VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

January 31, 1979

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
Attn: Mr. D. G. Eisenhut, Acting Assistant
Director for Systems and Projects
Division of Operating Reactors
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Serial No. 603B/101978
PO/DLB:scj
Docket Nos.: 50-280
50-281
License Nos.: DPR-32
DPR-37

Dear Mr. Denton:

In our letter of December 15, 1978 we stated our intention to perform certain tests, inspections, and analyses of the low head safety injection (LHSI) pumps, the outside recirculation spray (ORS) pumps, and the inside recirculation spray (IRS) pumps. The status of our activities for each of these pumps is discussed below.

A. LHSI

A temporary test rig will be installed to permit testing of a Unit 2 LHSI pump at a moderate flow rate, i.e. 1500 to 3000 gpm. The test has been tentatively scheduled for March 1979. An exact date is not available due to uncertainties in the availability of materials and in the test rig completion date.

The test will run for a total of 100 hours. During the test, periodic measurements of pump suction and discharge pressure, water temperature, discharge flow rate, upper and lower motor bearing vibration, and pump shaft and suction bell vibration will be recorded. Following the test the pump will be disassembled for measurement of bearing wear and inspection for evidence of abnormal shaft wear. A report of test results will be forwarded within 30 days of test completion.

B. ORS Pump

In our letter of December 15, 1978 we agreed to provide a modal analysis in order to demonstrate that the Surry ORS pumps are sufficiently similar to the tested North Anna ORS pumps to justify applying the results of the North Anna tests to the Surry pumps. The results of this analysis are attached. The modal analysis results confirm our initial contention that the North Anna test results are applicable to Surry and that no additional testing is necessary.

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C. IRS Pump

During the Unit 1 steam generator inspection outage, IRS pump 1-RS-P-1B was inspected and optically aligned. All casing and impeller wear ring clearances were measured and were within the manufacturers accepted tolerances. There was no evidence of abnormal bearing or shaft wear. Both Unit 1 IRS pumps have now been inspected with satisfactory results. Both Unit 2 IRS pumps will be inspected during the steam generator replacement outage. Results of these inspections will be forwarded as they are available.

Very truly yours,

W C Stallings

C. M. Stallings
Vice President-Power Supply
and Production Operations

Attachment

OUTSIDE RECIRCULATION SPRAY PUMPS
COMPARISON OF NATURAL FREQUENCY CHARACTERISTICS
NORTH ANNA AND SURRY
VIRGINIA ELECTRIC AND POWER COMPANY

Modal analyses of the Outside Recirculation Spray Pumps installed at Surry and North Anna show similar natural frequency characteristics. Mathematical models of each pump were developed to describe the geometry of the motor, motor stand, discharge head, pump column and bowl sections, shafting, fluid, casing, and support systems (see Figure 1). A computer model of each pump was analyzed by the STRUDL computer program to determine the free vibrational characteristics of the pump as represented by the mass and stiffness of the pump elements. Natural frequencies (eigen values) and mode shapes (eigen vectors or relative amplitudes) of the pump system were evaluated.

Table 1 provides a comparison of the natural frequencies of the North Anna and Surry recirculation spray pumps. The results indicate the similarity of the vibration characteristics of both units. Figures 1-4 describe the geometry and computer models of the pump installations. Natural frequencies and mode shapes for the North Anna recirculation spray pumps are shown in Figures 5-14, while Figures 15-23 provide comparable data for the Surry pumps. From a vibration standpoint, the Surry and North Anna recirculation spray pumps have similar natural frequency characteristics. As can be seen by comparison of the mode shapes and corresponding natural frequencies, the relative amplitudes of vibration are primarily bending of the pump column, pump casing, motor support, and pump shafting. Based on the satisfactory vibration amplitudes recorded during extensive operational testing of the North Anna recirculation spray pumps and the similarity of vibration

frequency traits, the Surry recirculation spray pumps have satisfactory natural frequency characteristics for long-term continuous operation.

TABLE 1

OUTSIDE RECIRCULATION SPRAY PUMPS
COMPARISON OF NATURAL FREQUENCY CHARACTERISTICS
NORTH ANNA AND SURRY
VIRGINIA ELECTRIC AND POWER COMPANY

	NATURAL FREQUENCY, CPS	
MODE	NORTH ANNA	SURRY
1	3.37	2.88
2	6.80	6.28
3	8.24	9.04
4	15.28	15.03
5	19.02	18.26
6	24.45 (V)	21.16
7	28.24	26.53 (V)
8	39.56	28.42
9	40.79	35.19
10	41.67 (V)	37.22
11	43.79	38.86
12	44.33	39.97

NOTE: (V) is for vertical natural frequency. All other natural frequencies shown are in the horizontal direction. Vertical mode shapes are not shown.

CALCULATION SHEET

STONE & WEBSTER ENGINEERING CORPORATION

A5010 61

J.O./W.O./CALCULATION NO.	REVISION	PAGE

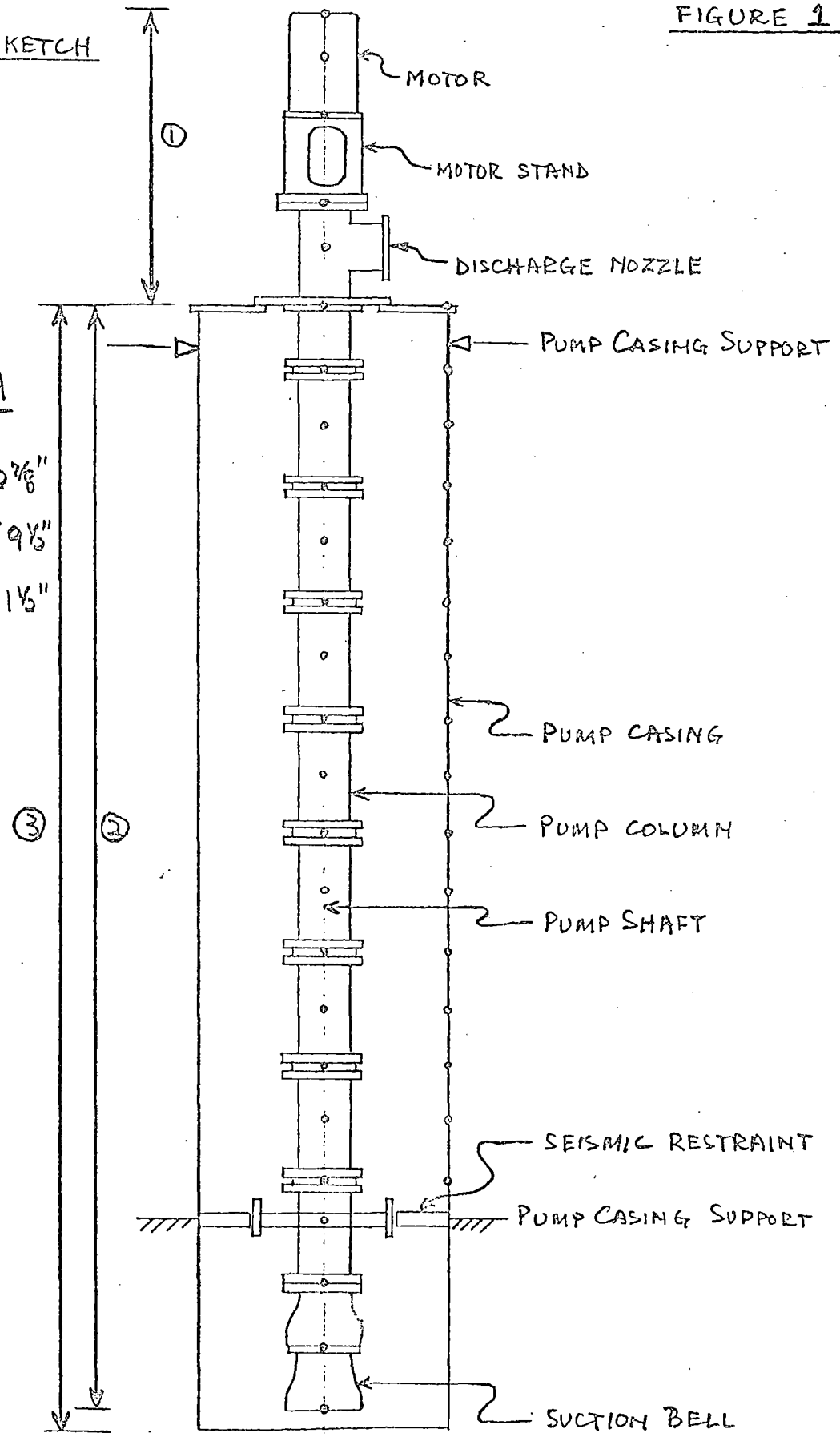
PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
JAF 12/14/78		

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
OUTSIDE RECIRC. SPRAY PUMP	

GEOMETRY SKETCH

FIGURE 1

	Surry	NA
①	8' 6 3/8"	9' 2 7/8"
②	51' 10 3/8"	49' 9 1/2"
③	52' 8 3/8"	50' 1 1/2"



STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Preliminary

Item 348-CBE

Client VEPCO | Location NA 1 & 2 | Est. No. | J.O. No. 11715

Subject OUTSIDE RECIRC SPRAY PUMP | Date 5/15/78 | By SAL

Checked 5/31/78 | By SNC

Based on | Revised | By

COMPUTER Model (Joint Numbers)

