VERMONT YANKEE NUCLEAR POWER CORPORATION

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September 18, 1992
BVY 92-112

United States Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

References:

a) License No. DPR-28 (Docket No. 50-271)

b) Letter, USNRC to All Holders of Operating Licenses Not Reviewed to Current Licensing Criteria on Seismic Qualification of Equipment, NVY 87-37, Generic Letter 87-02, dated 02/19/87

c) Letter, J.G. Partlow (USNRC) to all Unresolved Safety Issue (USI) A-46 Plant Licensees who are Members of the Seismic Qualification Utility Group (SQUG), NVY 92-88, dated 05/22/92

d) Letter, SQUG to James G. Partlow, NRR-NRC, "SQUG Response to Generic Letter 87-02, Supplement 1 and Supplemental Safety Evaluation Report No. 2 on GIP," dated 08/21/92

Subject: **Vermont Yankee Nuclear Power Corporation (VYNPC), Response to Supplement 1 to Generic Letter 87-02 on SQUG Resolution of USI A-46**

Dear Sir:

I. INTRODUCTION

On February 19, 1987, the NRC issued Generic Letter 87-02, "Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors, Unresolved Safety Issue (USI) A-46 [Reference b)]. This Generic Letter encouraged utilities to participate in a generic program to resolve the seismic verification issues associated with USI A-46. As a result, the Seismic Qualification Utility Group (SQUG) developed the "Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Plant Equipment." On May 22, 1992, the NRC Staff issued Generic Letter 87-02, Supplement 1, which constituted the NRC Staff's review of the GIP and which included Supplemental Safety Evaluation Report Number 2 (SSER-2) on the GIP, Revision 2, corrected on February 14, 1992 [Reference c)]. The letter to SQUG enclosing SSER-2 requests that SQUG member utilities provide to the NRC, within 120 days, a schedule for implementing the GIP. By letter dated August 21, 1992, to James G. Partlow, NRR-NRC, SQUG clarified that the 120 days would expire on September 21, 1992 [Reference d)]. This letter responds to the Staff's request.

II. COMMITMENT TO GIP

GIP Commitments

As a member of SQUG, Vermont Yankee Nuclear Power Corporation commits to use the SQUG methodology as documented in the GIP, where "GIP" refers to GIP Revision 2, corrected February 14, 1992, to resolve USI A-46 at Vermont Yankee. The GIP, as evaluated by the Staff, permits licensees to deviate from the SQUG commitments embodied in the Commitment sections, provided the Staff is notified of substantial deviations prior to implementation.

A001
1/1

Specifically, VYNPC hereby commits to the SQUG commitments set forth in the GIP, including the clarifications, interpretations, and exceptions identified in SSER-2 as clarified in Reference d).

GIP Guidance

VYNPC generally will be guided by the remaining (non-commitment) sections of the GIP, i.e., GIP implementation guidance, which comprises suggested methods for implementing the applicable commitments. VYNPC will notify the NRC as soon as practicable, but no later than the final USI A-46 summary report, of significant or programmatic deviations from the guidance portions of the GIP, if any. Reasons for such deviations, as well as for other minor deviations, will be retained for NRC review.

III. IN-STRUCTURE RESPONSE SPECTRA

For defining seismic demand, VYNPC will use the options provided in the GIP for "median-centered" and "conservative, design" in-structure response spectra, as appropriate, depending on the building, the location of equipment in the building, and equipment characteristics.

The licensing-basis SSE in-structure response spectra may be used as one of the options provided in the GIP for resolution of USI A-46. VYNPC intends to use in-structure response spectra as one of the options in determining equipment seismic demand. These in-structure response spectra have been generated using the ground response spectrum to which Vermont Yankee is licensed for the Safe Shutdown Earthquake (SSE). These spectra are considered "conservative, design" spectra per the definition in Section 4.2.4 of the GIP and the procedures and criteria which were used to generate them are described in Attachment 1. Sample in-structure response spectra will be sent by September 18, 1992 under separate cover.

IV. SCHEDULE

USI A-46 resolution is contingent upon the scope and schedule for completing the necessary SQUG training and availability of industry resources which may be unavailable because of the large number of licensees simultaneously implementing this program. Additionally, final implementation of USI A-46 must be carefully integrated with outage schedules at Vermont Yankee and implementation of the seismic portion of the GL 88-20, Supplement 4 IPEEE effort. A revised IPEEE plan and schedule is currently being prepared for submittal by Vermont Yankee, as requested by NRC. Resolution of USI A-46 and seismic IPEEE are both contingent upon the start date of USI A-46 efforts. Given the workload as set forth by the criteria of the GIP, as well as satisfactory resolution of the seismic IPEEE plan and schedule, Vermont Yankee currently plans to submit a Seismic Evaluation Report which summarizes the results of the USI A-46 program by December 31, 1995. In order to coordinate efforts associated with our next refueling outage, Vermont Yankee requests written NRC concurrence with this schedule by January 1, 1993. Concurrence received after this date may require rescheduling our planned efforts regarding USI A-46 implementation.

Additionally, Vermont Yankee requests written NRC concurrence regarding our in-structure response spectra. This concurrence should be consistent with Reference c), Page 3, Item 3 and be provided within 60 days , ie:

> "...The licensees in-structure response system are considered acceptable for USI A-46 unless the staff indicates otherwise during a <u>60 day review period</u>." [emphasis added]

Positive concurrence, comments or questions received after 60 days may impact the above described December 31, 1995 planned completion date for submittal of the Seismic Evaluation Report.

V. PLANT SEISMIC LICENSING BASIS

VYNPC, reserves the option to change its licensing basis methodology for verifying the seismic adequacy of new and replacement, as well as existing, electrical and mechanical equipment prior to receipt of a final plant-specific SER resolving USI A-46. Should this be the case, this change will be conducted under 10 CFR 50.59 and will be performed consistent with the guidance in Section 2.3.3 of Part I of the GIP, Revision 2, and with the clarifications, interpretations, and exceptions identified in SSER-2 as clarified by Reference d). Any necessary changes to the FSAR will be provided in accordance with 10 CFR 50.71(e).

We trust that the enclosed information is satisfactory; however, should you have any questions or desire any additional information on this issue, please do not hesitate to contact us.

