F	(ref. 4)	T	STD	40	40	40	40	40	
Spec Volume, Ft^3/Lb	(ref. 2)	v	0.01602	0.01602	0.01602	0.01602	0.01602	0.01602	
Viscosity, Centipoise	(ref. 1)	u	1.6	1.6	1.6	1.6	1.6	1.6	
Flow, gpm	(ref. 4)	Q	3720	3720	2790	2325	1860	1395	
Flow, Lb/Hr (8.02Q/v)		W	1,862,322	1,862,322	1,396,742	1,163,951	931,161	698,371	
Velocity, Ft/Sec (0.0509Wv/d^2)		V	10.55	6.53	4.90	4.09	7.56/3.26	5.67	
Reynolds No. (6.31W/du)		Re	612,044	481,609	361,207	301,005	366,494/240,974	274,970	
Friction Factor	(ref. 1)	f	0.0149	0.0149	0.0155	0.0158	0.0160/0.0161	0.0165	
dP/100' (0.000336W^{2}vf/d^5)			1.12	0.34	0.20	0.14	0.74/2.09	0.43	
L/D 90° Welding Elbow	(ref. 5)	13	52(4)	39(3)	—	—	52(4)	—	
L/D 45° Welding Elbow	(ref. 5)	8.5	—	25.5(3)	—	—	—	—	
L/D Tee (Thru run)	(ref. 5)	20	—	20(1)	20(1)	20(1)	20(1)	20(1)	
L/D Tee (Thru branch)	(ref. 5)	60	—	—	—	—	—		
L/D 45° Lateral (Thru branch)		30	—	—	—	—	—		
L/D Reducer/Enlarger	(ref. 1+5)		5.2(1)	—	—	—	10(1)		
L/D Gate Valve*	(ref. 5)	10	10(1)	10(1)	—	—	—		
L/D Globe Valve*		340	—	—	—	—			
L/D Swing Check Valve*	(ref. 5)	80	—	—	—	—	—	—	
Total Fitting L/D			67.2	94.5	20	20	52/30	20	
Fitting Equiv. Length, Ft (L/D)(d/12)			67.2	120.1	25.4	25.4	43.4/39.1	16.7	
Piping Length, Ft	(ref. 5)		134	137.1	40.3	12	153.5/2	12	
Total Equiv. Length, Ft		L	201.2	257.2	65.7	37.4	196.9/41.1	28.7	
Orifice Plate dP, psi			—	—	—	—	—	—	
Pressure Drop, psi (dP/100')(L/100)			2.25	0.87	0.13	0.05	1.46/0.04 1.50	0.12	

*L/D for valves are in the fully open position.

PRESSURE DROP CALCULATION SHEET

Sheet 11 of 16

SYSTEM Auxiliary Feedwater (#03B)

CALC ID SNP 1-2-CA-D053

0-HCG-JWW-082274

Computed by GOB Date 4-21-89

Checked by MHH Date 4-24-89

Line Identification			△17 to △18	△18 to △19					
Nominal Dia, In	(ref.5)	D	8	10					
Schedule	(ref.3)		40	40					
Internal Dia, In.	(ref.2)	d	7.981	10.02					
Pressure, psia	(ref.3)	P	*	*					
Temperature, °F	(ref.4)	T	40	40					
Spec Volume, Ft^3/Lb	(ref.2)	v	0.01602	0.01602					
Viscosity, Centipoise	(ref.1)	u	1.6	1.6					
Flow, gpm	(ref.4)	Q	465	930					
Flow, Lb/Hr (8.02Q/v)		W	232,790	465,581					
Velocity, Ft/Sec ($0.0509Wv/d^2$)		V	2.98	3.78					
Reynolds No. (6.31W/du)		Re	115,021	183,247					
Friction Factor	(ref.1)	f	0.0189	0.0175					
dP/100' ($0.000336W^2vf/d^5$)			0.17	0.20					
L/D 90° Welding Elbow	(ref.5)	13	39(3)	117(9)					
L/D 45° Welding Elbow		8.5	—	—					
L/D Tee (Thru run)	(ref.5)	20	20(1)	20(1)					
L/D Tee (Thru branch)	(ref.5)	60	60(1)	60(1)					
L/D 45° Lateral (Thru branch)		30	—	—					
L/D Reducer/Enlarger (ref. 1+5)			5.4(1)	5.4(1)					
L/D Gate Valve*	(ref.5)	10	10(1)	10(1)					
L/D Globe Valve*		340	—	—					
L/D Swing Check Valve*	(ref.5)	80	80(1)	80(1)					
Total Fitting L/D			214.4	292.4					
Fitting Equiv. Length, Ft (L/D)(d/12)			142.6	244.2					
Piping Length, Ft	(ref.5)		17.9	105					
Total Equiv. Length, Ft		L	160.5	349.2					
Orifice Plate dP, psi			—	—					
Pressure Drop, psi (dP/100')(L/100)			0.27	0.70					

*L/D for valves are in the fully open position.

* Pressure is 65 psia up to the check valves, and 165 psia between the check valves and the pump.