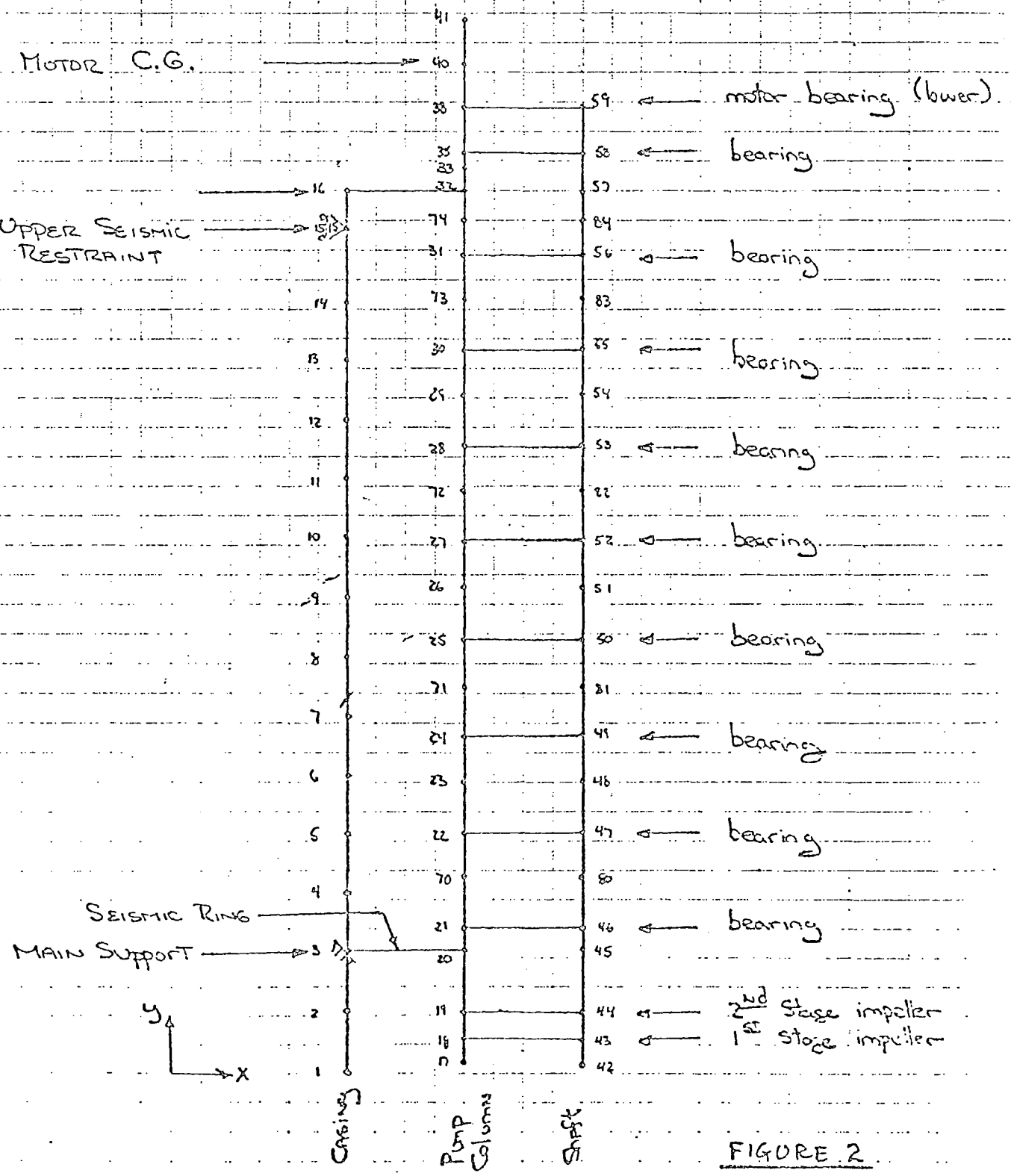


FIGURE 2

Computer Model (Member Numbers)

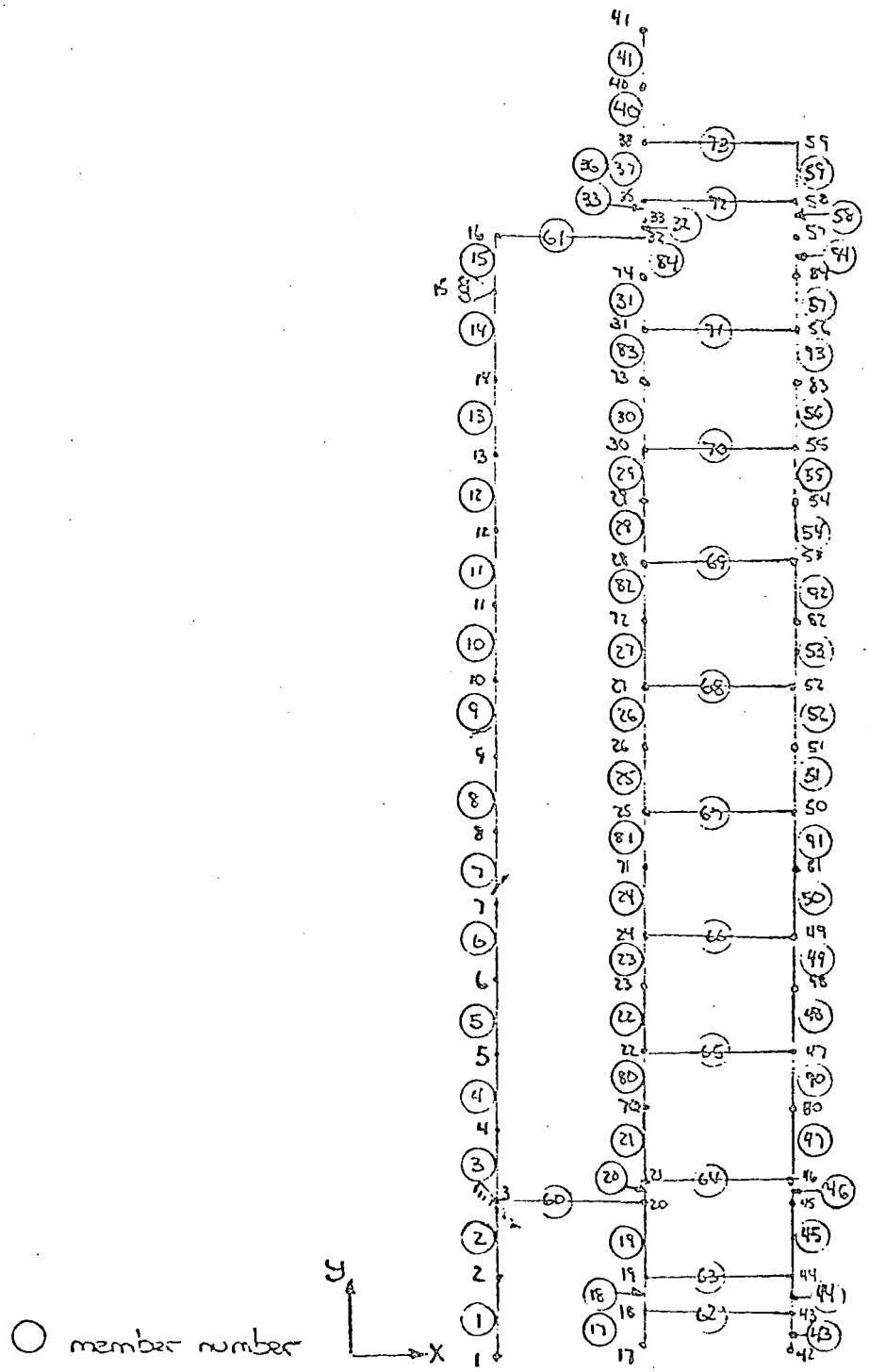


FIGURE 3

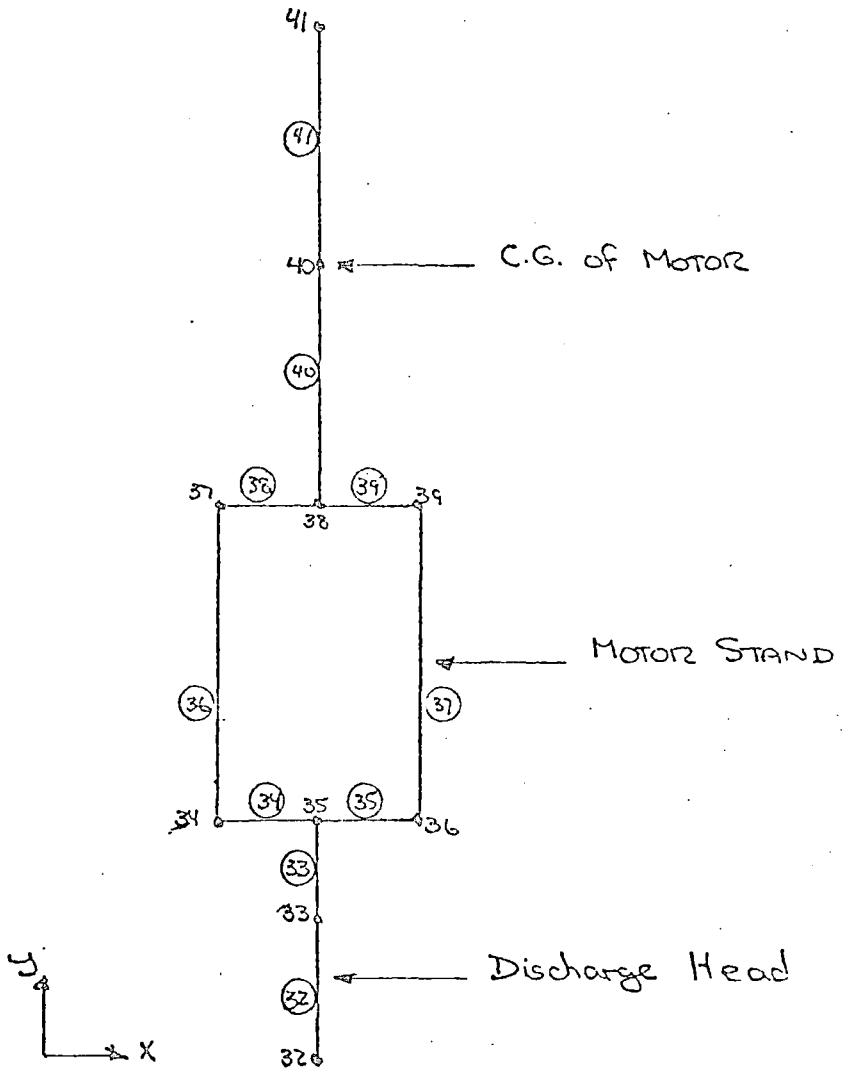
A501061

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
SAL 5/19/78	S.N.C 5/31/78	

SUBJECT/TITLE: OUTSIDE RECIRC SPRAY PUMP

QA CATEGORY/CODE CLASS: I

COMPUTER MODEL (CONTINUED)



