ACCELERATED DISTRIBUTION DEMONSTRATION SYSTEM

REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR:9209240334 DOC.DATE: 92/09/17 NOTARIZED: YES DOCKET #
FACIL:50-305 Kewaunee Nuclear Power Plant, Wisconsin Public Servic 05000305
AUTH.NAME AUTHOR AFFILIATION
STEINHARDT,C.R. Wisconsin Public Service Corp.
RECIP.NAME RECIPIENT AFFILIATION
Document Control Branch (Document Control Desk)

SUBJECT: Responds to Suppl 1 of GL 87-02 on SQUG resolution of USI A-46.Description of licensing basis in-structure response spectra & description of dynamic modeling & bases for selection of key modeling parameters discussed in encl.

DISTRIBUTION CODE: A025D COPIES RECEIVED:LTR 1 ENCL 1 SIZE: 16
TITLE: Seismic Qualification of Equipment in Operating Plants - A-46

NOTES:

	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL
	PD3-3 LA	2	2	PD3-3 PD	1	1
INTERNAL:	ACRS	6	6	NRR/DET CHENG,P	1	1
	NRR/DET/ESGB	1	1	NRR/DST/SELB	1	1
	NRR/DST/SICB	1	1	NRR/DST/SPLB	1	1
	NRR/DST/SRXB	1	1	OGC/HDS1	1	1
	REG FILE 01	1	1			
EXTERNAL:	NRC PDR	1	1			

R I D S / A D D S

R I D S / A D D S

NOTE TO ALL "RIDS" RECIPIENTS:

PLEASE HELP US TO REDUCE WASTE! CONTACT THE DOCUMENT CONTROL DESK. ROOM P1-37 (EXT. 504-2065) TO ELIMINATE YOUR NAME FROM DISTRIBUTION LISTS FOR DOCUMENTS YOU DON'T NEED!

TOTAL NUMBER OF COPIES REQUIRED: LTTR 18 ENCL 18

MA-4

WPSC (414) 433-1598
TELECOPIER (414) 433-5544

NRC-92-122

EASYLINK 62891993

PUBLIC PUBLIC

WISCONSIN PUBLIC SERVICE CORPORATION

600 North Adams • P.O. Box 19002 • Green Bay, WI 54307-9002

September 17, 1992

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Response to Supplement 1 of Generic Letter 87-02 on SQUG Resolution of USI A-46

References:

1) Generic Letter 87-02, "Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors, Unresolved Safety Issue (USI) A-46, dated February 19, 1987.

2) Supplement No. 1 to Generic Letter (GL) 87-02 That Transmits Supplemental Safety Evaluation Report No. 2 (SSER No. 2) On SQUG Generic Implementation Procedure, Revision 2, As Corrected on February 14, 1992 (GIP-2), dated May 22, 1992.

3) Letter from N.P. Smith (SQUG) to J.G. Partlow (NRR-NRC), "SQUG Response to Generic Letter 87-02, Supplement 1 and Supplemental Safety Evaluation Report No. 2 on GIP", dated August 21, 1992.

I. INTRODUCTION

On February 19, 1987, the NRC issued Generic Letter 87-02 (reference 1). 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

A025

1 (reference 2) which constituted the NRC Staff's review of the GIP and which included Supplemental Safety Evaluation Report Number 2 (SSER No. 2) on the GIP, Revision 2, corrected on February 14, 1992. The letter to SQUG enclosing SSER No. 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 (reference 3), SQUG clarified that the 120 days would expire on September 21, 1992. This letter serves as the Wisconsin Public Service Corporation (WPSC) response to the Staff's request.

II. COMMITMENT TO GIP

GIP Commitments

As a member of SQUG, WPSC 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 the Kewaunee Nuclear Power Plant (KNPP). The GIP, as evaluated by the Staff, permits licensees to deviate from the SQUG commitments embodied in the Commitments sections, provided the Staff is notified of substantial deviations prior to implementation. WPSC recognizes that the Staff's position in SSER No. 2 "is that if licensees use other methods that deviate from the criteria and procedures as described in SQUG commitments and in the implementation guidance of the GIP, Rev. 2, without prior NRC staff approval, the method may not be acceptable to the staff and, therefore, may result in a deviation from the provisions of Generic Letter 87-02."