D. CALCULATIONS 1) Orifice Plates

d.1 Compute the dP for the orifice plates installed in the AFW piping.

$$Q = 236\, d_o^2\, C \sqrt{\frac{\Delta P}{\rho}} \qquad \text{(ref. 2)}$$

Q = flow in gpm ; d_o = orifice plate hole diameter in inches ;
C = flow coefficient ; ΔP = pressure drop in psi ; ρ = weight density

$$\Delta P = \rho \left(\frac{Q}{236\, d_o^2\, C} \right)^2$$

Find ΔP for FE-3-142

Q = 880 gpm ; d_o = 3.8028 in (ref. 8) ; C = 0.69 ; ρ = 62.426 (@ 40°F)

$$\Delta P = 62.426 \left(\frac{880}{236\,(0.69)(3.8028)^2} \right)^2 = \underline{8.72 \text{ psi}}$$

Find ΔP for FE-3-147

Q = 220 gpm ; d_1 = 2.55027 in (ref. 8) ; C = 0.672 ; ρ = 62.426

$$\Delta P = 62.426 \left(\frac{220}{236\,(0.672)(2.55027)^2} \right)^2 = \underline{2.84 \text{ psi}}$$

PRESSURE DROP CALCULATION SHEET　　Sheet 13 of 16

SYSTEM Auxiliary Feedwater - #038
CALC ID SNP 1-2-CA-D053
0-HCG-JWW-082274
Computed by GPB Date 4-21-88
Checked by Date 4-26-88

SUBJECT Pressure Drop Across The AFW Level Contro Valves on the Discharge Of The Turbine - Driven AFW Pump - 3" LCV 3-172, 173, 174, & 175

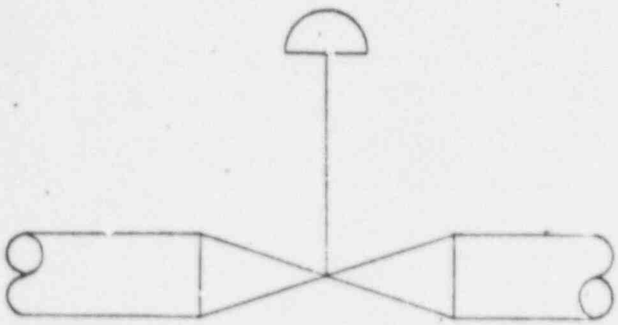
- -

D. Calculations

CONTROL VALVE

2) LCV's

d.2 Compute dP for LCV-3-172



Liquid Sizing Coeff.
C_v = 155 (ref. 9)

$$C_v = Q\sqrt{\frac{G}{\Delta P}} \dashrightarrow Q = C_v\sqrt{\frac{\Delta P}{G}}$$ (ref. 2)

$$\frac{C_v}{Q} = \sqrt{\frac{G}{\Delta P}}$$

$$\left(\frac{C_v}{Q}\right)^2 = \frac{G}{\Delta P}$$

$$\Delta P = G\left(\frac{Q}{C_v}\right)^2$$

G = SP. GR. = 1.001

Q = Flow Rate = 220 gpm

C_v = Flow Coeff. = 155

$$\Delta P = \frac{(1.001)(220)^2}{(155)^2}$$

$$= \frac{(1.001)(48{,}400)}{(24{,}025)}$$

ΔP = 2.02 psi

ΔP = Press. Drop = ______ psi

Q = Flow Rate = ______ gpm

G = Specific Gravity = ______

$$Q = \_\_\_\_\sqrt{\_\_\_\_}$$

$$= \_\_\_\_\sqrt{\_\_\_\_}$$

= (　　)(　　)

Q = ______ gpm

- -

PRESSURE DROP CALCULATION SHEET

Sheet 14 of 16

SYSTEM Auxiliary Feedwater - *038
CALC ID SNP 1-2-CA-D053
0-HCG-JWW-082274

Computed by QPB Date 4-21-88
Checked by [illegible] Date 4-2[illegible]

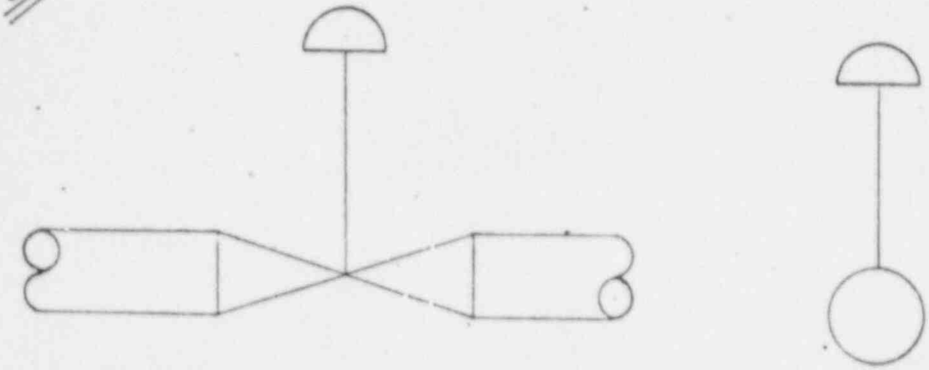
SUBJECT Pressure Drop Across the AFW Level Control Valves on the Discharge of the Motor-Driven AFW Pumps - 4" LCV-3-148, 156, 164, & 171

D. CALCULATIONS

CONTROL VALVE

a) LCV's

d.2 Compute dP for LCV-3-148



Liquid Sizing Coeff.
C_v = 195 (ref. 9)

$$C_v = Q\sqrt{\frac{G}{\Delta P}} \dashrightarrow Q = C_v\sqrt{\frac{\Delta P}{G}}$$ (ref. 2)

$$\frac{C_v}{Q} = \sqrt{\frac{G}{\Delta P}}$$

$$\left(\frac{C_v}{Q}\right)^2 = \frac{G}{\Delta P}$$

$$\Delta P = G\left(\frac{Q}{C_v}\right)^2$$

G = SP. GR. = 1.001

Q = Flow Rate = 220 gpm

C_v = Flow Coeff. = 195

$$\Delta P = \frac{(1.001)(220)^2}{(195)^2}$$

$$= \frac{(1.001)(48,400)}{(38,025)}$$

ΔP = 1.27 psi

ΔP = Press. Drop = ______ psi

Q = Flow Rate = ______ gpm

G = Specific Gravity = ______

$$Q = \_\_\_\_ \sqrt{\_\_\_\_}$$

$$= \_\_\_\_ \sqrt{\_\_\_\_}$$

= ( )( )