O member numbers

FIGURE 4

FIGURES 5 to 14
NORTH ANNA UNITS 1 & 2
OUTSIDE RECIRCULATION SPRAY PUMPS
NATURAL FREQUENCIES AND MODE SHAPES

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Preliminary

Item 348-CBE

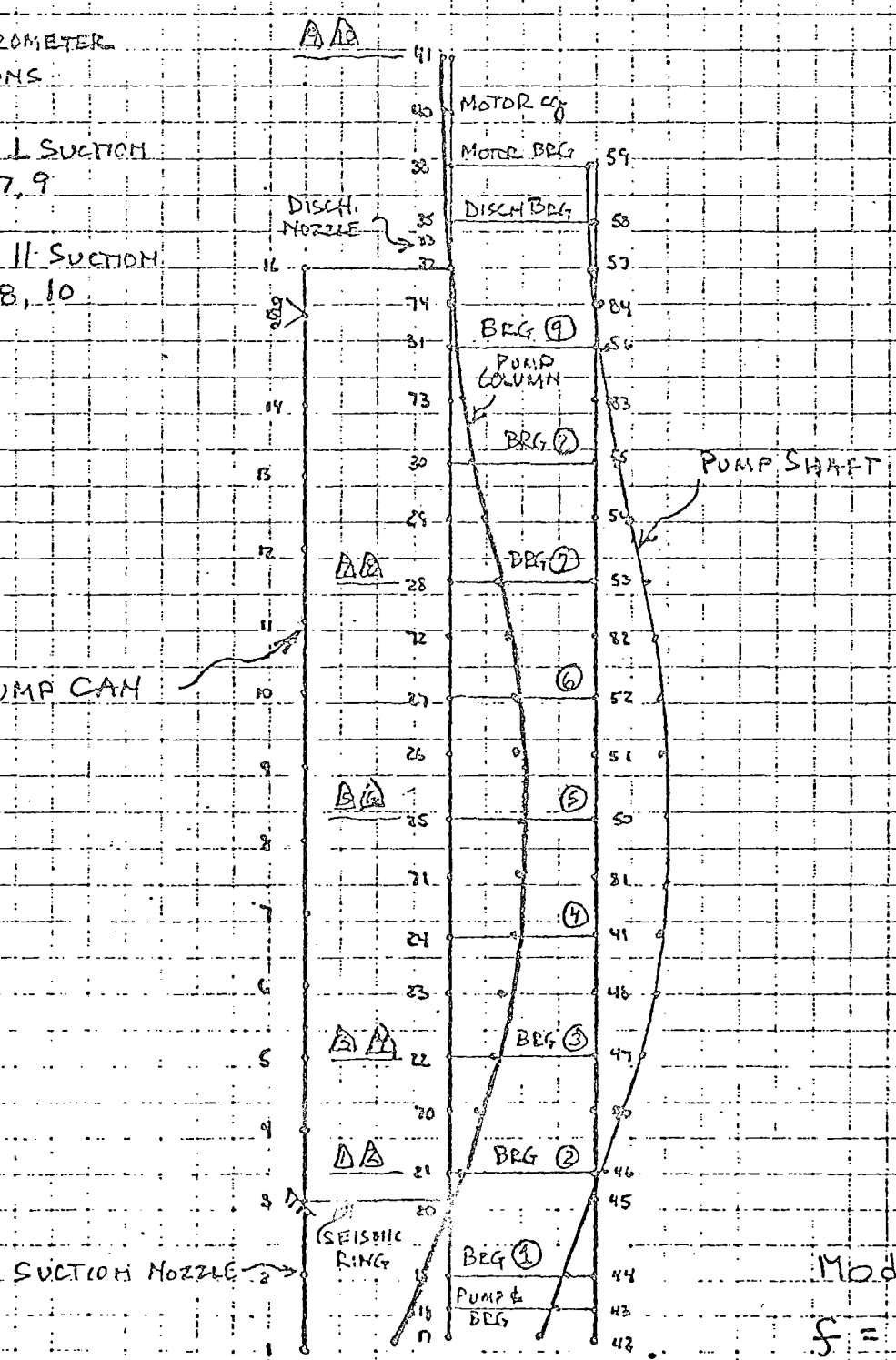
Client VEPCO Location NORTH ANNA Est. No. J.O. No. 11715

Subject RECIRCULATION SPRAY PUMP (OUTSIDE) Date 5/19/78 By SAL

VIBRATION MODE SHAPES Checked 5/31/78 By RMC

Based on Revised By

RELATIVE AMPLITUDES



Mode 1

f = 3.37 cps

(202 cpm)

FIGURE 5

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Preliminary ☐ Yes ☐ No

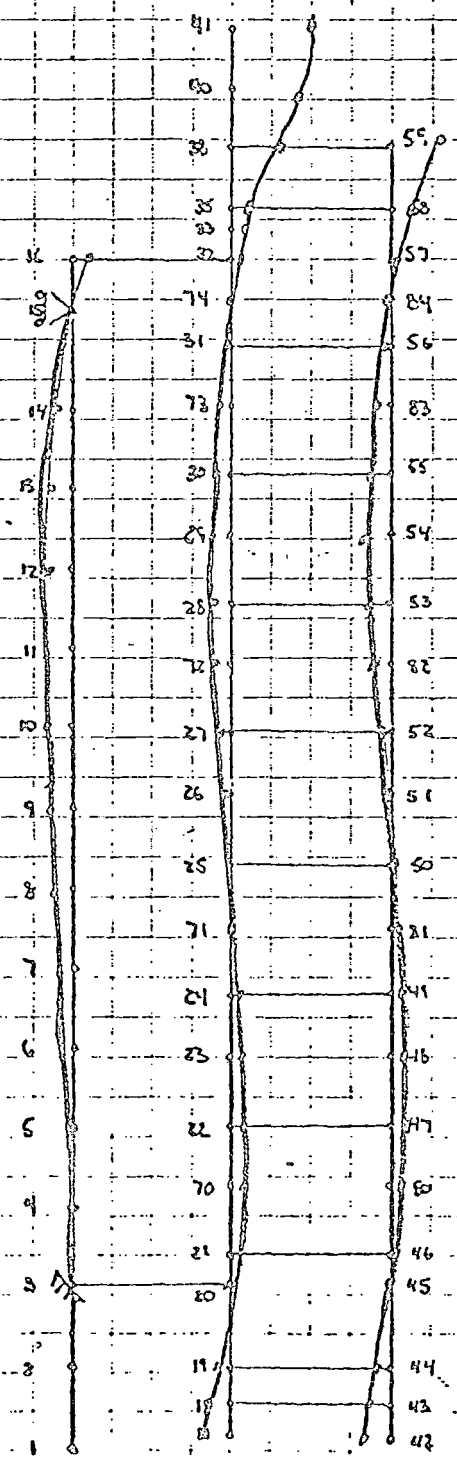
Item 548-CRE

Client VEPCO | Location NA 1 & 2 | Est. No. | J.O. No. 11715

Subject RECIRCULATION SPRAY PUMP (OUTSIDE) | Date 5/19/78 | By SAL

Checked 5/31/78 | By LMC

Based on | Revised | By



Mode 2

f = 6.80 cps

(408 cpm)

FIGURE 6

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Preliminary

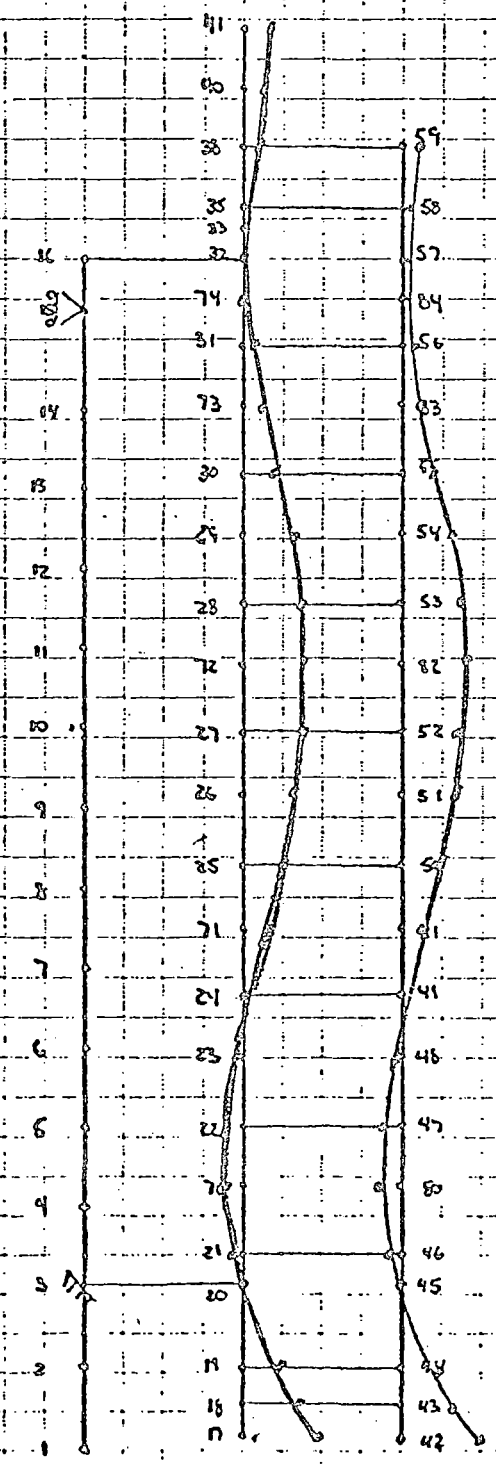
Item 348-CBE

Client Vecco | Location NA1 & 2 | Est. No. | J.O. No. 11715

Subject RECIRCULATION SPRAY PUMP (OUTSIDE) | Date 5/19/78 | By SAL

Checked 5/31/78 | By JME

Based on | Revised | By



Mode 3

f = 8.24 cps

(494 cpm)

FIGURE 7

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

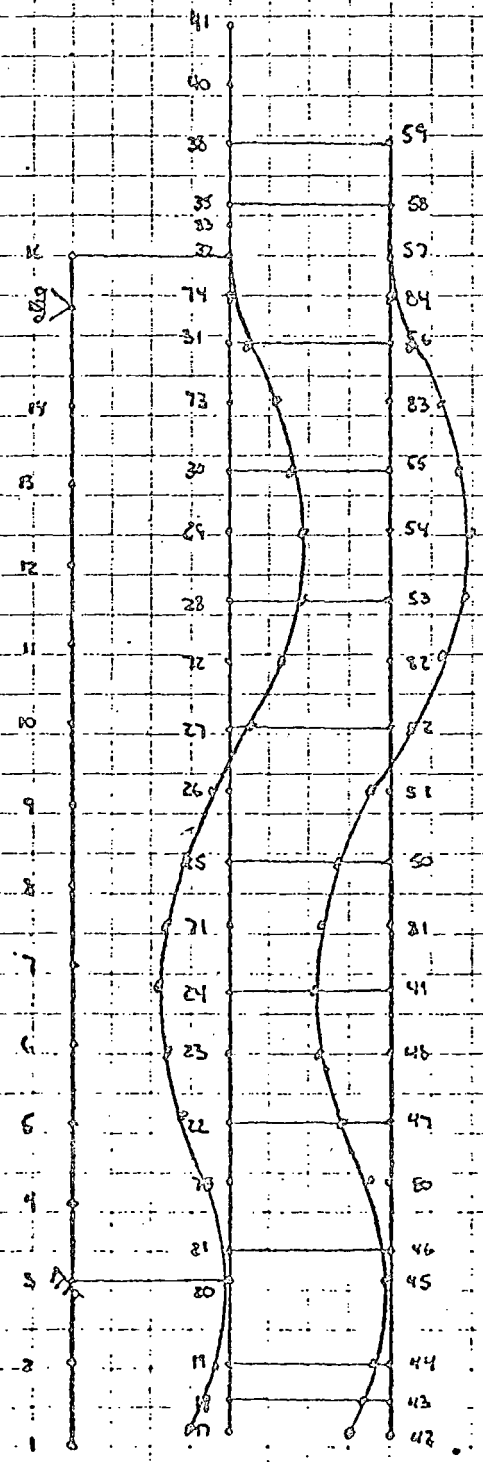
Preliminary ✓ Item 348-CBE

Client VEPCO Location NA 1 & 2 Est. No. J.O. No. 11715

Subject RECIRCULATION SPRAY PUMP (OUTSIDE) Date 5/19/78 By SAL

Checked 5/31/78 By JMC

Based on Revised By



Mode 4

f = 15.28 cps

(917 cpm)