Specifically, WPSC hereby commits to the SQUG commitments set forth in the GIP in their entirety, including the clarifications, interpretations, and exceptions identified in SSER No. 2 as clarified in reference 3.

GIP Guidance

WPSC 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. WPSC will notify the NRC as soon as practicable, but no later than the date of submittal of the final USI A-46 summary report, of significant or programmatic deviations from the guidance portions of the GIP, if any. Justifications for such deviations, as well as for other, minor deviations, will be retained on site for NRC review.

III. IN-STRUCTURE RESPONSE SPECTRA

For defining seismic demand, WPSC 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. The licensing-basis spectra referenced in the KNPP USAR and described in references A and B of Attachment 1, may be used and are considered to be conservative design spectra. The procedures and criteria which were used to generate the licensing-basis in-structure response spectra are described in Attachment 1.

IV. SCHEDULE

Given the magnitude of the effort required to achieve resolution of USI A-46, final program implementation must be carefully integrated with outage schedules and the seismic IPEEE program. WPSC currently plans to initiate plant walkdowns in March, 1993, depending on the date of staff approval of KNPP's in-structure response spectra. Considering the workload set forth by the criteria of the GIP, a Seismic Evaluation Report summarizing the results of the A-46 program at KNPP will be submitted to the NRC within 3 years following the date of staff approval of the in-structure response spectra, as described in section II.4.2.3 of SSER No. 2. However, the A-46 program completion schedule may be affected by coordination with the seismic IPEEE response, by the scope and schedule for completing the necessary SQUG training and by the availability of industry resources, which may be unavailable because of the large number of licensees implementing this program.

Regarding in-structure response spectra, if the Staff does not respond by accepting, questioning, or rejecting the spectra within sixty days, the Staff is deemed to have accepted our spectra, and we may proceed with implementation. If a rejection or question is received from the Staff, we will provide additional information to the Staff to resolve the problem. If the Staff takes no action on this new information for sixty days, the Staff is deemed to have accepted our resolution and we may proceed with implementation.

If there are any questions concerning this project, please contact a member of my staff.

Sincerely,

C. R. Steinhardt
Senior Vice President-Nuclear Power

GCR/jac

Attach.

cc - US NRC, Region III
Mr. Patrick Castleman, US NRC

Subscribed and Sworn to
Before Me This 17th Day
of September 1992

Jeanne M. Stein
Notary Public, State of Wisconsin

My Commission Expires:
June 18, 1995

LIC\NRC\GL8702.WP

DESCRIPTION OF LICENSING-BASIS IN-STRUCTURE RESPONSE SPECTRA

References: A) John A. Blume & Associates, Engineers, "Kewaunee Nuclear Power Plant - Earthquake Analysis of the Reactor-Auxiliary-Turbine Building", JAB-PS-01, February 16, 1971.

B) John A. Blume & Associates, Engineers, "Kewaunee Nuclear Power Plant - Earthquake Analysis: Reactor-Auxiliary-Turbine Building Response Acceleration Spectra", JAB-PS-03, February 16, 1971.

The procedures and criteria used to generate the licensing-basis in-structure response spectra which may be used by Wisconsin Public Service Corporation to resolve USI A-46 at the Kewaunee Nuclear Power Plant (KNPP) are described below.

I. DESCRIPTION OF INPUT MOTIONS

The input motions used to create the earthquake analysis of KNPP (reference A) were based on the Dames and Moore response spectra shown in Figures 1 and 2. Figure 1 represents the design basis spectra for a maximum horizontal ground acceleration of 6 percent of gravity. Figure 2 represents the safe shutdown spectra for a maximum horizontal ground acceleration of 12 percent of gravity. The response spectra represent the maximum amplitudes of motion in structures having a range of natural frequencies, subjected to earthquake ground motion.

