



Omaha Public Power District

1623 HARNEY # OMAHA, NEBRASKA 68102 # TELEPHONE 536-4000 AREA CODE 402

July 14, 1981

Mr. Darrell G. Eisenhut, Director
U. S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Division of Licensing
Washington, D.C. 20555



Reference: Docket No. 50-285

Dear Mr. Eisenhut:

In response to the Commission's letter dated February 10, 1981 (Generic Letter No. 81-14) regarding seismic qualification of the auxiliary feedwater (AFW) system, Omaha Public Power District submits the attached report. The attached evaluation report (Attachment 1) on the seismic qualification of the auxiliary feedwater system was performed for the District by Gilbert/Commonwealth engineering consultants, and the results and recommended actions are summarized below. Attachment 2 provides a summary listing of the qualification status of each AFW component.

Qualified personnel experienced in the analysis, design and evaluation of the AFW structures, systems, and components performed the walkdowns to identify potential seismic deficiencies of the system. From these walkdown inspections Gilbert/Commonwealth (G/C) has concluded that our AFW system (including mechanical and electrical equipment and components including battery racks, controls, instruments, motors, compressors, tanks, electrical supplies and the cabinets containing these items) is seismically qualified except for the four deficiencies outlined below.

The four identified deficiencies, along with the planned corrective actions, are as follows:

1. Electrical Supply Conduit to the AFW Pump FW-6 Motor--The conduit was found to be inadequately restrained. An additional support will be added by the end of 1981 to increase the conduit resistance to seismic movements.
2. Valve Operators on Small Bore Piping--The current operator supports were found to be unstable. Modification work will involve removing the existing support rods and replacing them with a more stable support by the end of 1981.
3. Small Bore Piping (Cold System)--The rigidity of this piping was found to be inadequate due to improper support spacing. Pipe restraints will be added as per the G/C recommendations by the end of 1981.

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1/1

Mr. Darrell G. Eisenhut, Director

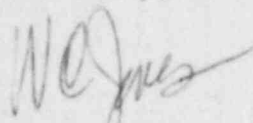
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4. Small Bore Piping (Hot System)--The rigidity of this piping also appeared to be inadequate although the high operating temperatures (350°F) of this piping makes it critical to consider potential negative impacts of additional restraints on thermal displacements and loads. The District is currently performing a detailed pipe stress analysis to determine detrimental impact of additional pipe restraints. This analysis is expected to be completed by September 30, 1981. Modifications as needed will be completed by the end of 1981.

After the four deficiencies have been modified, the entire AFW system will provide substantial resistance to movement caused by seismically induced forces. Since the schedule for resolving these deficiencies is consistent with the schedule for the overall upgrade of the AFW system, as required by NUREG-0737, the District believes there is adequate justification for continued plant operation.

Sincerely,



W. C. Jones
Division Manager
Production Operations

WCJ/KJM/TLP:jmm

Attachments

cc: LeBoeuf, Lamb, Leiby & MacRae
1333 New Hampshire Avenue, N.W.
Washington, D.C. 20036

INSPECTION EVALUATION REPORT

The following is an evaluation report of the inspection performed in response to the NRC's Generic Letter No. 81-14 (OPPD Task ES-81-01).

Upon investigation of the Auxiliary Feedwater (AFW) System it was determined through the use of Piping and Instrumentation Diagrams (P&ID) that the AFW system is seismically qualified. This system was included in the inspection and analysis performed within the scope of the NRC's I & E Bulletins 79-02 and 79-14. The remaining mechanical and electrical equipment which was not included in Bulletins 79-02 and 79-14 was inspected and deficiencies were numbered and red tagged for identification.

There were only four areas in which the inspection indicated deficiencies.

1. Electrical supply (Conduit) to Auxiliary Feedwater Pump FW-6 motor: The conduit was not adequately restrained seismically. The recommendation is to add a support to increase resistance to seismic movements (see Attachment 1).

<u>Support No.</u>	<u>Sheet</u>
AFW-5	2 & 3

2. Valve Operators: This deficiency is for the valve operators on small bore piping. The operators supports were found to be unstable as currently installed. The recommendation is to modify existing supports (see Attachment 1).