FIGURE 8

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Preliminary

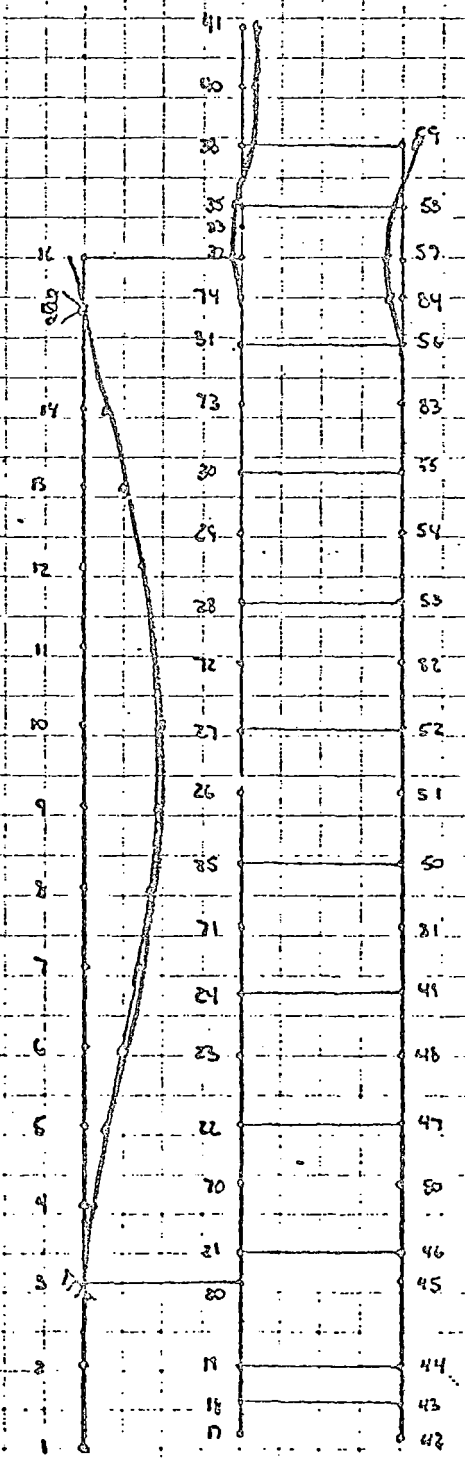
Item 348 - CPS

Client VEPCO | Location NA1&2 | Est. No. | J.O. No. 11715

Subject RECIRCULATION SPRAY PUMP (OUTSIDE) | Date 5/19/78 | By SAL

Checked 5/31/78 | By [illegible]

Based on | Revised | By



Mode 5

f = 19.02 cps

(1140 cpm)

FIGURE 9

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Preliminary

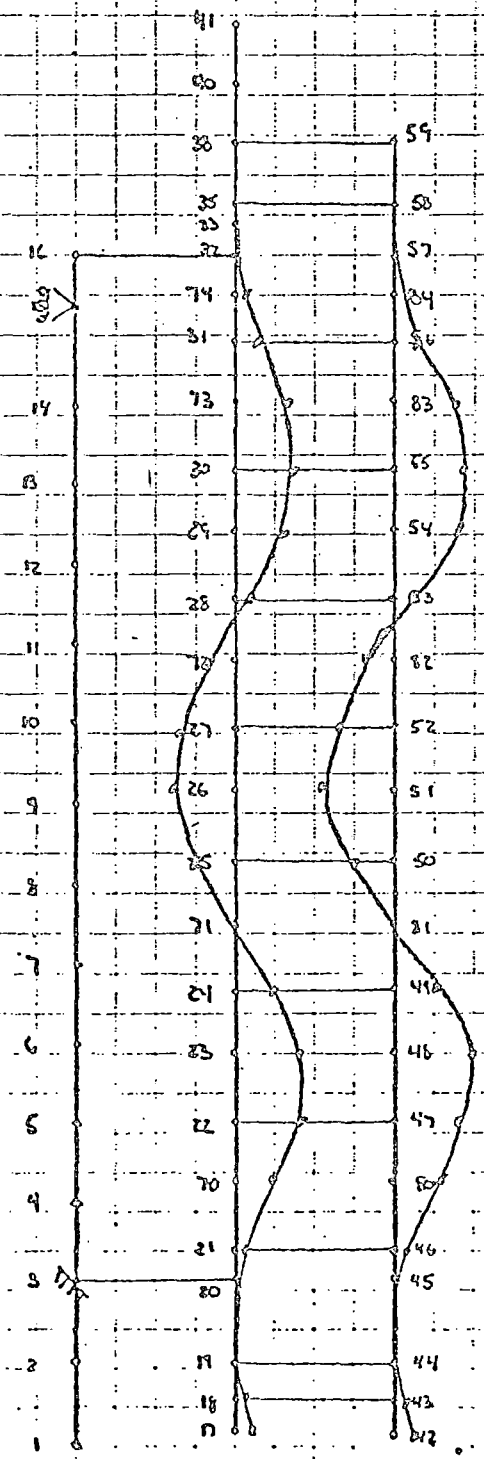
Item 3/4-CBE

Client VEPCO Location NA 1&2 Est. No. J.O. No. 11715

Subject RECIRCULATION SPRAY PUMP (OUTSIDE) Date 5/19/78 By SAL

Checked 5/31/78 By SME

Based on Revised By



Mode 7

f = 28.24

(1690 cpm)

FIGURE 10

CALCULATION SHEET

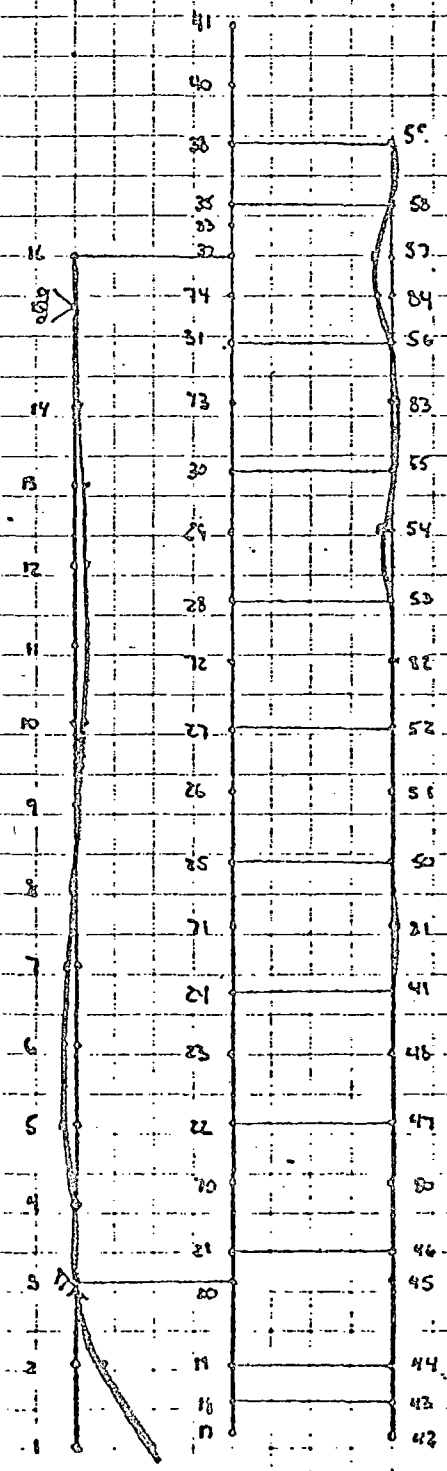
Item 348-CBE

Client Vepco | Location NAI & 2 | Est. No. | J.O. No. 11715

Subject RECIRCULATION SPRAY PUMP (OUTSIDE) | Date 5/19/78 | By SAL

Checked 5/31/78 | By [illegible]

Based on | Revised | By



Mode 8

f = 39.56 cps

(2380 cpm)