The response spectra have been evaluated utilizimg two separate procedures. These procedures are as follows:

1. Strong Motion Records: The spectra from sites with somewhat similar subsurface conditions were reviewed and response spectra were estimated from these records.

2. Calculated Values: Specific points on response spectra were calculated from ground motion estimates based on a procedure developed by Drs. N. Newmark and A. Veletsos for the Air Force Special Weapons Laboratory. This procedure is described in the paper, "Design Criteria for Nuclear Reactors Subjected to Earthquake Hazards," presented at the IAEA Earthquake Reactor Conference, Tokyo, Japan, 1967.

II. DESCRIPTION OF DYNAMIC MODELING AND BASES FOR THE SELECTION OF KEY MODELING PARAMETERS

The Kewaunee Nuclear Power Plant consists of the Reactor, Auxiliary and Turbine Building as one interconnected structure. The modeled structure has a mat foundation which is nominally 3 feet - 6 inches thick. The Reactor Building consists of the Shield Structure and the Containment Vessel. The Shield Structure is a cylindrical concrete shell modeled as approximately 120 feet in diameter and 208 feet high. The Containment Vessel, modeled as a steel cylindrical shell 105 feet in diameter and 199 feet high, is enclosed by the Shield Building. The Auxiliary Building is a reinforced concrete structure with steel framing over the fuel handling area. The Turbine building is a steel structure, with the exception of the Battery Room and Diesel Generator areas which are reinforced concrete. The Turbine Building is connected to the Auxiliary Building at the foundation, mezzanine, operating, and roof levels.

The mathematical model of the combined structure is shown in Figures 3, 4 and 5. The model is a discrete mass system with masses lumped at each floor and roof level, at points of intersection of diagonal bracing in the steel structures and at intermediate points in the shield and containment structures. The structure has been idealized as a three dimensional model with 63 degrees of freedom that include north-south and east-west translation for symmetrical elements and both translation and torsional rotation for unsymmetrical and irregular elements. Each mass point represents the mass of the concrete and steel structural elements and equipment at a particular level plus the tributary mass of the equipment and walls between adjacent levels. A snow load of 40 psf on the roof of each structure was included in the analysis.

As shown on the model, the Reactor-Auxiliary Building was assumed to be rigid between Elevations 584 ft and 606 ft. Floor plans of the basement level show a large number of walls in both the north-south and east-west directions between the above two elevations. This indicates that the structure is extremely stiff in this region. The period for the region was determined to be 0.06 seconds, which justifies the assumption of rigidity. The rigid vertical column on the model labeled Reactor Support Structure represents the concrete structure within the Containment Vessel that supports the reactor, steam generators and other equipment.

The structure was also modeled for response in the vertical direction. The concrete structures of the Reactor-Auxiliary Building have very short periods in the vertical direction.

As shown on the mathematical model in Figures 3, 4 and 5, the Turbine and Auxiliary Buildings are connected at the foundation, operating and roof levels. The connection at the foundation level is designed and reinforced such that it behaves as a link that is capable of transmitting moments about a vertical axis and forces in the horizontal plane only. These forces are a shear in the north-south direction and an axial force in the east-west direction. The mezzanine floor level in the Turbine Building is composed of steel framing covered with steel grating and some concrete slabs at several elevations. This type of framing is relatively flexible and resulted in a link that had a negligible effect in the mathematical model. At the operating floor and Turbine Building Roof the connecting links are capable of transmitting horizontal east-west axial and north-south shear forces and moments about a vertical axis.

The spectral method was used for the dynamic analysis of the Reactor-Auxiliary-Turbine Building. In this method, the maximum response for each mass point for each mode is computed and then the modal responses are combined to determine the total response. The total response was determined by computing the square root of the sum of the squares of the maximum response of each mode. The structure was analyzed for earthquake motion in both the north-south and east-west directions acting non-concurrently.