Very truly yours,

Vermont Yankee Nuclear Power Corporation

James P. Pelletier

James P. Pelletier
Vice President, Engineering

Attachment

cc: USNRC Region I Administrator
USNRC Resident Inspector - VYNPS
USNRC Project Manager - VYNPS

SALLY A. SANDSTRUM
NOTARY PUBLIC
WINDHAM COUNTY, VERMONT
My Term Expires 2/10/95

STATE OF VERMONT)
) SS
WINDHAM COUNTY)

SALLY A. SANDSTRUM ... WINDHAM COUNTY VERMONT

Then personally appeared before me, James P. Pelletier, who, being duly sworn, did state that he is Vice President-Engineering of Vermont Yankee Nuclear Power Corporation, that he is duly authorized to execute and file the foregoing document in the name and on the behalf of Vermont Yankee Nuclear Power Corporation and that the statements therein are true to the best of his knowledge and belief.

Sally A. Sandstrum 9/18/92

Sally A. Sandstrum Notary Public
My Commission Expires February 10, 1995

ATTACHMENT 1

Description of In-Structure Response Spectra
For Use in Resolving USI A-46

Vermont Yankee Licensing Basis Seismic Design Spectra

As described in Sections 2.5.4 and Appendix A of the Vermont Yankee Final Safety Analysis Report (FSAR), the design ground spectrum corresponds to the N69W component of the 1952 Taft Earthquake normalized to 0.07g (see Figures 1 & 2). This earthquake is defined as the design basis earthquake (DBE) and corresponds to the operating base earthquake (OBE).

The maximum hypothetical earthquake (MHE) values were taken as twice those for the design basis earthquake with 0.14g as the maximum ground acceleration. This corresponds to the safe shutdown earthquake (SSE).

The vertical component of the design spectrum is taken as two thirds of the horizontal design spectrum.

Overview of Dynamic Modeling of Seismic Class I Structures

The Seismic Class I structures at VY for which in-structure response spectra (ARS) have been generated, and are intended to be used as options for resolution of USI-A46 include; the Reactor Building, Control Building, the portion of the Turbine Building which houses the Day Tanks and Diesel Generators, and the Intake Structure.

Linear elastic lumped-mass models appropriate for ARS generation were developed for each of the structures above. Lumped mass points are generally located at major floor elevations and represent the weight distribution of the structure and its equipment. The effects of moment, shear and axial deformation are included in the structural stiffness matrix using either hand calculations or finite element models.

Soil-Structure Interaction - Structural Model Boundary Conditions

As stated in Sections 2 and 12 of the FSAR, all Class I structures are founded on firm bedrock which has a shear wave velocity of 6500 fps. The elevation of the top surface of bedrock at the site varies in elevation from approximately 200.ft. to 230.ft. Site grade elevation is at 252.5ft. Foundation type and the bottom elevations for Class 1 structures are as follows:

Building	Foundation Elev.(ft.)	Type of Construction
Intake Structure	187.0	Reinforced Concrete Mat
Reactor Building	207.75	Reinforced Concrete Mat
Control Building	230. +/-	Reinforced Concrete Piers
Turbine Building	214./222.	Reinforced Concrete Mat/ Bearing Piles

Structural backfill was placed around the structures up to finished grade. The Taft Earthquake seismic input was applied at the base elevation of each structure. The restraining effects of the surrounding backfill were conservatively neglected. A 2 inch wide gap called an "isolation joint" on plant drawings is provided between all Class 1 structures. The structural models were considered uncoupled due to this gap. The boundary conditions at the base of each structural model are discussed below.

The Reactor Building and the Intake Structure are supported on reinforced concrete mat foundations bearing directly on bedrock. The boundary conditions used for the models of these structures were either a rigid fixed base or linear elastic springs calculated using elastic half space theory to reflect the underlying bedrock.

The foundation of the main portion of the Turbine Building is a reinforced concrete mat founded on bedrock with the southern end supported on grade beams over grouped piles. The boundary condition used for the Turbine Building model was a rigid fixed base at the top of the mat at elevation 225.0 ft. The lateral effect of the surrounding soil between the bedrock elevation and the bottom of the floor slab on the overall structural response was addressed by varying the total mass at elevation 252.5ft.

The Control Building is founded a grillage of grade beams over a series of reinforced concrete piers. The boundary conditions used in the Control Building model consist of a set of six equivalent soil springs attached to the base of the slab at elevation 246.25. These equivalent soil springs were developed from a three dimensional finite element model which included, the slab at elevation 248.0, the reinforced concrete piers, and a series of lateral springs on each pier used to model the soil. The base of this model was at approximately elevation 230 ft.

A description of the buildings, dynamic models, and building frequencies for the Reactor Building are given below. Only the Reactor and Control building models are discussed for simplicity. The same procedures and criteria were used for both the Turbine Building and the Intake Structure.

Procedure Used in Generation of In-Structure Spectra

The procedure to develop ARS at each floor location consisted of:

First, performing a linear elastic time history analysis using the Taft acceleration time history as base input for each structural model. The Taft N69W time history records were scaled to 0.07g for OBE (equivalent to FSAR DBE) and 0.14g for SSE (equivalent to FSAR MHE). The base time histories were applied in three orthogonal directions. The results of this time history analysis are floor acceleration time histories which reflect the response of the structure to the Taft Earthquake base excitation.

Then response spectra (ARS) curves are developed for each desired damping from the calculated floor acceleration time histories. The ARS were then peak broadened +/-15% to account for variability in the calculated structural frequencies due to uncertainties in material properties and modeling assumptions.

The structural damping values used in the development of floor ARS are the same as those used for design of Class 1 Structures and are shown in Section 12.2.1.2.1 of the FSAR (see Figure 3).

Reactor Building Model

The Reactor Building including the suppression chamber is a complex three dimensional structure and is described in Section 12 of the FSAR. For the purpose of generating ARS two series of dynamic models were developed. One set was developed focusing on the reinforced concrete structure, the other for equipment in the suppression chamber including the reactor and its supports. Equipment in the scope of A-46 are located primarily in the reinforced concrete structure, therefore only the concrete structure model will be discussed.

The dynamic models for the reinforced concrete structure are shown in Appendix A to this Attachment. The three orthogonal directions, (N-S, E-W, and Vertical) have been de-coupled due to the structural symmetry. To account for torsional modes in the structure "bump factors" were applied to each horizontal spectra curve developed. The bump factors used were:

N-S Factor = 1.05
E-W Factor = 1.15

Separate models were evaluated. One reflects the normal operating condition and the other the drywell flooded condition. Floor ARS were generated for each condition and then enveloped.

Appendix A to this Attachment contains a summary of the modal frequencies for the Reactor Building models.

Control Building Model

A functional description of the building is given in Section 12 of the FSAR. The Control Building is a three story reinforced concrete structure. It is rectangular in plan with monolithically poured slabs, beams, and interior columns. Lateral load resistance is provided by the exterior walls. These range in thickness from one to two feet.