FIGURE 11

A 8010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Page No. 8 of 14

Preliminary

Item 348-CBE

Client VEPCO Location NA 1&2 Est. No. J.O. No. 11715

Subject RECIRCULATION SPRAY PUMP (OUTSIDE) Date 5/19/78 By SAL

Checked 5/31/78 By SMC

Based on Revised By

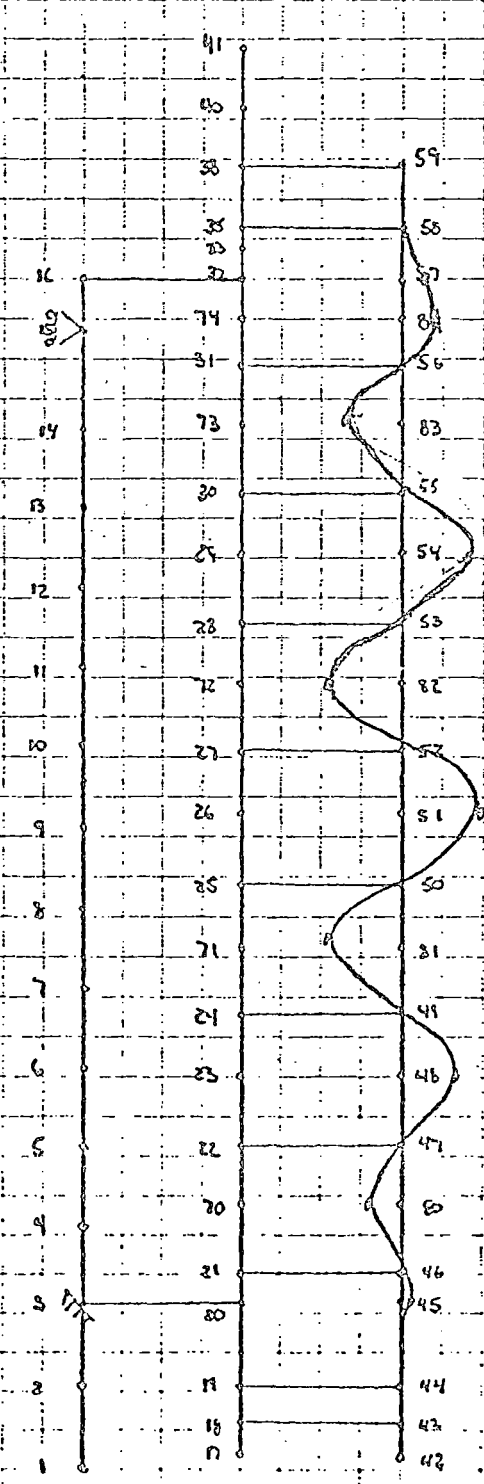


FIGURE 12

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Preliminary

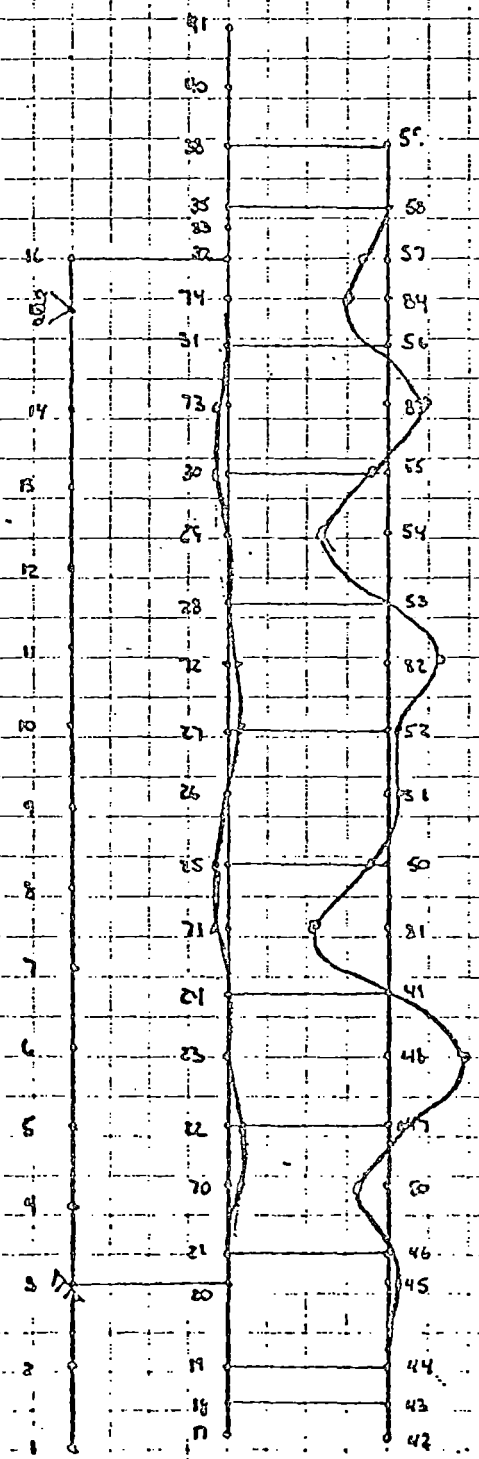
Item 3 Yrs - CBE

Client VEPCO Location NA1&2 Est. No. J.O. No. 11715

Subject RECIRCULATION SPRAY PUMP (OUTSIDE) Date 5/19/78 By SAL

Checked 5/31/78 By DMC

Based on Revised By



Mode II

f = 43.79

(2630 cpm)

FIGURE 13

A 0010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Preliminary 10 05 14

Item 348-CBS

Client VEPCO Location NAIES Est. No. J.O. No. 11715

Subject RECIRCULATION SPRAY PUMP (OUTSIDE) Date 5/19/78 By SAL

Checked 5/31/78 By [illegible]