III. DESCRIPTION OF SOIL-STRUCTURE INTERACTION STUDIES

The soil-structure interaction under seismic motions is represented by the translational and rotational springs in the model as shown in Figures 3, 4 and 5. The stiffness of these springs were determined by using finite element techniques of structural mechanics and then reviewed using equations developed for the case of a rigid plate on a semi-infinite elastic half-space.

IV. SAMPLE IN-STRUCTURE RESPONSE SPECTRA

Reference B describes the horizontal and vertical in-structure response acceleration spectra. The spectra for accelerations in the horizontal direction were developed for damping values of 0.5 percent and 1.0 percent of critical damping. In addition, all the response acceleration spectra are presented in a period vs acceleration format.

As described in the SQUG GIP, Revision 2, the use of 5 percent damped in-structure response acceleration curves is allowed for characterizing seismic demand. Seismic capacity, as described in the GIP by the "Bounding Spectrum" and the "Generic Equipment Ruggedness Spectra" (GERS), is presented in a frequency vs acceleration format. Therefore, in order to facilitate the comparison of seismic demand to capacity, WPSC converted the in-structure response spectra provided in reference B into 5 percent damped spectra in a frequency vs acceleration format.

The original design basis amplified response spectra were used to generate damping independent, acceleration power spectral densities (PSD's). These acceleration PSD's were then converted back to acceleration response spectra at 5 percent damping. Figures 6 and 7 represent a sample of the 5 percent damped in-structure response spectra. The spectra as shown are unbroadened and will be converted to broadened spectra per the Standard Review Plan prior to the USI A-46 walkdowns.

V. PEAK FLOOR ACCELERATION VALUES AT IMPORTANT FLOOR LOCATIONS

As shown in Figures 6 and 7, peak acceleration values for important floor elevations of the Reactor, Auxiliary and Turbine Buildings are 1.1 g in the horizontal (N-S & E-W) direction and 0.58 g in the vertical direction.

The mass points listed in Figures 6 and 7 correspond to the mass point locations shown in Figure 5, and represent several floor elevations in the Reactor, Auxiliary and Turbine buildings. As described in reference B, the spectra for these individual mass points were combined into one horizontal spectra, as shown in Figure 5, and one vertical spectra, as shown in Figure 6. The reasons for combining the spectra were (1) the response acceleration spectra obtained at the various mass points in the Reactor-Auxiliary building showed that the building response was primarily due to deformation of the foundations, and (2) the response due to earthquakes acting in the north-south and east-west directions were not significantly different. Therefore, the spectra were combined for the various mass points and for the two earthquake directions to facilitate their application in the seismic design and analysis of critical equipment. The combination of spectra resulted in conservative demand response spectra for the lower elevations of the Reactor, Auxiliary and Turbine buildings, where a majority of the USI A-46 safe shutdown equipment is located.