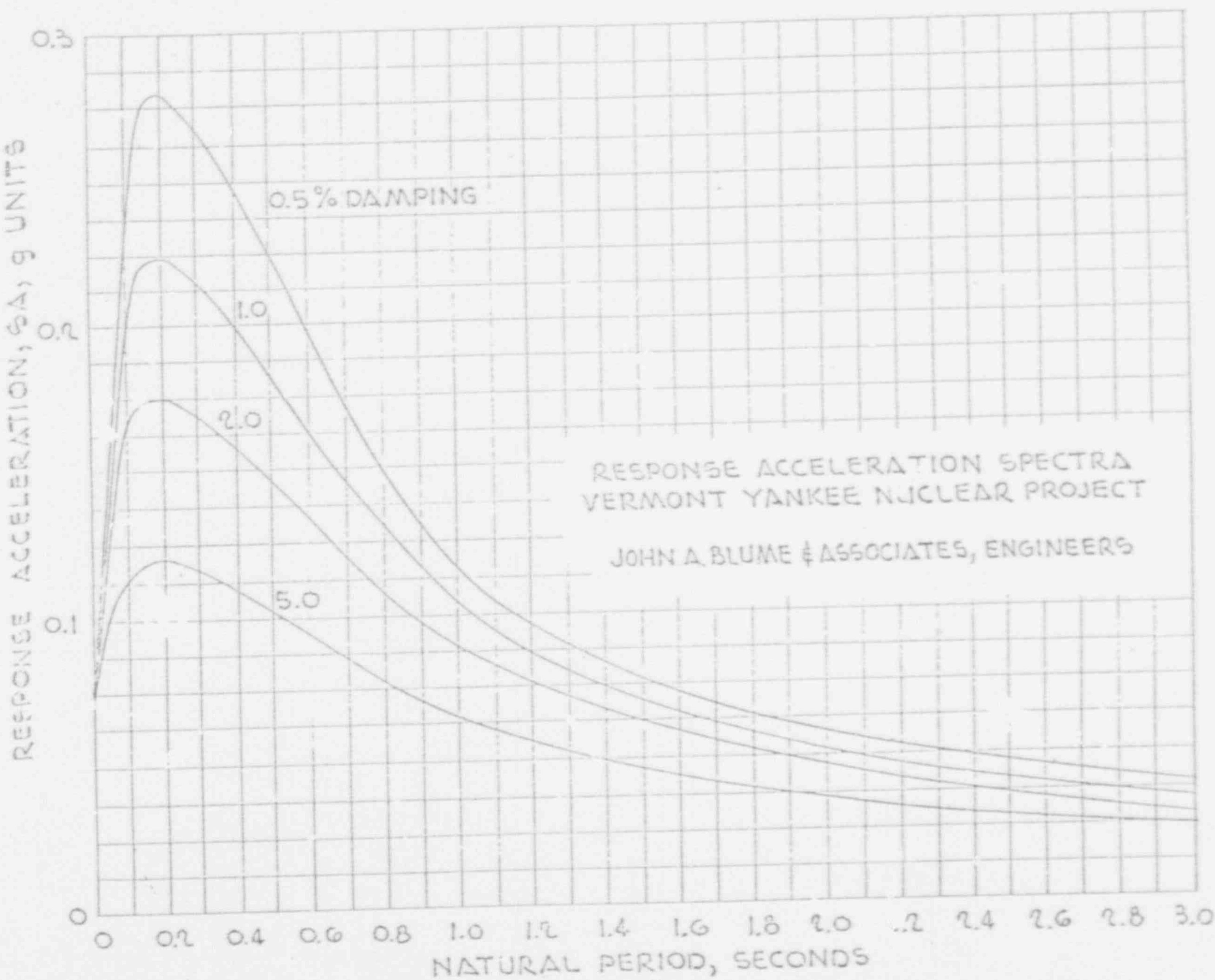
The foundation is a grillage of grade beams over a series of reinforced concrete piers which bear directly on bedrock. The piers, grade beams, and slab at elevation 248.5 are integrally cast. The piers are square in plan and range in size from 30 to 42 inches.

The dynamic model for the Control Building is a three dimensional stick model and is shown in Appendix B to this Attachment. The boundary conditions used in the model consist of a set of six equivalent soil springs attached to the base of the slab at elevation 246.25. These equivalent soil springs were developed from a three dimensional finite element model which included the slab at elevation 248.0, the reinforced concrete piers, and a series of lateral springs on each pier used to model the soil. The base of this model was at approximately elevation 230.ft. The horizontal soil springs were calculated from the coefficient of horizontal subgrade reaction.

The effects of variation in the soil properties on the response of the structure were studied. Mode shape and frequency runs were made varying the average value of the coefficient of horizontal subgrade reaction approximately +/- 50 percent. The frequency and modal mass results for the average recommended soil properties were used to develop the ARS.

To model torsional effects in the structure, four additional massless nodes were connected by rigid beams to the center of rigidity at each elevation. These represent the furthest corner of the building at each elevation. The ARS curves were generated at these nodes.