Based on Revised By

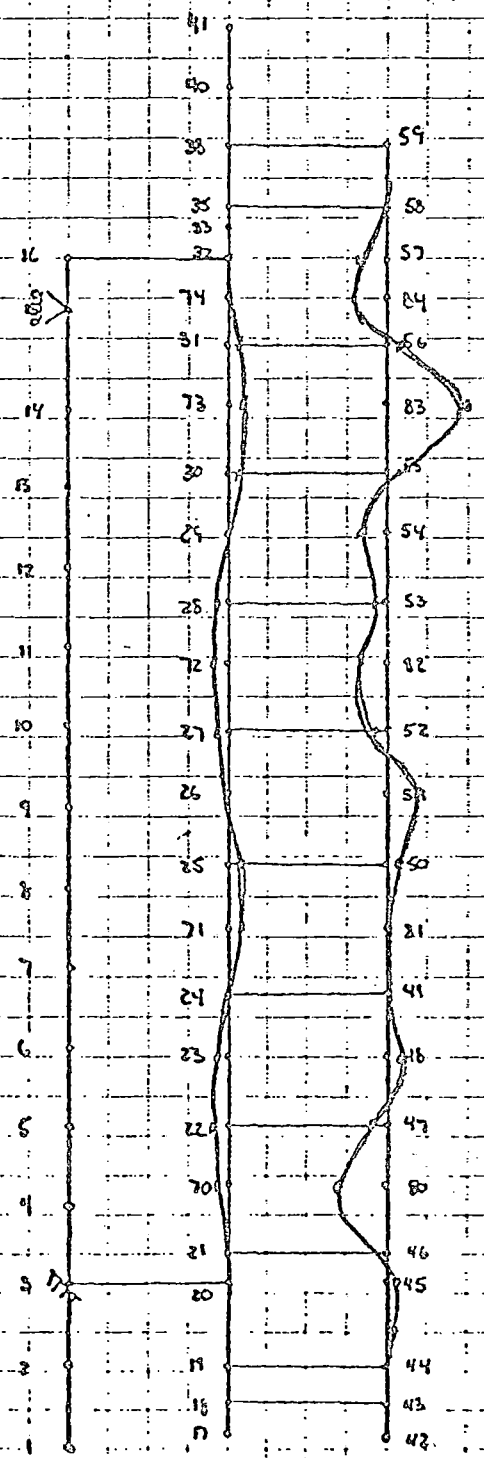


FIGURE 14

FIGURES 15 to 23
SURRY UNITS 1 & 2
OUTSIDE RECIRCULATION SPRAY PUMPS
NATURAL FREQUENCIES AND MODE SHAPES

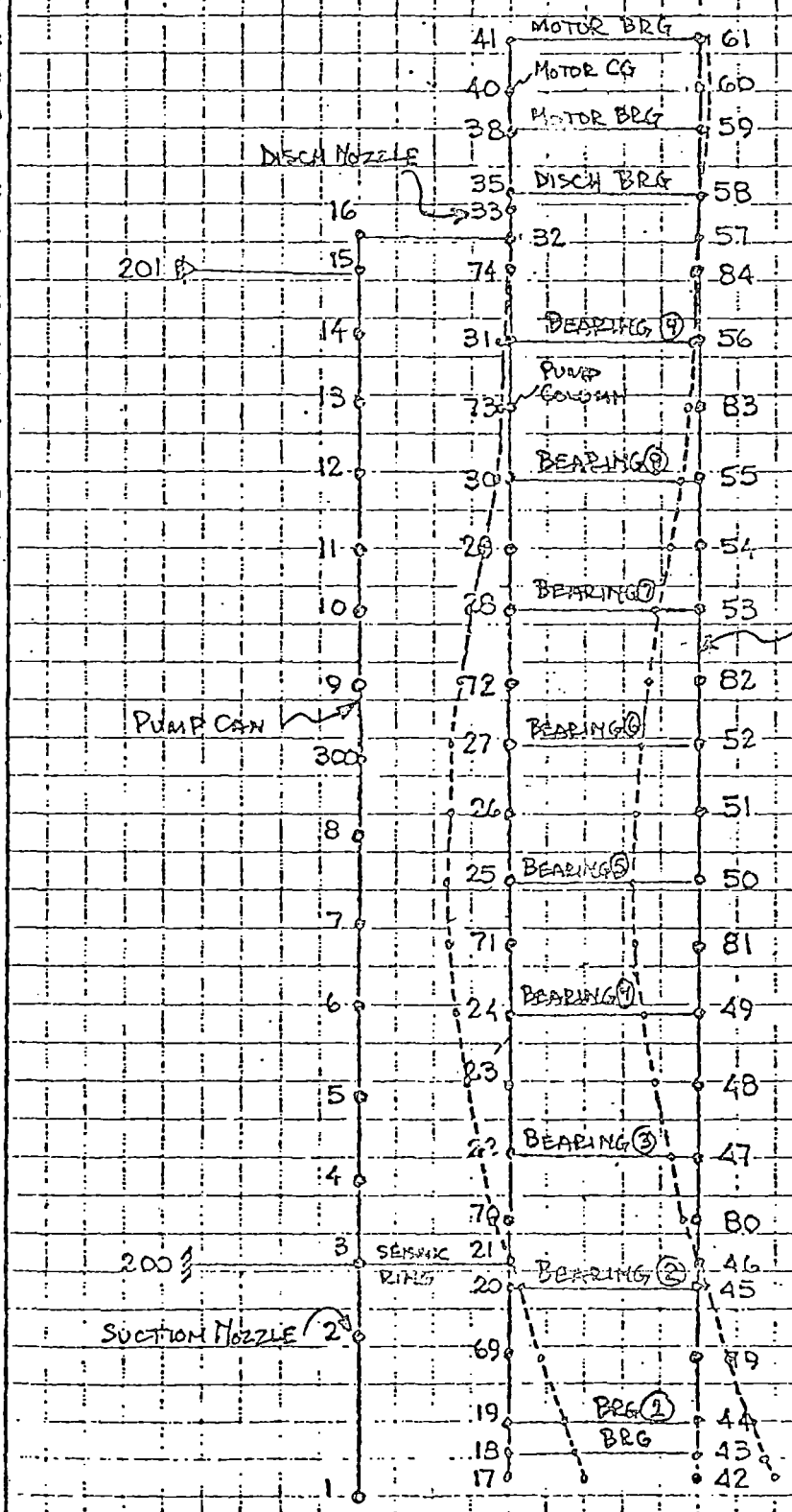
CALCULATION SHEET

Client VEPCO Location SURRY Est. No. J.O. No 12846.0

Subject OUTSIDE RECIRC SPRAY PUMPS Date 5/4/78 By BAB

Checked 5/19/78 By MC

Based on Revised By



MODE NO. 1

FREQUENCY 2.88 Hz

FIGURE 15

CALCULATION SHEET

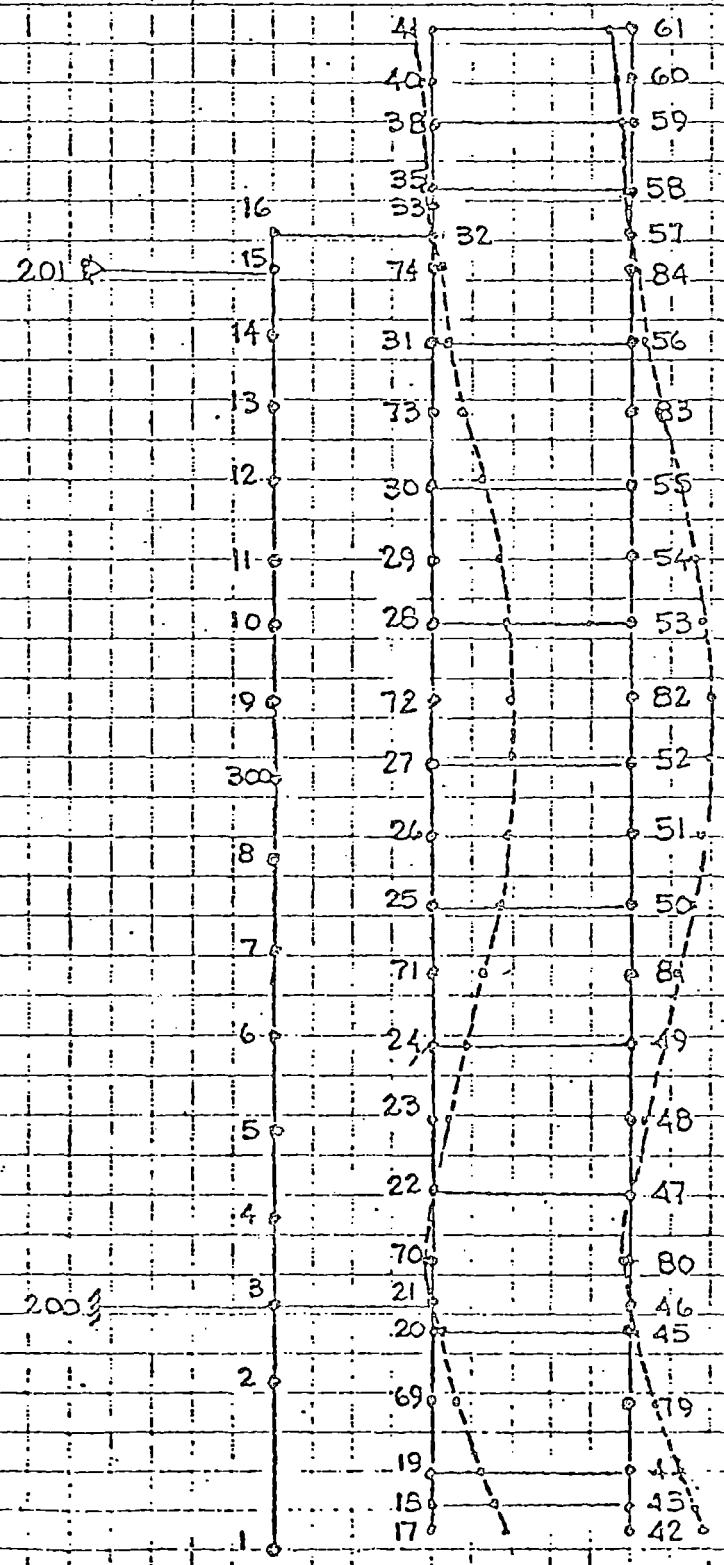
Item 44-1...