<u>Support No.</u>	<u>Sheet</u>
AFW-1	2 & 3
AFW-15	6 & 7
AFW-18	6 & 7

Page 2

INSPECTION EVALUATION REPORT

3. Pipe rigidity (Cold Systems): This deficiency involves small bore piping 2 inch and smaller which was not within the scope of the NRC's I & E Bulletin 79-14 and was, therefore, not analyzed or inspected during the bulletin work. This piping was inspected and evaluated within the scope of this work to comply with the NRC's Generic Letter No. 81-14.

The evaluation of this piping was based on frequency, rigidity, and stability of the system during inspection. The frequency of the piping was analyzed using a nomograph furnished by the District, which was the original design basis of Gibbs and Hill Inc. during construction.

Using this nomograph (see Attachment 1, Sheet 8) the support spacing was found to be inadequate to achieve first mode frequencies of 18 CPS for vertical and 6 CPS for the horizontal. The following support modifications and additions are recommended to increase rigidity under seismic conditions. Also, the relative frequency is estimated for both as found and with proposed modifications (see Attachment 1).

<u>Support No.</u>	<u>Sheet</u>
AFW-2	2 & 3
AFW-3	2 & 3
AFW-4	2 & 3
AFW-6	2 & 3
AFW-7	2 & 3
AFW-8	2 & 3
AFW-9	2 & 3
AFW-10	2 & 3
AFW-11	4 & 5
AFW-20	6 & 7

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INSPECTION EVALUATION REPORT

4. Pipe Rigidity (Hot Systems): The same analysis was done on additional piping of the same description as item No. 3 above, with one important difference. This piping could reach or operates at temperatures above 300°F. At these temperatures it is critical to consider thermal displacement and thermal loads.

Due to the complexity of the piping involved, which appears to need additional supports for rigidity, G/C recommends that a detailed pipe stress analysis be performed for the steam drive and condensate portions of the Auxiliary Feedwater piping associated with pump FW-10. This analysis should be performed to assure that additional supports do not have a detrimental thermal impact on the system. The following support additions should not be incorporated until approved by pipe stress analysis (see Attachment 1).

<u>Support No.</u>	<u>Sheet</u>
AFW-12	4 & 5
AFW-13	4 & 5
AFW-14	4 & 5
AFW-15	4 & 5
AFW-16	4 & 5
AFW-17	4 & 5
AFW-18	4 & 5
AFW-19	4 & 5
AFW-22	6 & 7

All other mechanical and electrical equipment and components including battery racks, controls, instruments, motors, compressors, tanks, electrical supplies and the cabinets containing such items, associated with the Auxiliary Feedwater System were found to be securely attached to their supporting structures, such that substantial resistance to movement caused by seismically induced forces would be provided.

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INSPECTION EVALUATION REPORT

This inspection and evaluation was accomplished using personnel experienced in the analysis, design, and evaluation of structures, systems, and components. These personnel were familiar with the plant and the requirements for other seismically qualified systems. This was due to their direct involvement with the NRC's I & E Bulletins 79-02 and 79-14.

As described previously, all large bore piping (2½ and larger) associated with the Auxiliary Feedwater system was deemed seismically qualified. This piping was analyzed during the work performed as a result of the NRC's I & E Bulletin 79-14. The analysis of the Auxiliary Feedwater piping and associated equipment was accomplished by the dynamic computer code entitled T-Pipe. The appropriate response spectra, as described in the Fort Calhoun Station Unit #1 Final Safety Analysis Report (FSAR), Appendix F, Section F.2.5, was used as input for the seismic analysis. Also, the loading combinations and stress limits used for analysis were taken from the FSAR, Appendix F, Table F-1. Detailed information concerning input and analysis results are available through Gilbert/Commonwealth's documentation of the NRC's I & E Bulletin 79-14.

Also, included in this evaluation are the support designs which were requested by the District, and are associated with the Auxiliary Feedwater system. These supports were designed in order to replace mechanical snubbers with Hydraulic Snubbers (see Attachment 1).