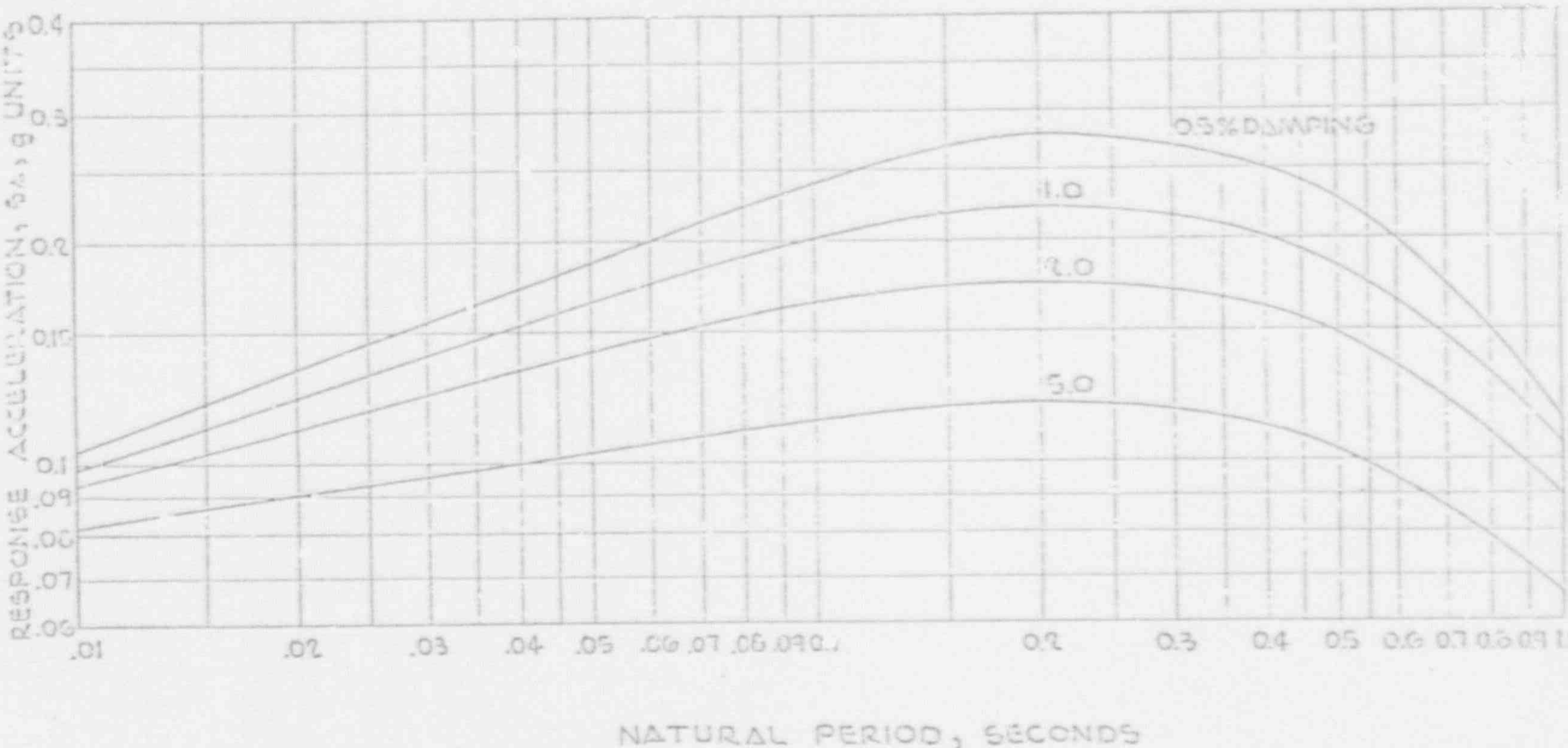
Appendix B to this Attachment contains; the Control building model, and a summary of the modal frequencies.



ATTACHMENT 1 FIGURE 1

RESPONSE ACCELERATION SPECTRA
VERMONT YANKEE NUCLEAR PROJECT

JOHN A. BLUME & ASSOCIATES, ENGINEERS



ATTACHMENT 1 - FIGURE 2

ATTACHMENT I

FIGURE 3

STRUCTURAL DAMPING VALUES USED TO CALCULATE IN-STRUCTURE SPECTRA

STRUCTURE OR COMPONENT	PERCENT OF CRITICAL DAMPING
Reinforced concrete structures	5.0
Steel frame structure	2.0
Bolted or riveted assembly	2.0
Welded assembly (equipment and supports)	1.0

Note: the same values are used for both DBE and SSE.

Reference: Section 12.2.1.2.1 of the Vermont Yankee - Final Safety Analysis Report.