Q = ______ gpm

D. CALCULATIONS

3) MDAFWP

d.3 Compute the total pressure drop (dP) for the MDAFWP (piping, valves, and fittings) at the minimum required flow of 440 gpm to two steam generators (S/G).

$$\text{MDAFWP } dP = \left(\triangle 3 \text{ to } \triangle 1\right) + \left(\triangle 11 \text{ to } \triangle 18\right) + \text{LCV} + \text{Orifice Plate}$$

$$dP_M = dP_{3-2} + dP_{2-7} + dP_{7-1} + \underset{\{\text{see d.2}\}}{dP_{11-12}} + \underset{\{\text{see d.1}\}}{dP_{12-13}} + dP_{13-14} + dP_{14-15} + dP_{15-16} + dP_{16-17} + dP_{17-18} + dP_{LCV-3-148} + dP_{FE-3-147}$$

$$dP_M = 1.73 + 3.76 + 8.95 + 2.25 + 0.87 + 0.13 + 0.05 + 1.50 + 0.12 + 0.27 + 1.27 + 2.84$$

$$dP_M = 23.74 \text{ psi}$$

NOTE: This MDAFWP dP value does not include the dP value for the Cavitating Venturi (on the pump discharge). The cavitating venturi dP is accounted for in reference # 7.

d.4 4) TDAFWP - Compute the total dP for the TDAFWP (piping, valves, and fittings) at the minimum required flow of 440 gpm to two S/G.

$$\text{TDAFWP } dP = \left(\triangle 4 \text{ to } \triangle 1\right) + \left(\triangle 11 \text{ to } \triangle 19\right) + \text{LCV} + \text{Orifice Plates}$$

$$dP_T = \left(dP_{4-5}\right)\left(\frac{440\text{ gpm}}{880\text{ gpm}}\right)^2 + dP_{5-6} + dP_{6-7} + dP_{7-1} + \underset{\{\text{see d.2}\}}{dP_{11-12}} + \underset{\{\text{see d.1}\}}{dP_{12-13}} + \underset{\{\text{see d.1}\}}{dP_{13-14}} + dP_{14-15} + dP_{15-16} + dP_{16-17} + dP_{17-19} + dP_{LCV-3-172} + dP_{FE-3-147} + dP_{FE-3-142}\left(\frac{440\text{ gpm}}{880\text{ gpm}}\right)^2$$

$$dP_T = 6.97\,(0.25) + 0.37 + 1.40 + 8.95 + 2.25 + 0.87 + 0.13 + 0.05 + 1.50 + 0.12 + 0.70 + 2.02 + 2.84 + 8.72\,(0.25)$$

$$dP_T = 25.12 \text{ psi}$$

The dP values used for the MDAFWP and TDAFWP suction piping assumes a TDAFWP flow of 880 gpm which is greater than the minimum required flow of 440 gpm. Therefore, the total pump suction piping dP value used is conservative, even though the difference between dP values for a TDAFWP flow of 880 and 440 gpm are small. Also, the flow through the suction piping is higher than that of the specific pump being considered because it is assumed that all six AFW pumps are running simultaneously. This approach is conservative since the total dP for the suction piping is higher.

The flow rates for the AFW pumps suction piping includes the pump ecirc. flow of 25 gpm per MDAFWP and 50 gpm per TDAFWP.

The pressure drop (dP) through the main feedwater line from the AFW p[illegible] tie in to the steam generator is neglilible since it is a short run of pipe and the dP for 220 gpm through a 16" pipe is very small.

ATTACHMENT A

PAGE A1

SNP 1-2-CA-D053
0-HCG-JWW-082274
R-1

I&C F-014 R10/73

REQUISITION NO. 83577

		GENERAL	1	ITEM NO.	→23←			MFR DATA (IF APP)	
			2	QUANTITY	8		X		
			3	INSTRUMENT NO. →	LCV-3-148,156,164,171		←		
			4	DRAWING					
			5	REFERENCE	SPEC 1643				
	*		6	MANUFACTURER & MODEL	MASONEILAN	MS	X		
			7	UNIT PRICE/UNIT WT			X		
			8	SERVICE	AUX FW				
			9	TVA CLASS/SEISMIC	C	I			
R-1			10	ACTION/INPUT SIGNAL	MODULATE	10-50MA	X		
		DESIGN	11	LINE SIZE/SCHEDULE	4"	120			
			12	MAX LINE PRESS. (PSIA)	1650				
			13	MAX ΔP (VLV CLOSED)	1305				
			14	MAX INLET TEMP (F)	100				
		BODY	15	SIZE/STYLE		Globe	X		
			16	ANSI RATING/MATERIAL	900	CARBON STEEL	X		
			17	END CONNECTIONS	FLANGED		X		
			18	BONNET TYPE	MS		X		
			19	PACKING	MS		X		
			20	LEAKOFF CONNECTIONS	NA		X		
			21						
		TRIM	22	PLUG FORM	MS		X		
			23	MATERIAL	STAINLESS STEEL		X		
			24	NO. OF PORTS/PORT SIZE	1	MS	X		
			25	GUIDING	MS		X		
			26	SPECIAL TRIM	HARDENED FACE		X		
			27						
		ACT.	28	TYPE	MS		X		
			29	SIZE & STROKE	MS	MS	X		
			30	AIR SUPPLY	70-100 PSIG		X		
			31	FAILURE POSITION	OPEN		X		
R-1	*	POS'NER	32	MANUFACTURER & MODEL	MASONEILAN 8012		X		
R-1			33	BYPASS/GAUGES	MS	MS	X		
R-1			34	FOR INPUT OF	10 MA	50 MA	X		
R-1			35	OUTPUT SHALL BE	3 PSIG	15 PSIG	X		
	*	ACCESSORIES	36	FILTER-REG TYPE	67FR-35 FISHER		X		
			37	LIMIT SWITCHES 1 EA LIMIT	DPDT		X		
			38	L.S. CONTACT RATING	PAR 21.2.3		X		
			39	SOLENOID VALVE (SEE NOTE 2)	3 WAY (PARA 21.2.6)		X		
			40	S.V. COIL VOLTAGE	125 VDC		X		
			41						
			42						
		OPER COND	43	FLOWING MEDIUM	WATER				
			44	SIZING CONDITIONS	MAX	MIN		MAX	MIN
			45	FLOW RATE	550 GPM	NA			
			46	PRESSURE (PSIA)	1110	NA			
			47	TEMPERATURE (F)	100	NA			
			48	ΔP (PSI)	20	NA			
			49	CV (CALC) (1)			X		
			50	CV (ACTUAL)			X		