Client VEPCO Location SURRY Est. No. J.O. No. 12846

Subject OUTSIDE RECIRC SPRAY PUMPS Date 5/4/78 By BAB

Checked 5/19/78 By JMC

Based on Revised By



MODE No. 2

FREQUENCY 6.28 Hz

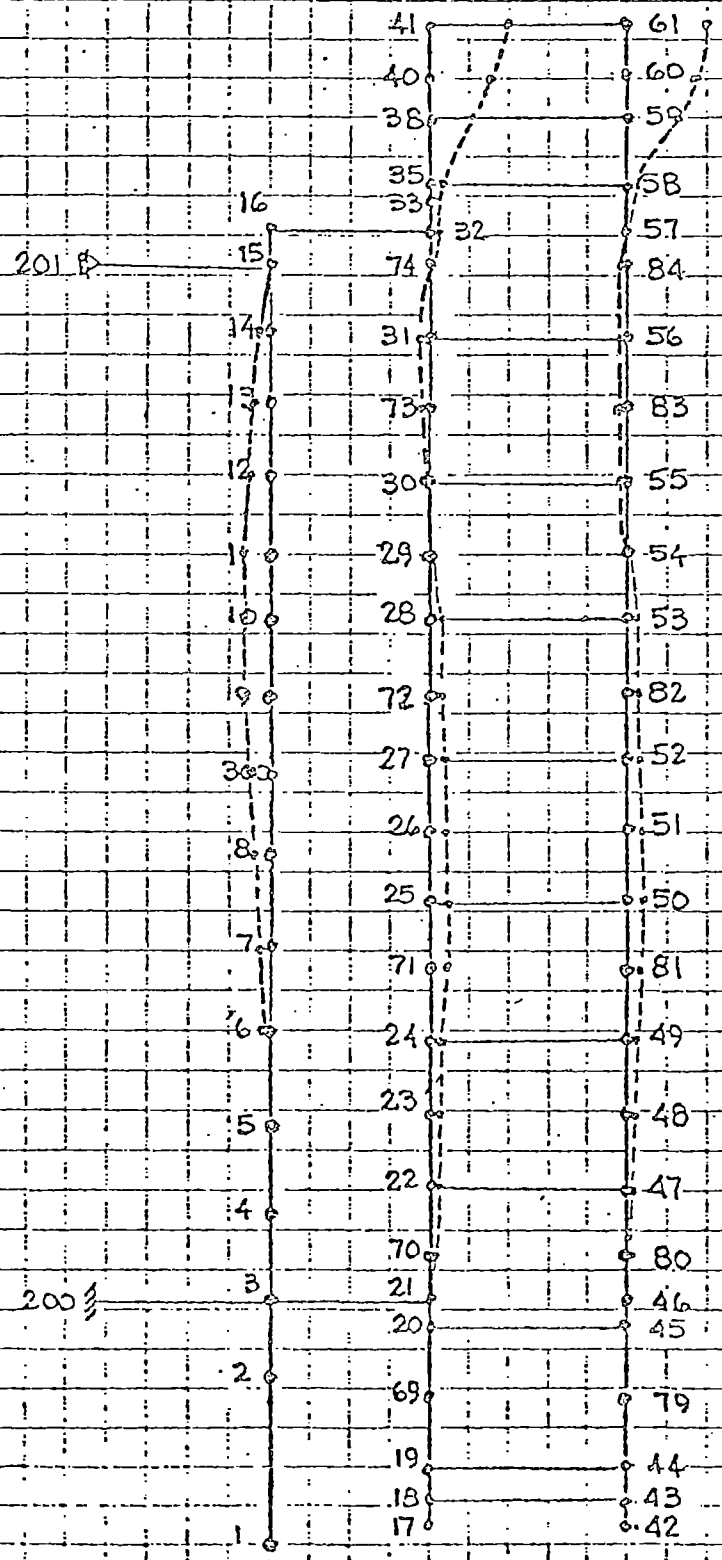
FIGURE 16

Client VEPCO Location SURRY Est. No. J.O. No. 12846.0

Subject OUTSIDE RECIRC SPRAY PUMPS Date 5/4/78 By DAB

Checked 5/19/78 By JNC

Based on Revised By



MODE NO. 3

FREQUENCY 9.04 Hz

FIGURE 17

CALCULATION SHEET

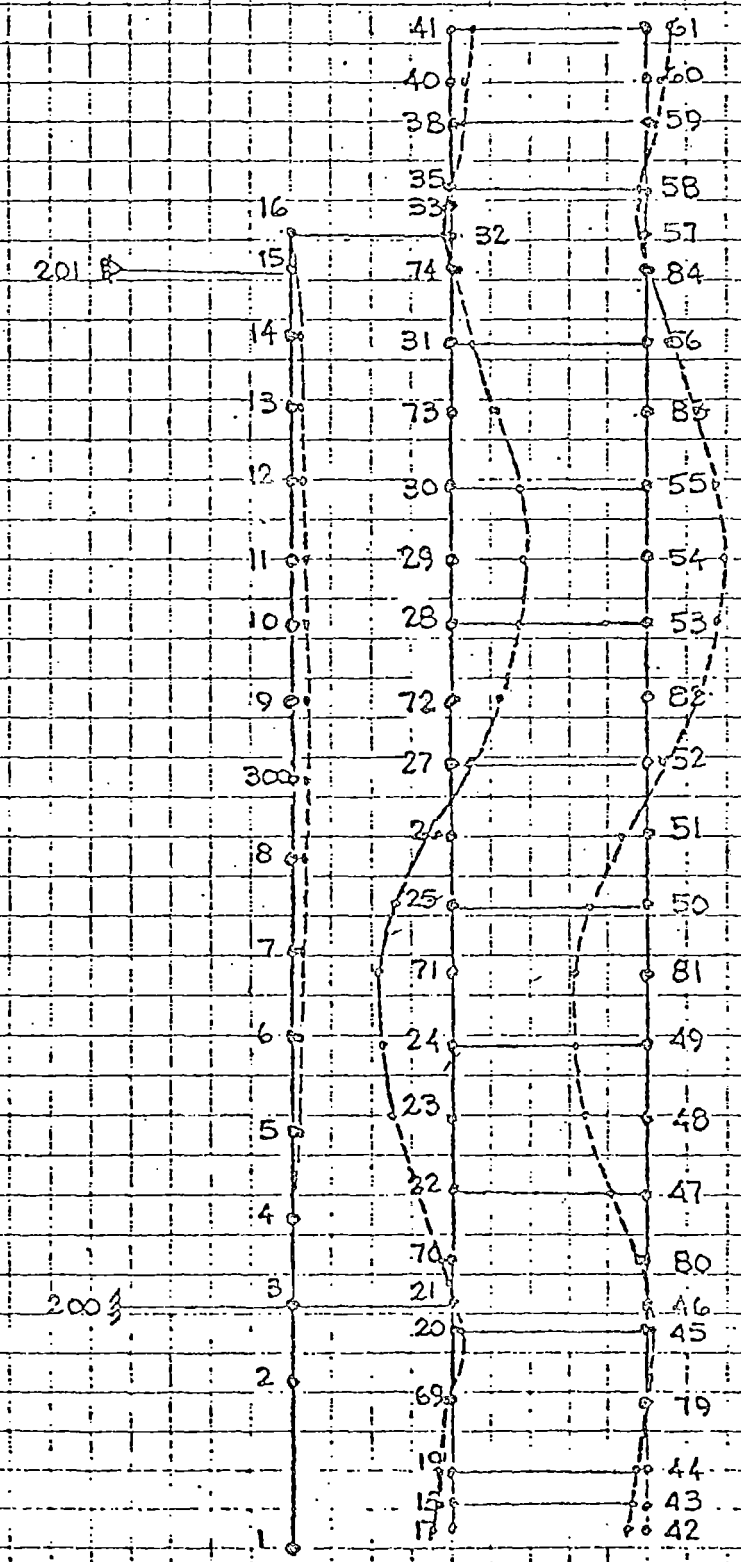
Item

Client VEPCO Location SURRY Est. No. J.O. No. 12846.0

Subject OUTSIDE RECIRC SPRAY PUMPS Date 5/4/78 By BLB

Checked 5/19/78 By JNC

Based on Revised By



MODE No. 4

FREQUENCY 15.03 Hz

FIGURE 18

CALCULATION SHEET

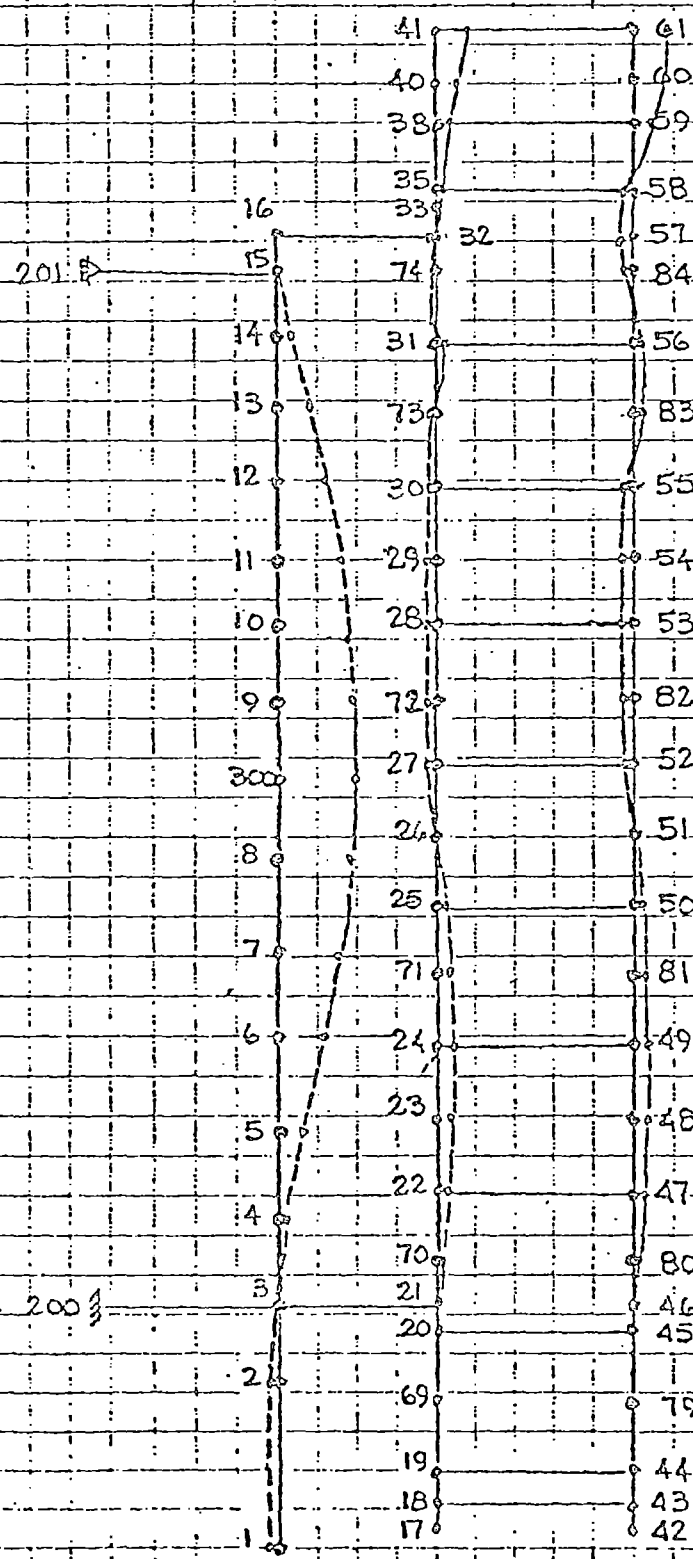
Item

Client VEPCO Location SURRY Est. No. J.O. No 12246

Subject OUTSIDE RECIRC SPRAY PUMPS Date 5/4/78 By BLB

Checked 5/19/78 By

Based on Revised By



MODE No. 5

FREQUENCY 18.26 Hz

FIGURE 19

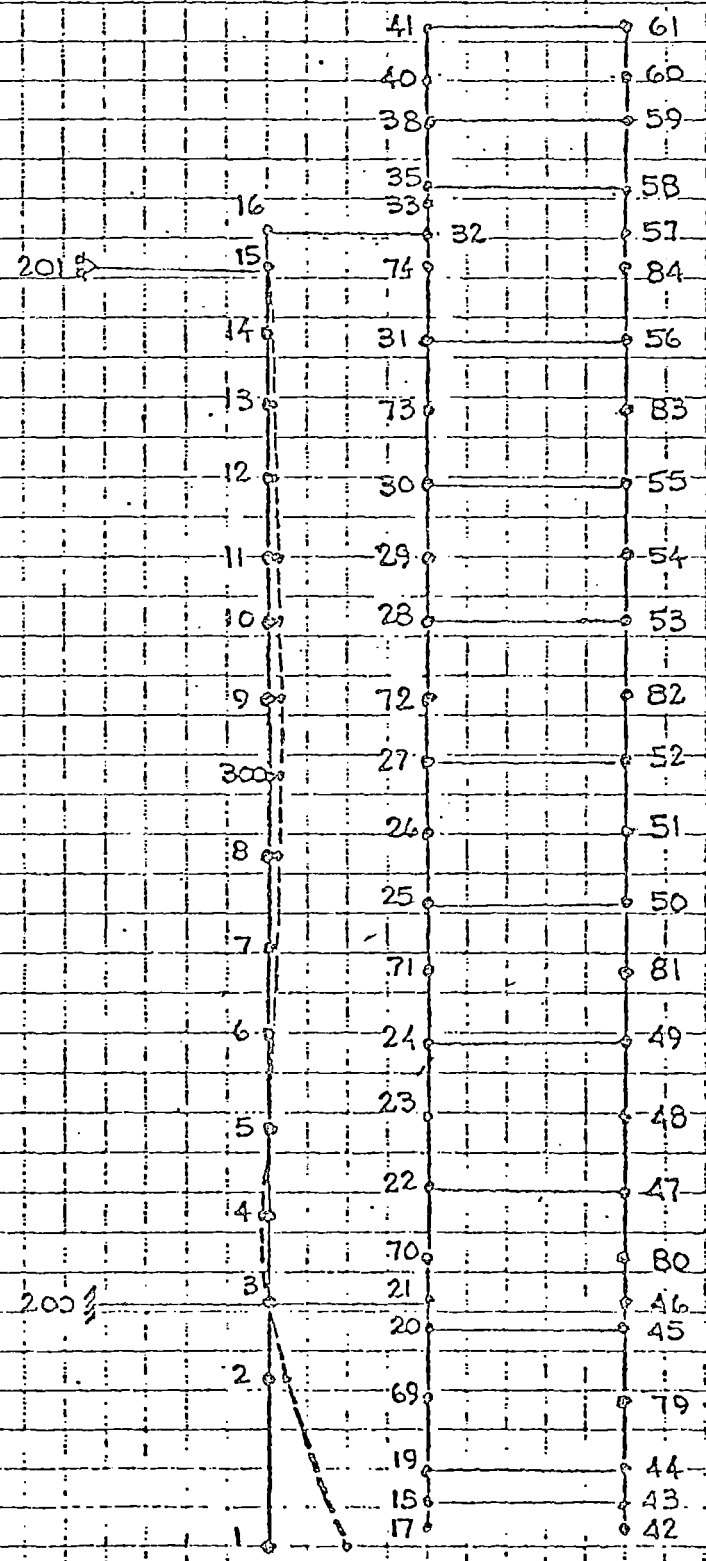