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INSPECTION EVALUATION REPORT

<u>Support No.</u>	<u>Sheet</u>
AFW-23	6 & 7
AFW-24	6 & 7
AFW-25	6 & 7
AFW-26	6 & 7
AFW-27	6 & 7



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engineers/consultants/architects

OMAHA PUBLIC
POWER DISTRICT
FT. CALHOUN, UNIT 1

FILING CODE

JOB NO. 64-0285-000

CALC. BY/DATE

REVIEW BY/DATE

SUBJECT

DESIGN OF PIPE SUPPORT

Auxiliary Feedwater

SHEET 1 OF 9

BOOK NO. Attch. 1

REV.

Tabulation & analysis of unsupported lengths of small-bore piping for evaluation of Auxiliary Feedwater System.
Values are for 2", 1 1/2" and 1" ϕ lines with & without insulation.

Using Frequency \rightarrow (14 - 18)

(5-6)

K	Value	Vertical		Horizontal	
		Feet	Avg.	Feet	Avg.
2" ϕ , sch. 40, w/o insulation					
S-S	1417	10'-8 $\frac{1}{2}$ '	12'	17'-15'	20'
F-S	2212	13'-11 $\frac{1}{2}$ '		21'-19'	
F-F	3222	15'-14'		26'-24'	
2" ϕ , sch. 40, w/ insulation					
S-S	1159	9'-8'	11'	15'-14'	18'
F-S	1809	12'-10'		19'-17 $\frac{1}{2}$ '	
F-F	2635	13 $\frac{1}{2}$ '-12 $\frac{1}{2}$ '		22 $\frac{1}{2}$ '-21'	
1 $\frac{1}{2}$ " ϕ , sch. 40, w/o insulation					
S-S	1151	9'-7 $\frac{1}{2}$ '	11'	15'-14'	18'
F-S	1797	12'-10'		19'-18'	
F-F	2618	14'-12 $\frac{1}{2}$ '		23'-21'	
1 $\frac{1}{2}$ " ϕ , sch. 40, w/ insulation					
S-S	883	8'-7'	9 $\frac{1}{2}$ '	13 $\frac{1}{2}$ '-12 $\frac{1}{2}$ '	16'
F-S	1379	10'-8 $\frac{1}{2}$ '		17'-15'	
F-F	2008	12 $\frac{1}{2}$ '-11'		20'-18 $\frac{1}{2}$ '	
1" ϕ , sch. 40, w/o insulation					
S-S	809	8'-7'	9'	13'-12'	15'
F-S	1263	9'-8'		16'-14'	
F-F	1841	12'-10'		19'-18'	
1" ϕ , sch. 40, w/ insulation					
S-S	580	6 $\frac{1}{2}$ '-5 $\frac{1}{2}$ '	8'	11'-10'	13'
F-S	906	8'-7'		14'-13'	
F-F	1320	10'-8 $\frac{1}{2}$ '		16'-15'	

Above (K) values tabulated according to end conditions:

- Simple - Simple
- Fixed - Simple
- Fixed - Fixed



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DESIGN OF PIPE SUPPORT


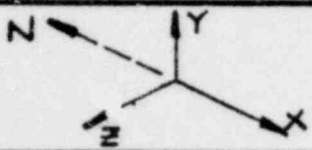
Auxiliary Feedwater


SHEET 2 OF 9

BOOK NO. Atch. 1

REV.

SUPPORT NUMBER	PIPE SIZE	FREQUENCY	ROOM No.	SUPPORT DISCREPANCY
AFW-1	1 1/2" ϕ	N/A	19	Valve operator is unstable in (L) direction
AFW-2	1 1/2" ϕ	8.5	19	Unsupported riser span (12')
AFW-3	1 1/2" ϕ	N/A	19	U-Bolt is not restraining pipe
AFW-4	1 1/2" ϕ	5.5	19	Unsupported riser span (14')
AFW-5	3" ϕ conduit	N/A	19	Riser is unstable in (x) direction
AFW-6	1 1/2" ϕ	7.5	56	Unsupported riser span (12 1/2')
AFW-7	1 1/2" ϕ	9.5	81	Unsupported riser span (11')
AFW-8	1 1/2" ϕ	11.0	81	Unsupported run span (10')
AFW-9	2" ϕ	3.5	81	Unsupported comb. riser & run (21 1/2')
AFW-10	2" ϕ	8.5	56	Unsupported riser span (13')