X---DATA BY BIDDER
*---OR EQUAL
NA--NOT APPLICABLE
MS--MFR STANDARD

NOTES: (1) USE FOR 80% TO 90% OF VALVE OPERATOR STROKE.

(2) TAG SOLENOID VALVES LSV-3-148, 156, 164, 171

M-6: DATE:
M-5: DATE:

SPECIFICATION NO. 1643

ATTACHMENT A

PAGE A2

SNP-1-2-CA-D053
0-HCG-JWW-082274
R-2

I&C F-014 R10/73

REQUISITION NO. 83577

			No.					MFR DATA (IF APP)
		GENERAL	1	ITEM NO.	24			
			2	QUANTITY	8			
			3	INSTRUMENT NO.	LCV-3-172,173,174,175		X	
			4	DRAWING				
			5	REFERENCE	SPEC 1645			
			6	MANUFACTURER & MODEL	MASONEILAN	(40,000)	X	
			7	UNIT PRICE/UNIT WT			X	
			8	SERVICE	AUX FW			
			9	TVA CLASS/SEISMIC	C	I		
R-2			10	ACTION/INPUT SIGNAL	MODULATING	10-50MA	X	
		DESIGN	11	LINE SIZE SCHEDULE	4"	120		
			12	MAX LINE PRESS. (PSIA)	1650			
			13	MAX ΔP (VLV CLOSED)	1250			
			14	MAX INLET TEMP (F)	100			
		BODY	15	SIZE/STYLE	MS	MS	X	
			16	ANSI RATING/MATERIAL				
			17	END CONNECTIONS	900 lb FLANGED		X	
			18	BONNET TYPE	MS		X	
			19	PACKING	MS		X	
			20	LEAKOFF CONNECTIONS	NA			
			21					
		TRIM	22	PLUG FORM	MS		X	
			23	MATERIAL	STAINLESS STEEL		X	
			24	NO. OF PORTS/PORT SIZE	SINGLE	MS	X	
			25	GUIDING	MS		X	
			26	SPECIAL TRIM	HARDENED FACE		X	
			27					
		ACT.	28	TYPE	DIAPHRAGM		X	
			29	SIZE & STROKE	MS	MS	X	
			30	AIR SUPPLY	70-100 PSIG		X	
			31	FAILURE POSITION	CLOSED		X	
R-2	*	POS'NER	32	MANUFACTURER & MODEL	MASONEILAN 8012		X	
R-2			33	BYPASS/GAUGES	YES	2	X	
R-2			34	FOR INPUT OF	10MADC	50MADC	X	
R-2			35	OUTPUT SHALL BE	6 PSIG	30 PSIG	X	
	*	ACCESSORIES	36	FILTER-REG TYPE	MN-77-41		X	
			37	LIMIT SWITCHES	DPDT		X	
			38	L.S. CONTACT RATING	15A/120VAC OR .1A/125VDC		X	
			39	SOLENOID VALVE	3 WAY (NOTE 2)		X	
			40	S.V. COIL VOLTAGE	125 VDC		X	
			41	HAND WHEEL	YES.	SIDEMOUNTED	X	
			42					
		OPER COND	43	FLOWING MEDIUM	WATER			
			44	SIZING CONDITIONS	MAX	MIN		MAX / MIN
R-2			45	FLOW RATE	440	0		
			46	PRESSURE (PSIA)	1250	12.5		
			47	TEMPERATURE (F)	100	60		
			48	ΔP (PSI)	1250	20		
			49	CV (CALC) (1)			X	
			50	CV (ACTUAL)			X	

X---DATA BY BIDDER
*---OR EQUAL
NA--NOT APPLICABLE
MS--MFR STANDARD

NOTES: (1) USE FOR 80% TO 90% OF VALVE OPERATOR STROKE.

(2) TAG LSV-3-172,173,174,175

M-6: DATE:
M-5: DATE:
ENGR: JJS DATE: 5 8 74

SPECIFICATION NO. 1645

PLANT: SEQUOYAH NUCLEAR PLANT UNITS 1 AND 2

CONTROL VALVES
DATA SHEET NO. 24

CUSTOMER TVA

REFERENCE Contract 73C34-83577
Plant-Watts Bar - Units 1&2

Masoneilan International, Inc.
Norwood, Massachusetts 02062
Montebello, California 90030

ATTACHMENT A

CONTROL VALVE SPECIFICATION

SNP 1-2-CA-D053
0-HCG-JWW-082274.