ATTACHMENT 1 - APPENDIX A

VERMONT YANKEE REACTOR BUILDING

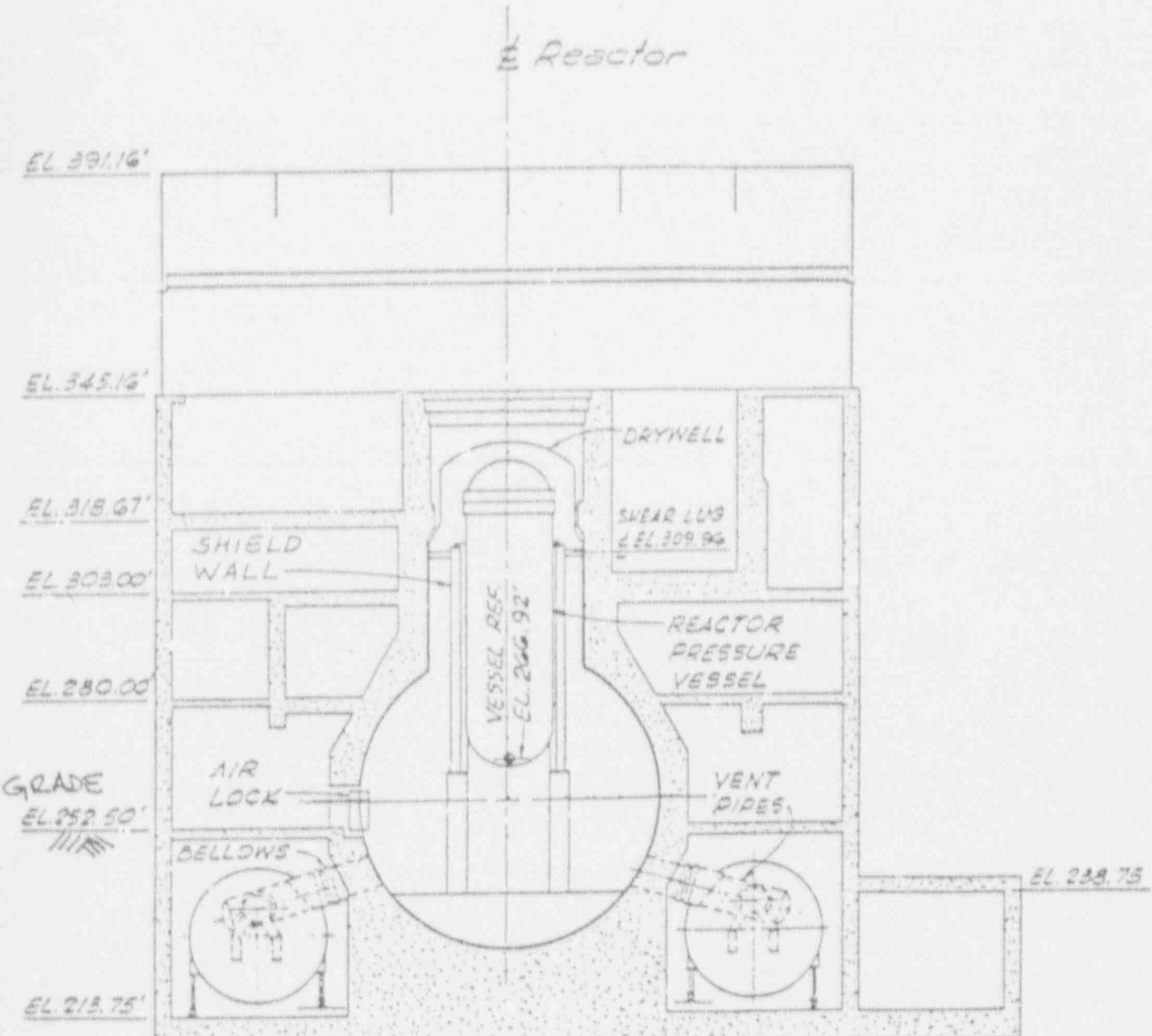
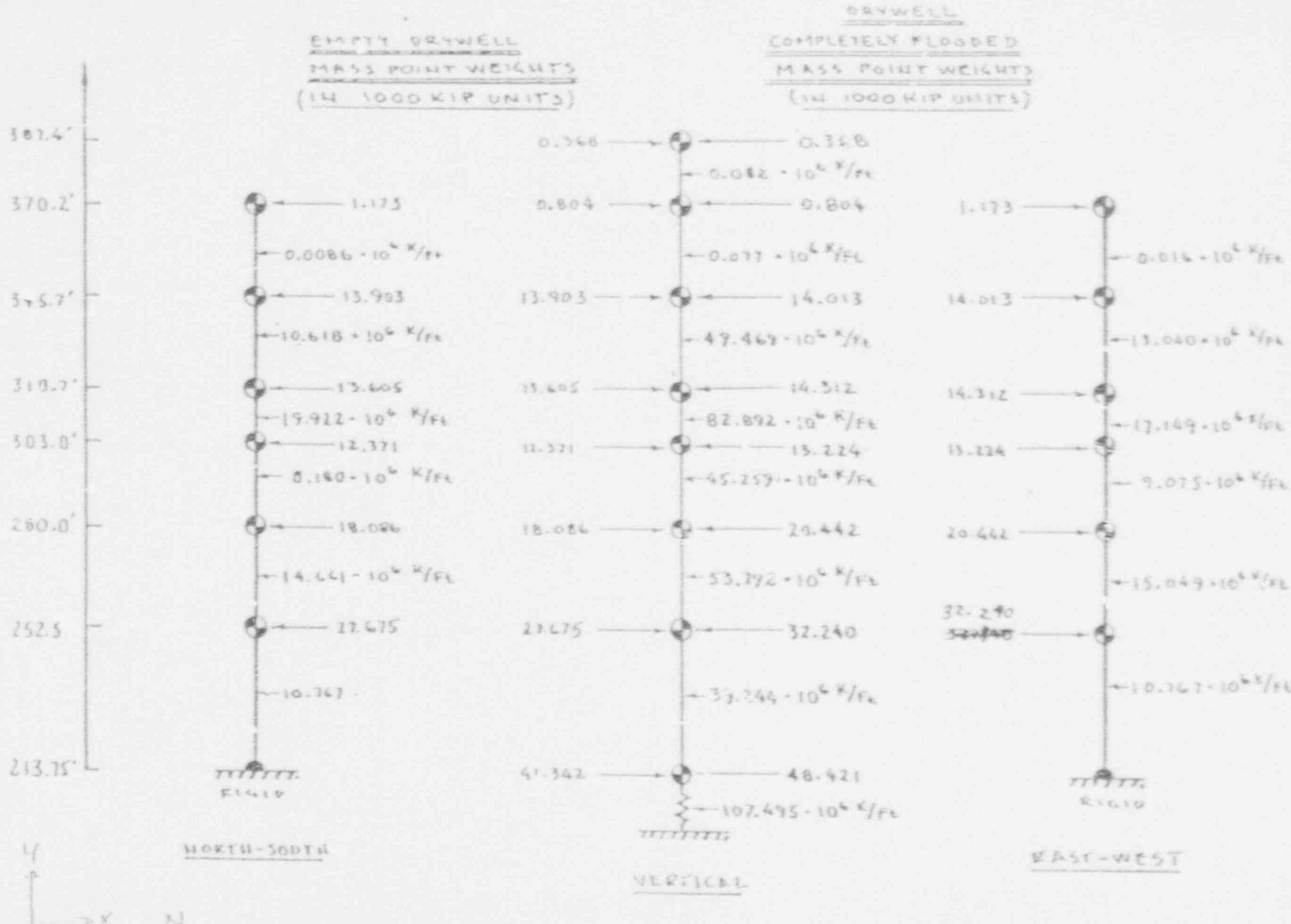


FIGURE 2.1 REACTOR BUILDING COMPLEX - LONGITUDINAL SECTION

ATTACHMENT 1
APPENDIX A



VERMONT YANKEE REACTOR BUILDING DYNAMIC MODEL DATA

A.V. RODDEIKO
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ATTACHMENT 1
APPENDIX A

CALCULATION SHEET

ATTACHMENT 1
FIGURE 6

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
17214		0	8

ORIGINATOR	DATE	CHECKED	DATE
JeFr	12/12/84	P. Ghaemmaghami	12/27/84

III MODAL ANALYSIS

MODAL ANALYSIS RESULTS (CPS)

Freq No.	N-S DIRECTION		E-W DIRECTION		VERTICAL DIRECTION	
	Empty model	Flooded model	Empty model	Flooded model	Empty model	Flooded model
1	2.4404	2.4404	3.3224	3.3222	6.905	6.905
2	7.2873	7.0734	7.3942	7.1792	13.334	12.873
3	18.4772	17.4746	18.7796	17.7632	17.182	17.180
4	30.9259	29.7812	32.6280	31.4136	34.906	33.073
5	38.9485	36.8002	40.3901	38.4098	54.522	50.925
6	56.7352	55.1047	55.2307	53.6884	65.543	62.579
7						
8						