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	CALC BY/DATE <hr/> REVIEW BY/DATE <hr/>	SUBJECT DESIGN OF PIPE SUPPORT <u>Auxiliary Feedwater</u>	SHEET <u>3</u> OF <u>9</u> BOOK NO. <u>Attch. 1</u>
<div style="text-align: center;">  </div>			REV.
SUPPORT No.	PROPOSED MODIFICATION		
AFW-1	Remove existing rod & replace w/ strut		
AFW-2	Add pipe restraint in the (x & z) directions increasing frequency to ≈ 42 & reduce span to 6'		
AFW-3	Tighten U-Bolt to restrain pipe		
AFW-4 (Work w/AFW-11)	Add pipe restraint in the (x & z) directions increasing frequency to ≈ 30 & reduce span to 7'		
AFW-5	Add restraint to conduit in the (x) direction		
AFW-6 (Work w/AFW-10)	Add pipe restraint in the (x & z) directions increasing frequency to ≈ 27 & reduce span to 6'2"		
AFW-7	Add pipe restraint in the (x) direction on run above riser increasing frequency to ≈ 35 & reduce span to 11'		
AFW-8	Add pipe restraint in the (z) direction increasing frequency to ≈ 41 & reduce span to 5'		
AFW-9	Add pipe restraint in the (x & y) directions at AFW-7 location- increasing frequency to ≈ 25 & reduce span to 10'		
AFW-10 (work w/ AFW-6)	Add pipe restraint in the (x & z) directions increasing frequency to ≈ 34 & reduce span to 6'2"		

 <p>Gilbert Commonwealth Companies</p>	Commonwealth Associates Inc. engineers/consultants/architects		OMAHA PUBLIC POWER DISTRICT FT. CALHOUN, UNIT 1		FILING CODE JOB NO. 64-0285-000
	CALC. BY/DATE REVIEW BY/DATE		SUBJECT DESIGN OF PIPE SUPPORT <u>Auxiliary Feedwater</u>		SHEET <u>4</u> OF <u>9</u> BOOK NO. <u>Atch. 1</u>
	REV.				

SUPPORT Number	PIPE SIZE	FREQUENCY	Room No.	SUPPORT DISCREPANCY
AFW-11	2" ϕ	11	19	Unsupported comb. riser & run (11'2')
AFW-12	2" ϕ Insulated	4.5	19	Unsupported comb. riser & run (15')
AFW-13	2" ϕ Insulated	3.5	81	Existing support is unstable
AFW-14	2" ϕ Insulated	5.5	81	Unsupported run span (14')
AFW-15	2" ϕ Insulated	N/A	81	Valve operator is unstable in (x) direction
AFW-16	2" ϕ Insulated	Less than 2	81	Unsupported run span (18') Vert. & (27') Horiz.
AFW-17	2" ϕ Insulated	Less than 2	81	Work w/ AFW-16
AFW-18	2" ϕ Insulated	N/A	81	Valve operator is unstable in (x) direction
AFW-19	2" ϕ Insulated	3.5	81	Unsupported comb. run & riser (17')



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SUBJECT

DESIGN OF PIPE SUPPORT

Auxiliary Feedwater

SHEET 5 OF 9

BOOK NO. Atch. 1

REV.



SUPPORT No.	PROPOSED MODIFICATION
ΔFW-11 (Work w/ΔFW-4)	Add pipe restraint on riser in (x & z) directions increasing frequency to ≈ 42 & reduce span to $5\frac{1}{2}'$
ΔFW-12 *	Add pipe restraint in (z) direction increasing frequency to ≈ 20 & reduce span to $7\frac{1}{2}'$
ΔFW-13	Remove existing support & replace w/ new (x & y) restraint
ΔFW-14 *	Add pipe restraint in (x) direction increasing frequency to ≈ 22.5 & reduce span to $7'$
ΔFW-15	Remove rod restraint & replace w/ strut in (x) direction
ΔFW-16 *	Add pipe restraint in (x & z) directions at 2 pts. & in (y) direction at 1 pt. increasing frequency to ≈ 14 & reduce span to $9'$
ΔFW-17 *	Add pipe restraint to work w/ ΔFW-16
ΔFW-18	Remove rod restraint & replace w/ strut in (x) direction
ΔFW-19 *	Add pipe restraint in (z & y) directions increasing frequency to ≈ 15 & reduce span to $8\frac{1}{2}'$

* = Add only after detailed pipe stress analysis



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DESIGN OF PIPE SUPPORT

Auxiliary Feedwater

SHEET 6 OF 9

BOOK NO. Atch. 1

REV.