QUOTE 2073-Add PAGE

DATE 7-30-73 BY RMM

— Equipment Tagging —
(Aluminum Tags)

Quote Item		Control Valve		Solenoid Valve
		SG Blowdown Isol. Vlv.		
21.	Tag one each:	1-FCV-1-181	Flow	1-FSV-1-181
		2-FCV-1-181		2-FSV-1-181
		1-FCV-1-182		1-FSV-1-182
		2-FCV-1-182		2-FSV-1-182
		1-FCV-1-183		1-FSV-1-183
		2-FCV-1-183		2-FSV-1-183
		1-FCV-1-184		1-FSV-1-184
		2-FCV-1-184		2-FSV-1-184
		Aux FW Pump Back Press. Control		
22.	Tag one each:	1-PCV-3-122	Pressure	(none)
		2-PCV-3-122		
		1-PCV-3-132		
		2-PCV-3-132		
		Aux Feedwater Isol.		
23.	Tag one each:	1-LCV-3-148	Level	1-LSV-3-148
		2-LCV-3-148		2-LSV-3-148
		1-LCV-3-156		1-LSV-3-156
		2-LCV-3-156		2-LSV-3-156
		1-LCV-3-164		1-LSV-3-164
		2-LCV-3-164		2-LSV-3-164
		1-LCV-3-171		1-LSV-3-171
		2-LCV-3-171		2-LSV-3-171
		Aux Feedwater Isol.		
24.	Tag one each	1-LCV-3-172	Level	1-LSV-3-172
		2-LCV-3-172		2-LSV-3-172
		1-LCV-3-173		1-LSV-3-173
		2-LCV-3-173		2-LSV-3-173
		1-LCV-3-174		1-LSV-3-174
		2-LCV-3-174		2-LSV-3-174
		1-LCV-3-175		1-LSV-3-175
		2-LCV-3-175		2-LSV-3-175

ATTACHMENT A

PAGE A4

SNP 1-2-CA-D053
0-HCG-JWW-082274

TENNESSEE VALLEY AUTHORITY
KNOXVILLE, TENNESSEE 37902

W8C126 Commercial Realty Management Building
400 Commerce Avenue

EEB '791227 922

December 21, 1979

Masoneilan International, Incorporated
63 Nahatan Street
Norwood, Massachusetts 02062

Attention: Mr. Edward J. Canniff, Certified Print Department

Gentlemen:

SEQUOYAH AND WATTS BAR NUCLEAR PLANTS UNITS 1 AND 2
VALVES AND CONTROLS - NUCLEAR
CONTRACT 73C34-83577
~~REF N00137 AND N00138~~

RECEIVED
SEQUOYAH
JAN 3 1980
DIV. OF CONSTR.

We have your transmittal letters dated September 17, 1979 (EEB 790920 029), October 9, 1979 (EEB 791015 028), and followup letter dated November 6, 1979 (EEB 791113 002), submitting drawings as listed below. We are returning two prints each of drawings marked (A) "Approved." We are returning one print and the sepia of each drawing marked (N) "Approved With Correction as Noted." Please make the necessary corrections on those marked (N) and resubmit.

Status	Item No.	Ref. or Serial No.	Plant	Dwg. No.	Rev Date	Title
A	23	N-00137-12	SQN	CP1-9-175	B	Control Valve 4" 20,000 Series ANSI CL 900
A	24	N-00137-27	SQN	CP40-8-98	A	Control Valve 3" 40,000 Series 900 ANSI
A	24	N-00138-23	WBN	CP40-8-195	9/14/79	Control Valve 3" 40,000 Series
N	39	N-00238-1	SQN & WBN	CP1-3-293	10/4/79	Control Valve 1" 20,000 Series
N	40	N-00238-2	SQN & WBN	CP1-3-293	10/4/79	Control Valve 1" 20,000 Series
N	41	N-00238-3	SQN & WBN	CP1-3-293	10/4/79	Control Valve 1" 20,000 Series
N	42	N-00238-4	SQN & WBN	CP1-5-172	10/4/79	Control Valve 1-1/2" 20,000 Series
N	43	N-00238-5	SQN & WBN	CP1-5-172	10/4/79	Control Valve 1-1/2" 20,000 Series
N	44	N-00238-6	SQN & WBN	CP1-5-172	10/4/79	Control Valve 1-1/2" 20,000 Series
N	45	N-00238-7	SQN & WBN	CP1-5-172	10/4/79	Control Valve 1-1/2" 20,000 Series
N	46	N-00238-8	SQN & WBN	CP1-5-172	10/4/79	Control Valve 1-1/2" 20,000 Series

ATTACHMENT A

Masoneilan

Masoneilan International, Inc.
Norwood, Massachusetts 02062
Montebello, California 90690

SNP 1-2-CA-D053
0-HCG-JWW-082274

CUSTOMER TVA

REFERENCE
Plant-Sequoyah, Units 1&2

CONTROL VALVE SPECIFICATION

QUOTE 2Q73-AJJ, PAGE 9-Rev A1
Rev. 1.