Note: Refer to Appendix A for the mathematic model

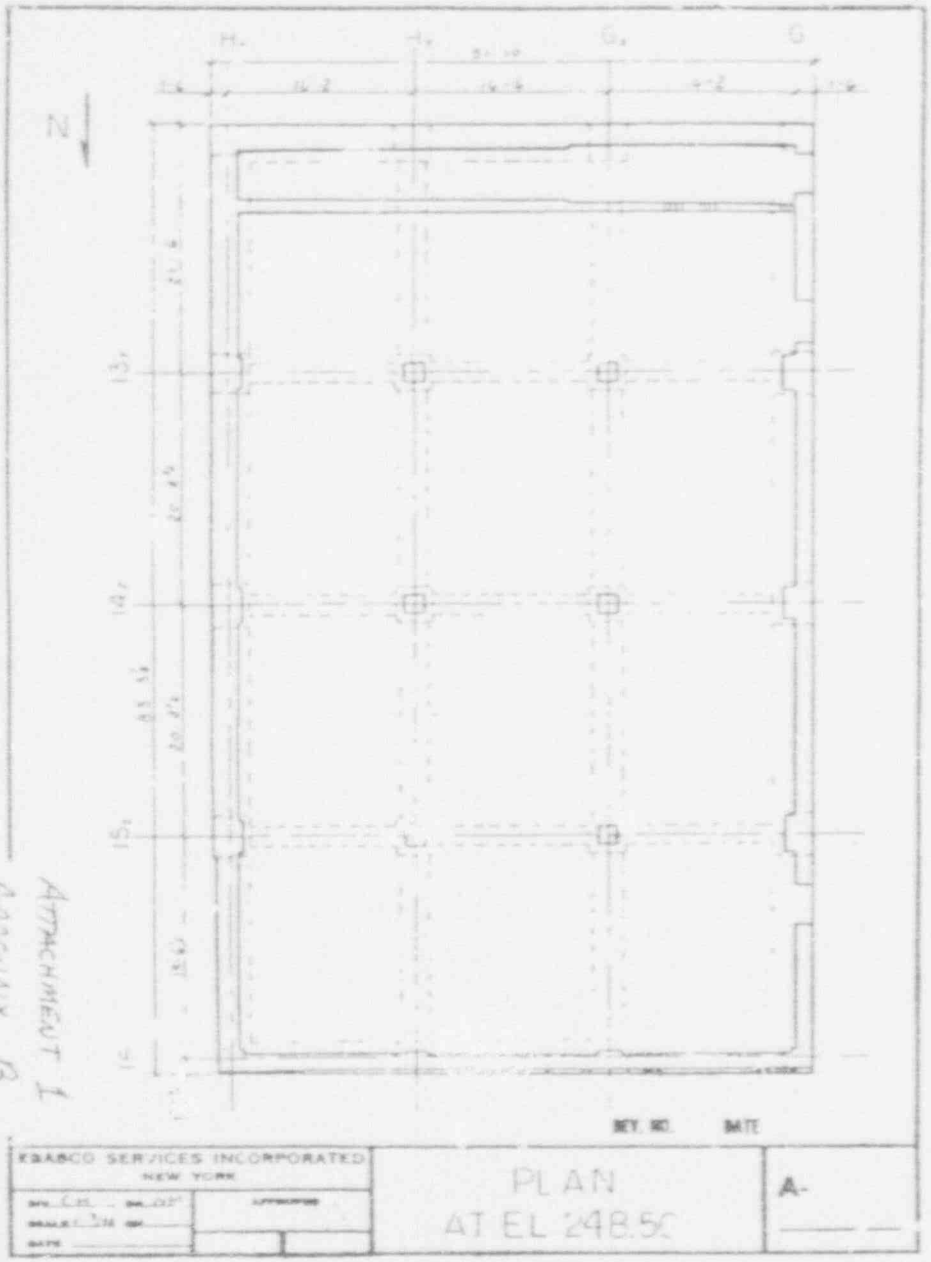
ATTACHMENT 1
APPENDIX A

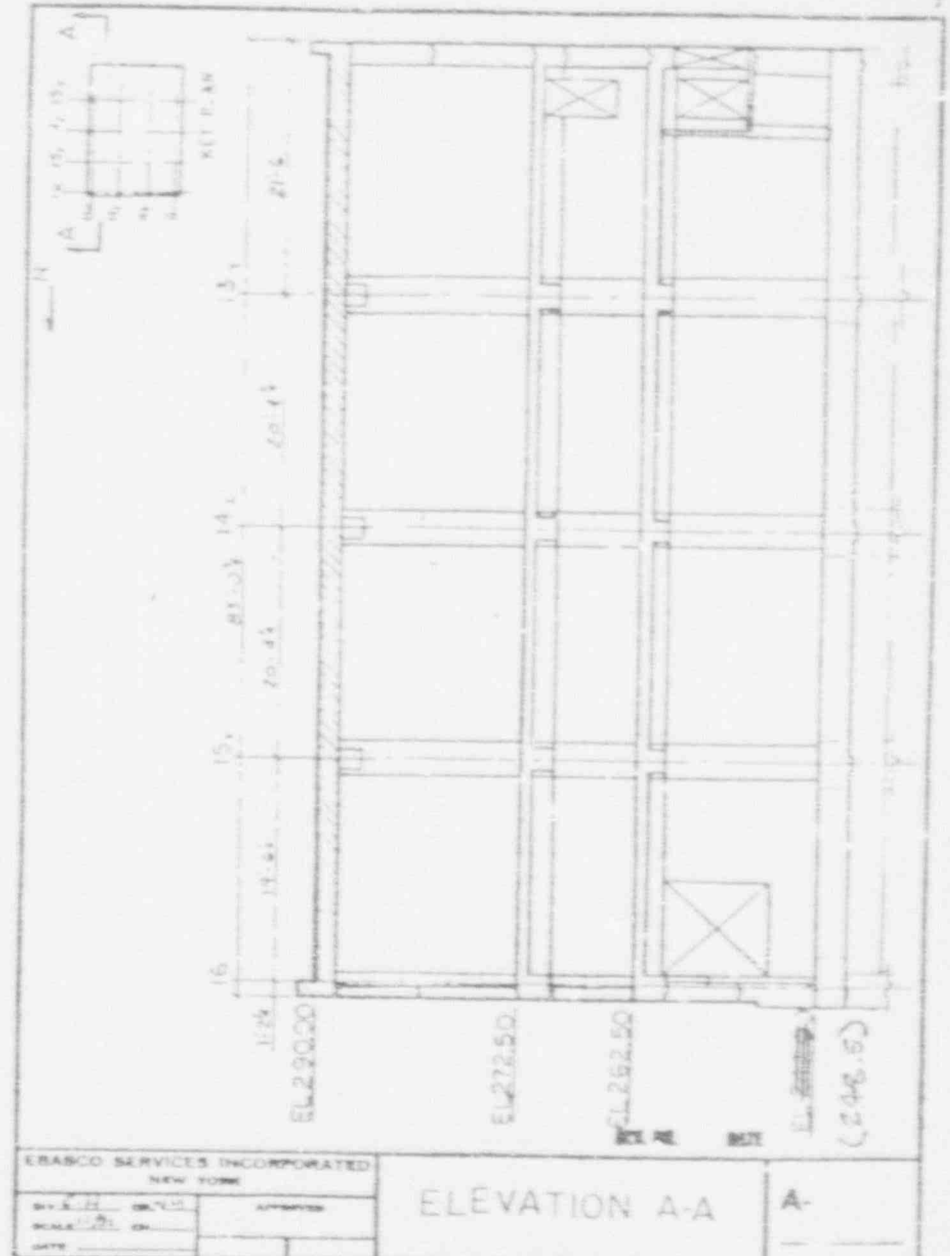
ATTACHMENT 1-APPENDIX B

VERMONT YANKEE CONTROL BUILDING

CONTENTS:

- Control Building Dynamic Model
- Summary of Modal Analysis and Modal Masses





VERMONT YANKEE CONTROL BLDG

ATTACHMENT 1
APPENDIX B

![Bechtel logo]

CALCULATION SHEET

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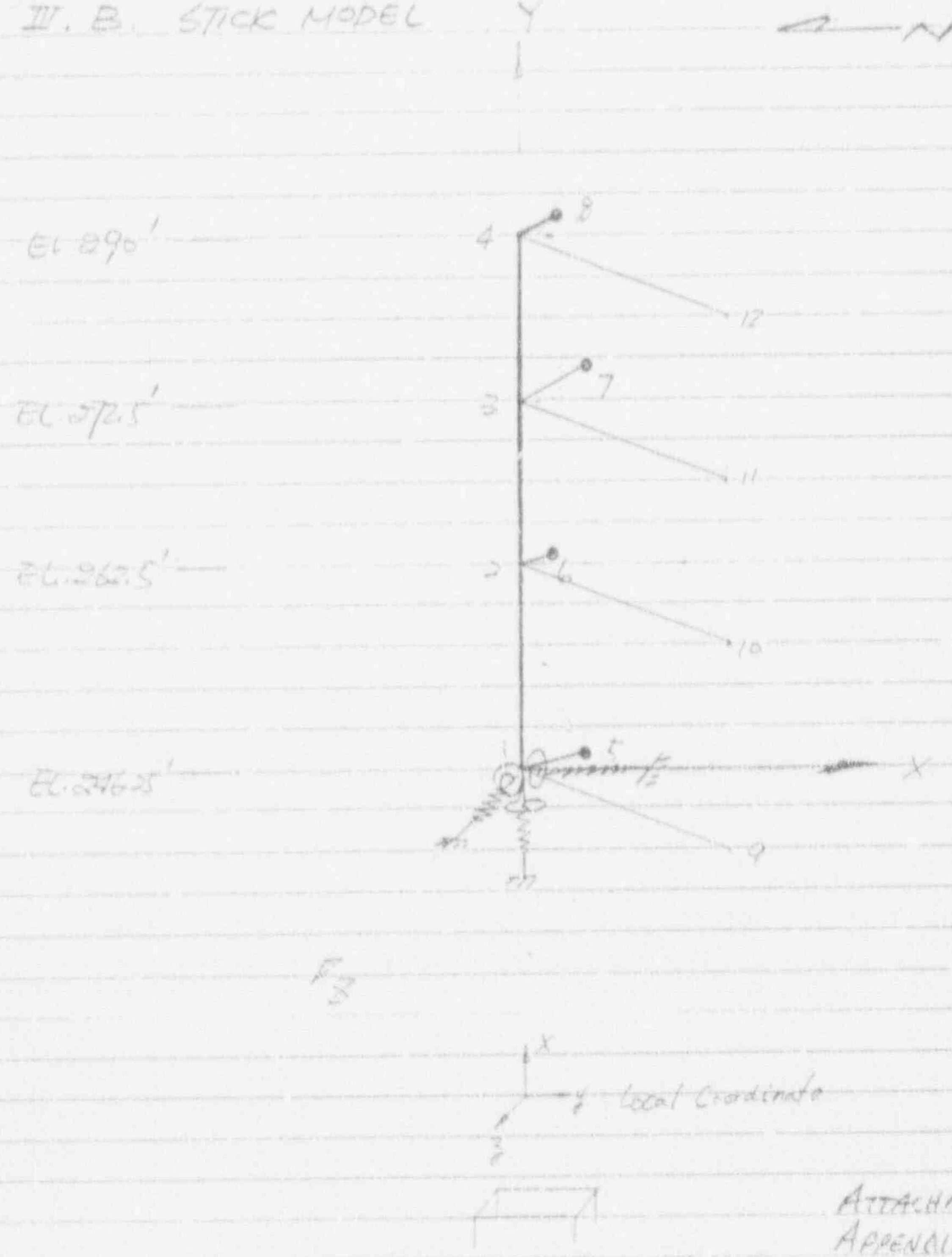
17214		0	34

ORIGINATOR	DATE	CHECKED	DATE
[illegible]	12/23/85	[illegible]	6/25/86

IV. B. STICK MODEL



STICK MODEL

ATTACHMENT 1
APPENDIX B

CALCULATION SHEET

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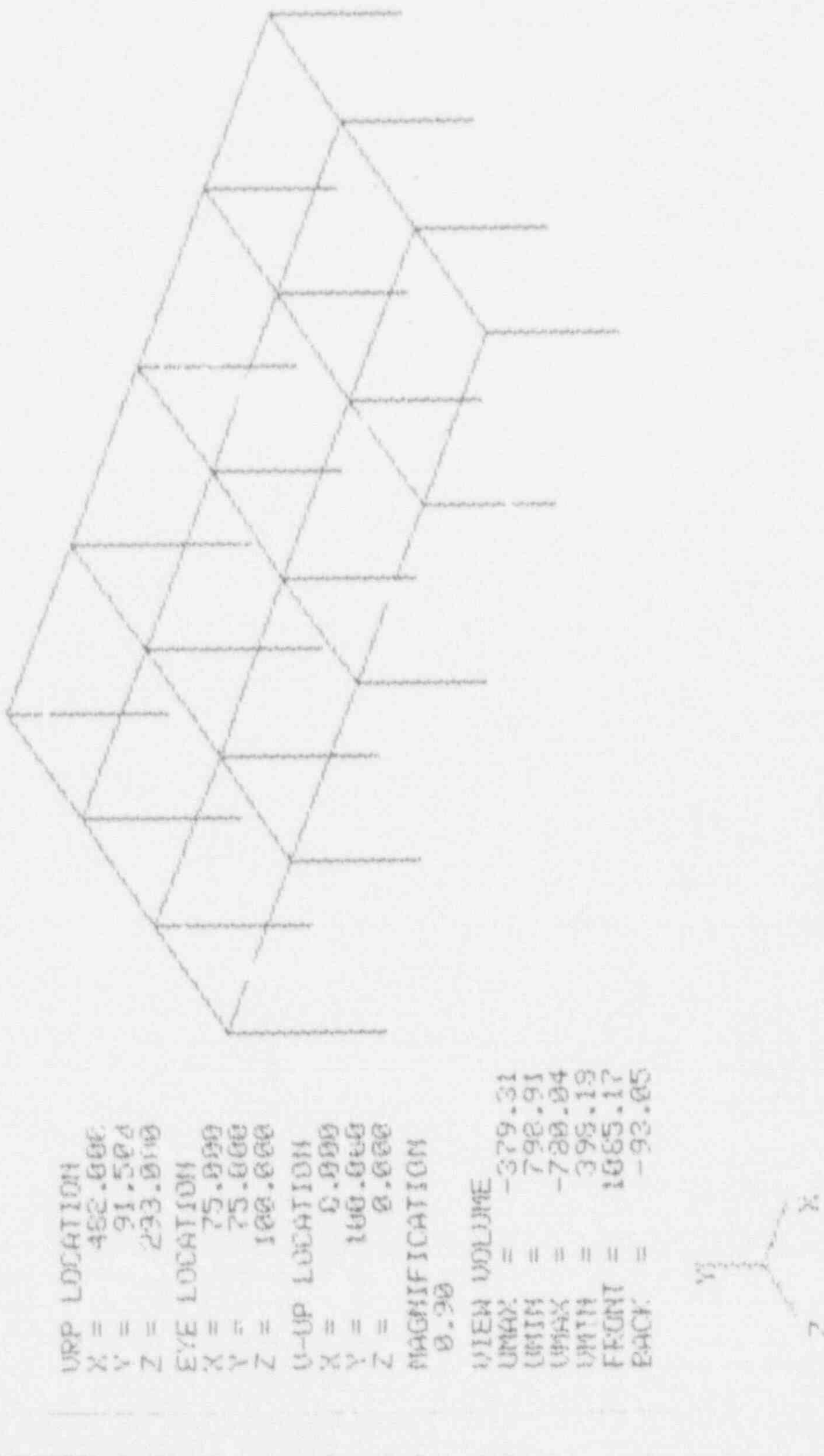
ORIGINATOR	DATE	CHECKED	DATE
John	12/26/85	P.J. Cimato	6/25/86