SUPPORT Number	PIPE SIZE	FREQUENCY	Room No.	SUPPORT DISCREPANCY
AFW-20	2" ϕ	N/A	81	Valve bypass is unstable in the (Z) direction
AFW-21	2" ϕ Insulated	N/A	19	Valve operator is unstable in the (Z) direction
AFW-22	1" ϕ	2.0	19	Unsupported riser span (20')
AFW-23	2" ϕ Insulated	N/A	81	O.P.P.O. request to remove mechanical snubber & replace w/ Hydraulic snubber Retrofit Design 5-1
AFW-24	Refer to AFW-23			Retrofit design 5-2
AFW-25	Refer to AFW-23			Retrofit design 5-3
AFW-26	Refer to AFW-23			Retrofit design 5-4
AFW-27	Refer to AFW-23			Retrofit design 5-5



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SUBJECT

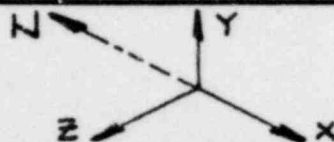
DESIGN OF PIPE SUPPORT

Auxiliary Feedwater

SHEET 7 OF 9

BOOK NO. Attch. 1

REV.

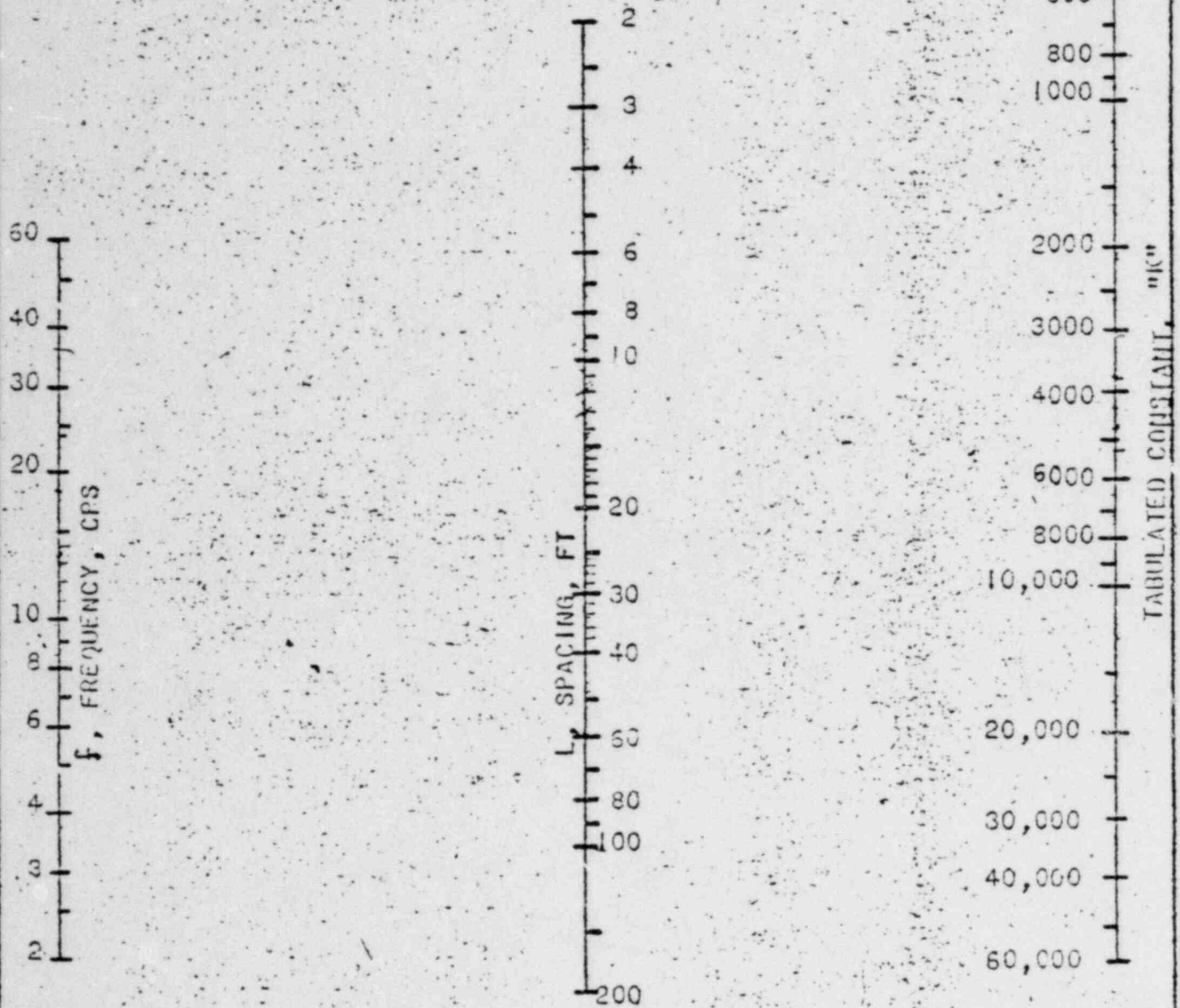


SUPPORT NO.	PROPOSED MODIFICATION
AFW-20	Remove existing rod & replace w/ strut
AFW-21	Remove existing rod & replace w/ strut