DATE 7-23-74 BY RNM

TVA Piping Class

PAGE A5

1		ITEM		22-R1		→ 23-R1 ←				
2		TAG		See Page 1-Cont.		→				
3		QUANTITY	SIZE	4	4"	8	4"		"	"
4		MODEL		58-20721		37-20721 ③				
5	BODY	TYPE	Design Press	Globe	1650 PSIA	→	→			
6		MATERIAL		ASME SA-216, Gr. WCB		→				
7		RATING ANSI		900 lb.		→				
8		CONN.		R.F. Flanged		→				
9	BONNET	TYPE	Material	Std.-Bolted	Same as Body	→	→			
10		GUIDE Bushing		#440-C St.St.		→				
11		PACKING		Crane 2CRJ		→				
12		Packing Box		Oversize		→				
13	TRIM	SIZE		Full - 4"		Full - 4"			"	"
14		TYPE		Equal Percent Contoured		→				
15		PLUG MATERIAL		ASME SA-479, Ty. 316 ①		→ ①				
16		RING(S) MATERIAL		ASTM A276, Ty. 316 ①		→ ①				
17		FLOW TO	AIR TO	Open	n/a	→	Close			
18		RANGE				3-10 PSIG			PSI	PSI
19	ACTUATOR	TYPE &		MEA Electrohydraulic-Model No. 2-19K-6-C		Diaph.-Spring				
20		SIZE		No. 2 (w/HWL Oper.) 19,000 lbs. Stall Thrust		No. 24 (Direct)				
21		Stroke		2"		2"				
22	POSITIONER	MODEL		n/a		8012 E/P				
23		INPUT		10-50 ma. D.C		10-50 ma. D.C.				
24		SUPPLY		120V, 60Cy AC		60 PSIG			PSI	PSI
25		AIRSET		n/a		No. 77-41 w/Gauge				
26	SERVICE CONDITIONS	FLUID		Water		→				
27		LINE SIZE	SCHED.	6"	120	4"	120			
28		SP. GR. @ 60°	TEMP	1.0	0.9926 at 80°F 0.9938 at 120°F	1.0	0.9931			
29		ΔP SIZING	MAX.	20 psi (Max. Cv) 460 " (Min. Cv)	1305 psi Shut-off	20 psi	1305 psi Shut-off			
30		TEMP (°F)	MAX.	120° (R-1)		100°				
		Norm	Suprht	80° at Max. Cv [illegible] at Min. Cv	-	100°	-			
31		QTY MAX	MIN	550 GPM	550 GPM	550 GPM	(on [illegible] off)			
32		INLET	OUTLET	1110	1096 at Max. Cv 170 at Min. Cv	1110	1090			
		VAPOR	CRIT.	0.9656 Max. Cv 1.6924 Min. Cv	3206.2	0.9492	3206.2			
33		CF FACTOR		0.9		0.9				
34		REQ'D CV		17.2333 (Min.) 122.705 (Max.)		122.485				
35		RATED CV		195		→ 195 ←				
36		Net Unit Price		No Change in Contract		$4620.00 (was $4,323.00)				
		Unit Shipping Weight - lbs.		760		735				
		NOTES: Nuclear Class		3		3				
		Seismic Class		I		I				
		Casting Quality Factor		1.00		1.00				
		Valve Action		Back Press. Control		Modulates ② (R-1)				
		Allowable Seat Leakage at Shut off ΔP.		10.5 cc/hr H_2O		40 cc/hr. H_2O				
		Body Face-to-Face Dim.		18 1/4"		18 1/4"				
		General Notes: See Quote Page 14 for definition of Code Numbers.		1b, 2c, 6, 7, 9, 11 thru 19, 21, 22, 23, 24a, 26, 27, 28b, 30 thru 33.		1b, 2d, 3c, 4, 6, 7, 9, 11 thru 19, 21, 22, 23, 24b, 26, 27, 28a, 30 thru 33.				
		Accessories: See Quote Page 15 for definition of Code Letters		A		A, E-1, H, R(1) & S				
		Reference Bulletins		334E A MEA		334E				
		Remarks		User to Provide Controller						

(1) Hard-faced Seating Surface.

(2) Changed from "On-Off." ③ Changed from Model No. 37-20761.

Note. Soft Seat for tight shut-off on Item 22-R1 is not available for 1305 max. shut-off ΔP; 500 - 550 psi is max. for soft seat construction.