CALCULATION SHEET

Client VEPCO Location SURRY Est. No. J.O. No. 12846.3

Subject OUTSIDE RECIRC SPRAY PUMPS Date 5/4/78 By BB

Checked 5/19/78 By LNC

Based on Revised By



MODE NO. 6

FREQUENCY 21.16 Hz

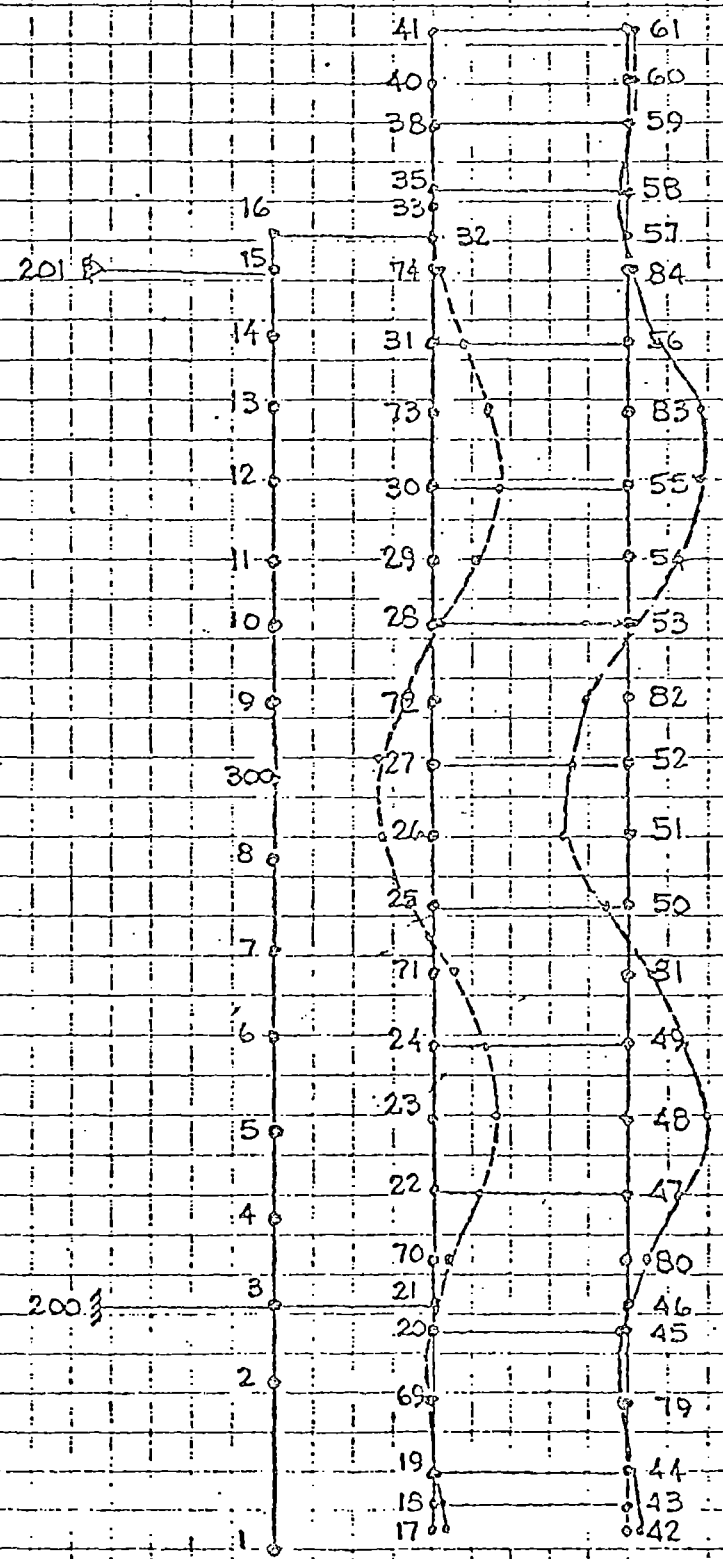
FIGURE 20

Client VERCO Location SURREY Est. No. J.O. No. 12346.3

Subject OUTSIDE REPC SPRAY PUMPS Date 5/4/78 By BAB

Checked 5/19/78 By DNC

Based on Revised By



MODE No. 8

FREQUENCY 28.42 Hz

FIGURE 21

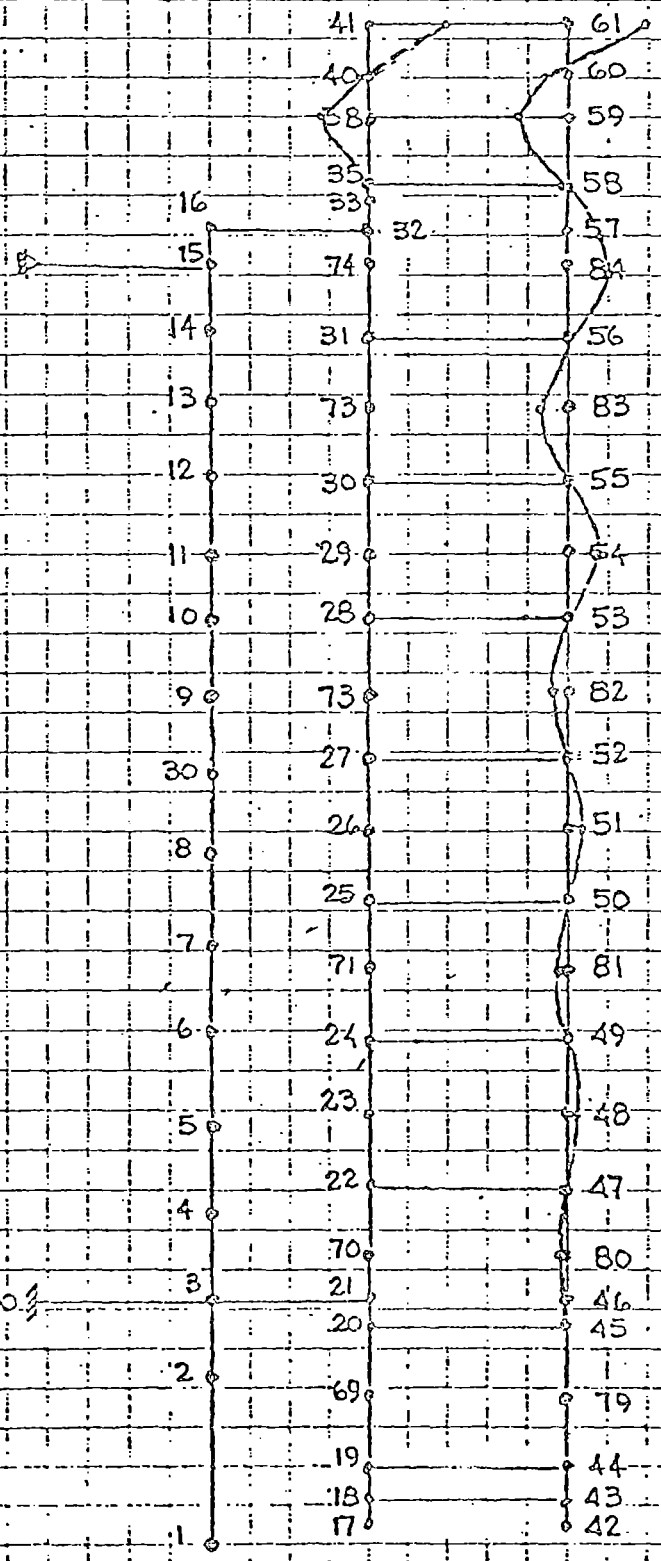
CALCULATION SHEET

Client: VEPCO Location: SURRY Est. No. J.O. No. 12346.0

Subject: OUTSIDE RECIRC SPRAY PUMPS Date: 5/4/78 By: BLB

Checked: 5/19/78 By: JHC

Based on Revised By



MODE NO. 9

FREQUENCY 35.19 Hz

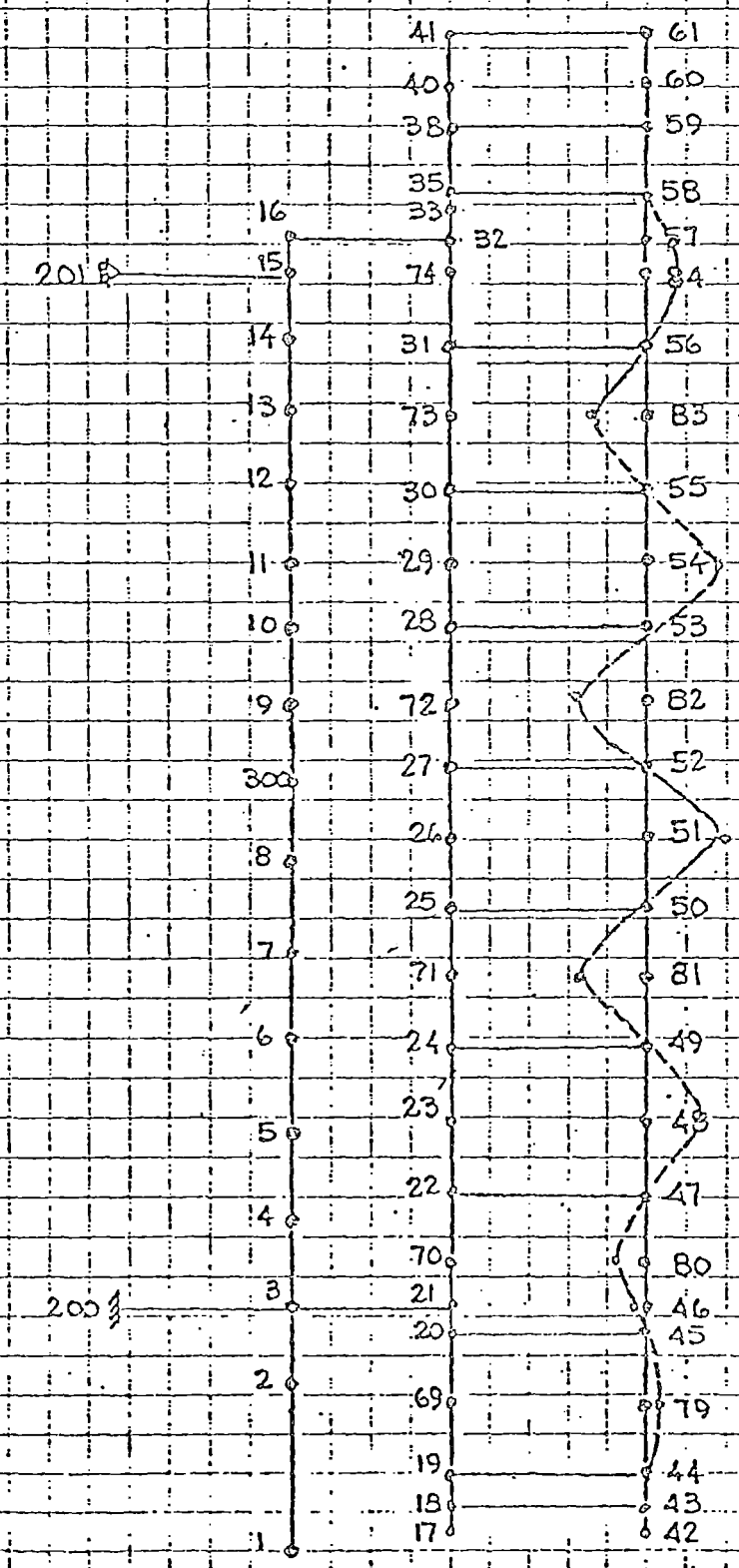
FIGURE 22

Client VEPCO Location SURRY Est. No. J.O. No. 12841.0

Subject OUTSIDE RECIRC SPRAY PUMPS Date 5/4/78 By BAB

Checked 5/19/78 By JAC

Based on Revised By



MODE No. 10

FREQUENCY 37.22 Hz

FIGURE 23