AFW-22 *	Add pipe restraint in (z) direction on riser. Other restraints required
AFW-23	Redesign support: Remove existing mechanical snubber & replace w/ hydraulic snubber (Design complete - S.1)
AFW-24	See AFW-23 (S.2)
AFW-25	See AFW-23 (S.3)
AFW-26	See AFW-23 (S.4)
AFW-27	See AFW-23 (S.5)

* = Add only after detailed pipe stress analysis

NOMOGRAPH FOR SEISMIC RESTRAINT SPACING

SOLUTION OF $L = \sqrt{K/f}$



FOR USE WITH TABULATED VALUES OF THE CONSTANT
"K" FOR SEISMIC RESTRAINT SPACING.

NOMOGRAPH FOR SEISMIC RESTRAINT SPACING	
SCALE: ———	DATE: 11/17/58
Gibbs & Hill, Inc. ENGINEERING, ARCHITECTURE, CONSTRUCTION NEW YORK	

CORRECTION FACTOR FOR "K"

ATTCH 1

FOR

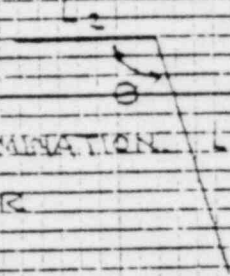
PIPE BEND WITH TWO LEGS

(VIBRATION PERPENDICULAR TO PLANE OF BEND)

$$L = L_1 + L_2$$

L IS USED FOR FREQUENCY DETERMINATION

CURVE GIVES CORRECTION FACTOR FOR
TABULAR VALUES OF "K"



This is the only part of graph that AS PROVEN
VALID.