MAT MODEL PLOT

ATTACHMENT 1
APPENDIX B

CALCULATION SHEET

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
17214		0	37

ORIGINATOR	DATE	CHECKED	DATE
JOK	12/23/85	[signature]	6/25/86

III.B.2

STICK MODEL NODAL COORDINATES

NODE	NODAL COORDINATES X	Y	Z	NODE	NODAL COORDINATES X	Y	Z
1	0	0	0				
2	0	195	0	5	12.21	0	-6.06
3	0	315	0				
4	0	525	0	6	14.54	195	-7.72
9	482	0	293				
10	482	195	293	7	9.39	315	-16.01
11	482	315	293				
12	482	525	293	8	26.65	525	-32.87

III.B.3 STICK MODEL WEIGHT DEFINITION

NODE	X-WEIGHT	Y-WEIGHT	Z-WEIGHT	Y-WEIGHT MOM OF INR
5	2263.19	2263.19	2263.19	$.32542 \times 10^9$
6	1650.80	1650.80	1650.80	$.25356 \times 10^9$
7	1758.78	1758.78	1758.78	$.26488 \times 10^9$
8	1684.30	1684.30	1684.30	$.26433 \times 10^9$

Conversion factor for mass = 1/386.4 = 0.002588

III.B.4 STICK MODEL BOUNDARY ELEMENT

NODE	X-DIRECTION TRANSLATION	X-DIRECTION ROTATION	Y-DIRECTION TRANSLATION	Y-DIRECTION ROTATION	Z-DIRECTION TRANSLATION	Z-DIRECTION ROTATION
1	8694	2.2873×10^{10}	471,117	1.27733×10^9	8058	4.6853×10^{10}

(Ref. (2), Computer Run No. $B16K22 and Page 1 of this calculation)

ATTACHMENT 1
APPENDIX B

MATERIAL E = 3123 ksi
μ = 0.167
ρ = 8.68E-5 (Don't count)

CALCULATION SHEET

JOB NO	CALC NO	REV NO	SHEET NO
17219		0	38

ORIGINATOR	DATE	CHECKED	DATE
JCK	12/23/85	R J Lunato	6/25/86

III B.5 DEFINITION OF STICK MODEL STIFFNESS.

BEAM ELEM	AREA (IN^2)			MOMENT OF INERTIA (IN^4)		
	X	Y	Z	X	Y	Z
1 (1-2)	62,881	43,451	26,536	9,810,118,645 (9.8101×10^9)	36,063,367 (3.6063×10^{10})	58,965,696 (5.8966×10^{10})
2 (2-3)	58,431	32,897	18,089	8,943,479,450 (8.9435×10^9)	9,388,720 (9.3887×10^9)	16,909,638 (1.6910×10^{10})
3 (3-4)	53,473	47,699	19,036	7,539,742,000 (7.5397×10^9)	29,963,981 (2.9964×10^{10})	43,569,432 (4.3569×10^{10})

DIRECTION COSINE = 1 (Local y = Global X)

III. B.6 NODAL DETAILS

NODE NUMB.	DYNAMIC DEGREE OF FREEDOM			CONSTRAINT CODE		
	X	Y	Z	MASTER NODE	SLAVED NODE	DIRECTION
5	1	1	1	5	1	ALL
6	1	1	1	6	2	"
7	1	1	1	7	3	"
8	1	1	1	8	4	"

In order to obtain the response Spectra for nodes 9 to 12, Constraints can not be applied to those nodes. So, rigid beams are created as belows:

III. B.7 DEFINITION OF RIGID BEAMS.

BEAM No	X-AREA	Y-AREA	Z-AREA	X-MOM. OF IN.	Y-MOM. OF IN.	Z-MOM. OF I.
4						
5	10^{10}	10^{10}	10^{10}	10^{15}	10^{15}	10^{15}
6						
7						

ATTACHMENT 1
APPENDIX B

BECHTEL

CALCULATION SHEET

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
17214		0	39

ORIGINATOR	DATE	CHECKED	DATE
JcHu	1/15/86	PJ Cmut	6/25/86

III.B.8 MODAL ANALYSIS RESULTS (AVERAGE SOIL K_h = 70 pci)

MODE NO.	FREQUENCY (CPS)	MODAL MASSES X-DIRECTION	MODAL MASSES Y-DIRECTION	MODAL MASSES Z-DIRECTION
1	3.16	0.351	0	15.942*
2	3.29	10.160*	0	2.338
3	3.41	8.528*	0	0.738
4	17.83	0	0.210*	0.031
5	21.43	0	17.713*	0
6	23.48	0.011	0.382*	0
7	27.56	0	0	0
8	29.54	0	0	0.001
SUMMATIONS		19.05	18.305	19.05
TOTAL MASSES		19.05	19.053	19.05

ATTACHMENT 1
APPENDIX B