ATTACHMENT A

SNP 1-2-CA-D053
0-HCG-JWW-082274

R-2
~~R-1~~

PAGE A6

I & C F-014

REQUISITION NO. 83577

GENERAL	1	ITEM NO.	2			MFR DATA (IF ACP)	
	2	QUANTITY	8		X	8	
	3	INSTRUMENT NO.	LCV-3-172,173,174,175				
	4	DRAWING					
	5	REFERENCE	SPEC. 1643				
	6	MANUFACTURER & MODEL	MASONEILAN	~~[illegible]~~ (40000)	X	Masoneilan	3R-40211-7A2
	7	UNIT PRICE/UNIT WT			X		[illegible]
	8	SERVICE	AUX. FW				
	9	TVA CLASS/SEISMIC	C	CLASS I			
	10	ACTION	ON	OFF	X	~~On-off~~ Modulates	
DESIGN	11	LINE SIZE/SCHEDULE	4"	120			
	12	MAX LINE PRESS. (PSIA)	1650				
	13	MAX ΔP (VLV CLOSED)	1250				
	14	MAX INLET TEMP (F)	100°				
BODY	15	SIZE/STYLE	MS	MS	X	3"	Globe
	16	ANSI RATING/MATERIAL	900 lb		X	900 lb.	ASME SA-216 Gr. WCB
	17	END CONNECTIONS	[redacted]	FLANGED	X	Flanged	
	18	BONNET TYPE	MS		X	Standard	
	19	PACKING	MS		X	Crane 187-I	
	20	LEAKOFF CONNECTIONS	NA				
	21						
TRIM	22	PLUG FORM	MS		X	Balanced Piston [illegible]	
	23	MATERIAL	STAINLESS STEEL		X	ASME SA-351 Gr. CF8M [illegible]	
	24	NO. OF PORTS/PORT SIZE	SINGLE	MS	X	1	2.500" [illegible]
	25	GUIDING	MS		X	Cage, [illegible] Stem Guide [illegible]	
	26	SPECIAL TRIM	HARDENED FACE		X	[illegible]	
	27	Req'd Seat Leak: [illegible] of valve size (...)	Attainable			Seat Leak Shut-off Test [illegible] cc/hr.	
ACT.	28	TYPE	DIAPHRAGM		X	Diaph./Spring	
	29	SIZE & STROKE	MS	MS	X	No. 24	2"
	30	AIR SUPPLY	70-100 PSIG		X	30 psig	
	31	FAILURE POSITION	CLOSE		X	Closed	
POS'NER	32	MANUFACTURER & MODEL	NA			Masoneilan	8012
	33	BYPASS/GAUGES	N/A	NA		Yes	2
	34	FOR INPUT OF	NA	NA		10 ma DC	50 ma D.C.
	35	OUTPUT SHALL BE	NA	NA		0 psig	30 psig
ACCESSORIES	36	FILTER-REG TYPE	67 FR-SS ~~[illegible]~~		X	Masoneilan 77-4 [illegible] Gauge	
	37	LIMIT SWITCHES	DPDT		X	[illegible]	
	38	L.S. CONTACT RATING	15A/120VAC [illegible]		X	20A/125V AC or 5.0A/125V DC	
	39	SOLENOID VALVE	3 WAY (NOTE 2)		X	ASCO [illegible]	
	40	S.V. COIL VOLTAGE	125 VDC		X	125V, D.C (90-140 V D.C)	
	41	HANDWHEEL	YES	SIDEMOUNTED	X	Masoneilan Model No. 7A2	
	42						
OPER COND	43	FLOWING MEDIUM	WATER			Water	
	44	SIZING CONDITIONS	MAX	MIN		MAX	MIN
	45	FLOW RATE (GPM)	440	0		440 GPM	0 GPM
	46	PRESSURE (PSIA)	1250	1250		1250 psia	1250 psia
	47	TEMPERATURE (F)	100°	80°		100° F	80° F
	48	ΔP (PSI)	1250	20		20 psi (Sizing)	1250 psi [illegible]
	49	CV (CALC) (1)			X	98	–
	50	CV (ACTUAL)			X	155	–

X---DATA BY BIDDER
*---OR EQUAL
NA--NOT APPLICABLE
MS--MFR STANDARD

NOTES: (1) USE FOR 80% TO 90% OF VALVE OPERATOR STROKE.

(2) TAG LSV-3-172,173,174,175

H-5: DATE:
ENGR: JCS DATE: 2-12-74 (KWH 7/14/74)

Masoneilan

SPECIFICATION NO. 1622

CONTROL VALVES

PLANT: SEQUOYAH NUCLEAR PLANT UNITS 1 AND 2

R-2

R-2
~~R-2~~
~~R-2~~
R-2

R-1

CUSTOMER TVA

REFERENCE [illegible] 113CM 08577
Plant-Sequoyah - Units 1&2

Norwood, Massachusetts 02062
Montebello, California 90090

40000 SERIES
CONTROL VALVE SPECIFICATION

QUOTE 2Q73-A11 PAGE 9-Rev.B
SNP 1-2-GA-D053
0-HCG-JWW-082274
DATE 7-24-74 BY RNM

TVA Piping Class C - Nuclear Class 3 - Seismic Class I. ATTACHMENT A PAGE A7

1		Item	24
2		Tags: 1-&2-LCV-172, -173, -174 & -175 - Aux. Feedwater Isol.	
3		Qty 8	Size - 3"
4		Model No. 03-40211-7A2	
5		Service: Modulates ✓ / On-Off ☐ / To Be Piped Flow-to-Open ☐ / Close ✓	
6	BODY	Type	Globe
7		Material	ASME SA-216, Gr. WCB
8		Rating ANSI	900 lb.
9		Connections	R.F. Flanged
10		Face-to-Face	17 3/8"
11		Special	
12	BONNET	Type	Standard Ribbed Design
13		Material	Same as Body ✓
14		Integral S.Ring Retainer	Yes ☐ No ✓
15		Backseat	Yes ✓ No ☐ (std.) ✓
16		Leak-off Conn. Pipe Plug	✓ - 1/4" NPT (ASTM A307 Cad. Plated) ✓
17		Leak-off Conn. ___" Nipple	
18		Packing Type	Crane 187-I ✓
19		Packing Qty. Rings above LNTRNG	- 3 ✓
20		Packing Qty. Rings below LNTRNG	- 5 ✓
21		Other	
22	TRIM	Control Characteristic: Eq. Percent ☐	Nominal Size: Full - 3" ✓
23		Control Characteristic: Linear ✓	Nominal Size: Reduced - "
24		Plug Type: Balanced ✓ / Piston ✓	- ASME SA-351, Gr. CF8M w/ Stellite Faced Seat & Guide Surfaces ✓
25		Plug Type: Unbalanced ☐ / Contoured ☐	
26		Bal. Plug: Teflon ☐	
27		Seal Ring: Ni-Resist ✓	- ASTM A436, Ty. 3 (Cast Iron) ✓
28		Balanced Plug Seal: Resilient Seat: Metal "K" Seal ✓	- 17-4 PH St. St. - Silver Plated ✓
29		Balanced Plug Seal: Resilient Seat: Teflon-Glass-filled ☐	
30		Balanced Plug Seal: Pilot ☐	
31		Seat Ring: Integral w/Cage ✓ / Standard ☐	Material - (See line 36) ✓
32		Seat Ring: Separate Part ☐ / 10-db (w/ Diffuser) ☐	Bore Diam. - 3.500" ✓
33		Valve Plug: Threaded & Pinned to Plug ☐	
34		Valve Plug: Weld-assembled to Plug ✓	
35		Stem: [illegible] " Diam Material	✓ - ASME SA-479 Gr. 316 (Finish 3 to 7 micro-inches RMS) ✓
36	GUIDING	Cage	✓ - Cast & Hardened, Heat-Treated ASTM A351, Gr. CA6NM - Martensitic St. St. ✓
37		Seal Retainer	✓ - ASTM A582, Ty. 416 Heat-Treated & Chrome Plated ✓
38		Bushing (Assembled in Bonnet) ☐	
39		Stems (in Bottom of Stuffing Box)	✓ ASTM A276, Ty. 440-C Heat-Treated. ✓
	ACTUATOR	Type:	Diaphragm / Spring
		Size	[illegible], 24 [illegible] (Rev.)
		Stroke 2"	Air-to-Open ✓ / Close ☐ / Supply Press. - 30 psig
		Range 10-21 1/2 psig	Spring Nos. 44-21 & 47-1
		Failure Position	Open ☐ Closed ✓
		Handwheel - Side ✓ / Top ☐	Mounted - Model No. 7A2
		Special: [illegible] in ASTM A216 Gr. WCB (Cast Steel)	