$$L_1 = 0, L_2 = 0, L = L$$

$$L_1 = L_2 = L/2$$

$$L_1/L_2 = 1/2$$

$$L_1/L_2 = 1/4$$

$$L_1/L_2 = 1/8$$

$$L_1/L_2 = 1/16$$

$$L_1/L_2 = 1/32$$

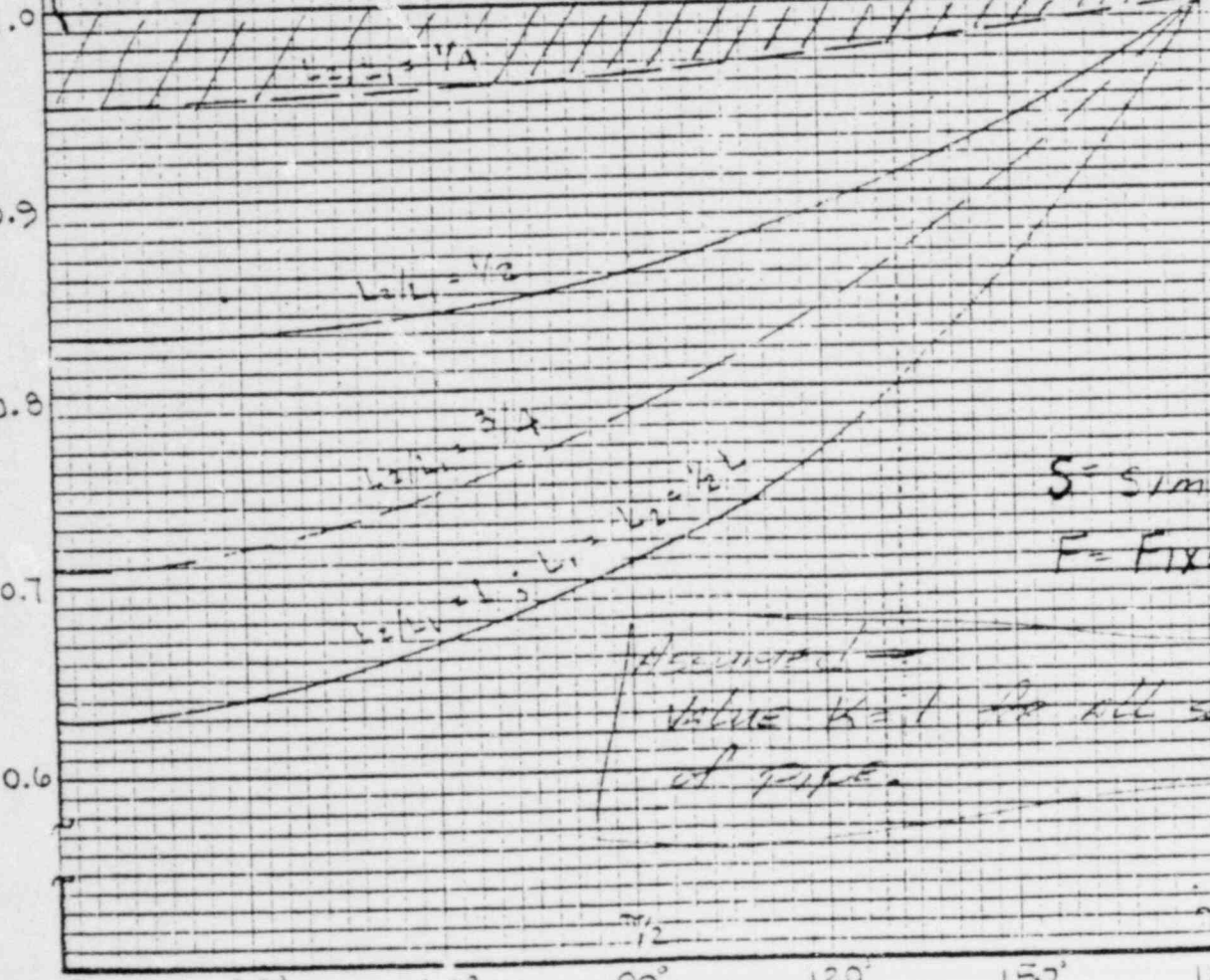
$$L_1/L_2 = 1/64$$

S = Simple

F = Fixed

Assumed
value K at all sections
of pipe.

CORRECTION FACTOR FOR CONSTANT "K".



ANGLE BETWEEN LEGS, DEGREES.

SUMMARY OF AUXILIARY
FEEDWATER SEISMIC QUALIFICATION

- (1) Pumps/Motors - Adequately restrained for seismic qualification.
- (2) Piping - 2" diameter and under piping requires additional restraint to be seismically qualified.
- (3) Valves/Actuators - Some valves and actuators require modifications to their restraints to be seismically qualified.
- (4) Power Supplies - One span of conduit was identified as needing additional restraints to be seismically qualified.
- (5) Primary Water and Supply Path - Storage tanks, major components, and structures are seismically qualified except as noted in items (2), (3), and (4).
- (6) Secondary Water and Supply Path - Not applicable to Fort Calhoun Station Unit No. 1.
- (7) Initiation and Control System - Instrument air tubing is adequately restrained seismically.
- (8) Structures Supporting or Housing These AFW Items - Adequately restrained and sturdily constructed for seismic qualification.