ES: Posi[illegible] [illegible] & Pinned)

MODEL (Positioner)	5012 Electropneumatic
[illegible] UT	10 - 50 ma DC.
[illegible] Y	30. PSIG
[illegible] T	Model 77-41

Attainable Leakage at 1250 psi Test Shut-off ΔP is 131 cc/hr. H_2O.

Allowable ΔP = approx. 1600 psi - max.

[illegible] Notes: 2C, 3C, 4, 6, 11, 12, 13, 14, 16 (Plug only), 19, 21, ,24, 2[illegible] [illegible]7, 28b (Norwich Plant), 30, 31, 32 & 33

Accessories: [illegible], D-1, H, R'' and S.

- Service Conditions -

FLUID		Water	
LINE SIZE	SCHED.	4"	120
SP. GR. @ 60F	TEMP	1.0	[illegible]
ΔP SIZING	MAX.	20 psi	1250 [illegible]
TEMP (°F)	MAX.	100°F	
TEMP (°F)	Norm Suprht	80°F	-
QTY MAX	MIN	440 GPM	0 GPM
INLET	OUTLET	1250	[illegible]
VAPOR	CRIT.	[illegible]	[illegible]
CF FACTOR		0.94	
REQ'D CV		98	
RATED CV		155	
Net Unit Price		$6,650.00	
Unit Shipping Weight - lbs.		855	

See Bulletin 370E

ENCLOSURE 3

PROPOSED TECHNICAL SPECIFICATION CHANGES

SEQUOYAH NUCLEAR PLANT UNIT 2

DOCKET NO. 50-328

(TVA-SQN-TS-88-02)

DETERMINATION OF NO SIGNIFICANT HAZARDS CONSIDERATIONS

ENCLOSURE 3

Page 1 of 1

Significant Hazards Evaluation

TVA has evaluated the proposed technical specification change and determined that it does not represent a significant hazards consideration based on criteria established in 10 CFR 50.92(c). Operation of SQN in accordance with the proposed amendment will not:

(1) involve a significant increase in the probability or consequences of an accident previously evaluated. As described in section 10.4.7.2 of the SQN FSAR, the AFW system is an engineered safety features system designed, constructed, and operated to serve as a backup to the main feedwater system to provide feedwater to the steam generator in the event that main feedwater is not available. This maintains the heat sink capabilities of the steam generators. The AFW system is directly relied upon to prevent core damage and system overpressurization in the event of transients, such as a loss of normal feedwater or a secondary system pipe rupture, and to provide a means for plant cooldown following any plant transient.

The proposed change to SR 4.7.1.2.a adds pump-specific, differential pressure test values for each AFW pump. The new test values ensure that each AFW pump will provide a flow of at least 440 gal/min plus pump recirculation flow. This flow satisfies the FSAR assumptions concerning 440 gal/min AFW flow to two intact steam generators. The addition of pump-specific test values merely reflects the performance characteristics of different pumps. Because the revised SR ensures conformance with the FSAR accident analysis assumptions, the probability or consequences of an accident previously evaluated remain unchanged.

(2) create the possibility of a new or different kind of accident from any previously analyzed. As described above, the proposed technical specification change to SR 4.7.1.2.a adds pump-specific, differential pressure requirements for the testing of the AFW system. The revised requirements ensure that the AFW pumps will satisfy the assumptions of the FSAR AFW analyses. No changes, other than those to the testing values, are made to the AFW system. As such, the possibility of a new or different kind of accident from any previously analyzed is not created by this change.

(3) involve a significant reduction in a margin of safety. The proposed changes to SR 4.7.1.2.a add pump-specific, differential pressure test values for each AFW pump. The new test values ensure that each AFW pump will provide a flow of at least 440 gal/min plus recirculation flow. This flow ensures that plant operation is bounded by the FSAR analyses assumptions that 440-gal/min AFW flow is available to the steam generators. Because operation remains bounded by the FSAR analyses, there is no reduction in the margin of safety.