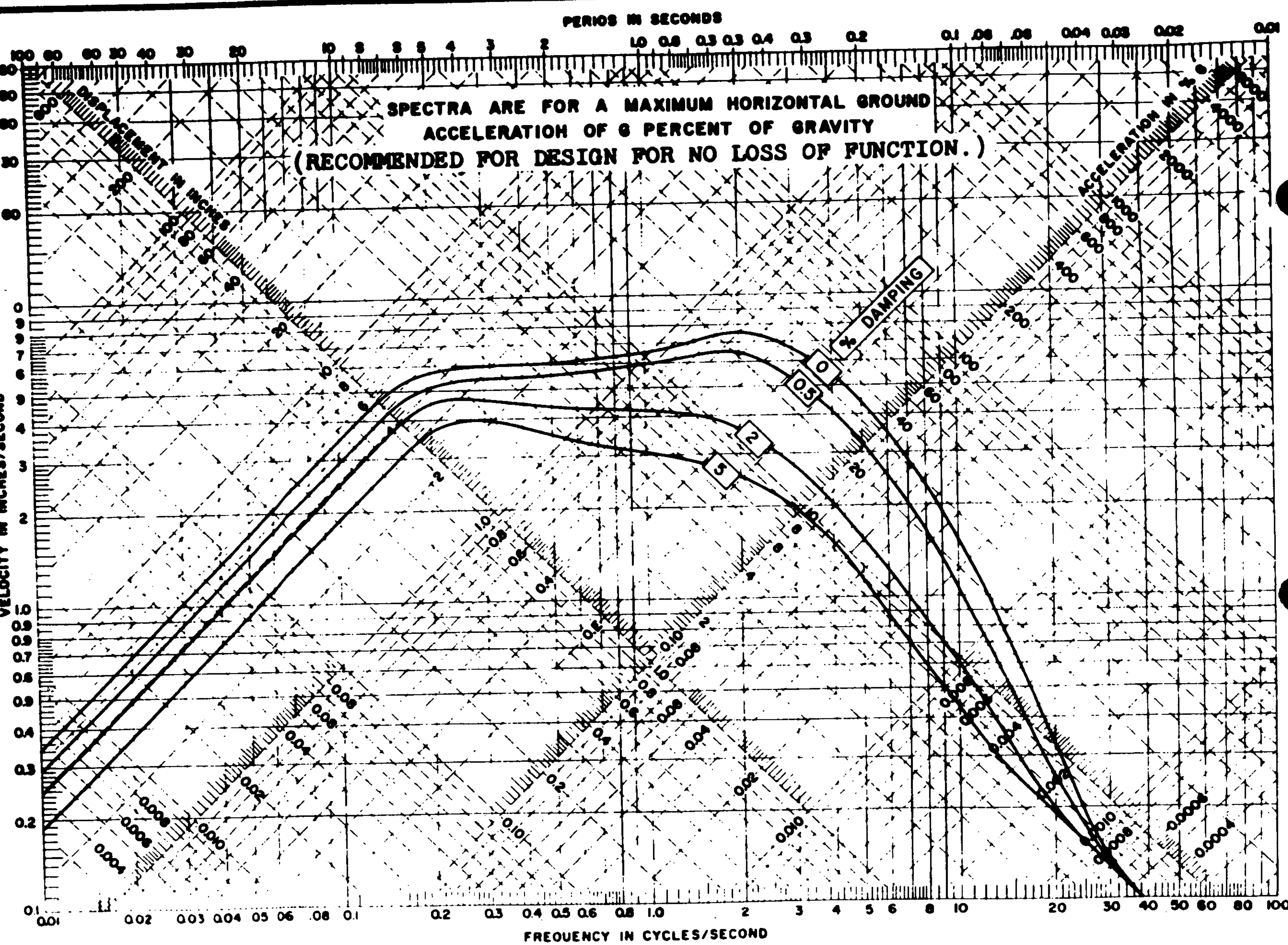
VI. NATURAL FREQUENCIES OF DOMINANT BUILDING MODES CONTRIBUTING TO THE IN-STRUCTURE RESPONSE SPECTRA

As previously mentioned, the mathematical model of the combined Reactor-Auxiliary-Turbine building has 63 degrees of freedom and the same number of possible modes of vibration. In the analysis, the periods of all 63 modes were determined and it was observed that the thirty-first and higher modes have periods of vibration approaching that of a rigid system and have a negligible participation in the overall response. For this reason, the influence of the thirty-first and higher modes was neglected in the analysis. The relatively large number of modes considered in the analysis reflects the fact that the structure is actually a combination of five buildings and that in some cases up to six modes are due primarily to the response of one building of the combined structure.

Modes of vibration were identified as being due primarily to the deformation of specific structural elements. The first thirty modes of vibrations and the damping values assigned to each of these modes are summarized in Table 1.

RECOMMENDED RESPONSE SPECTRA

(DESIGN EARTHQUAKE)



DAMES & MOORE

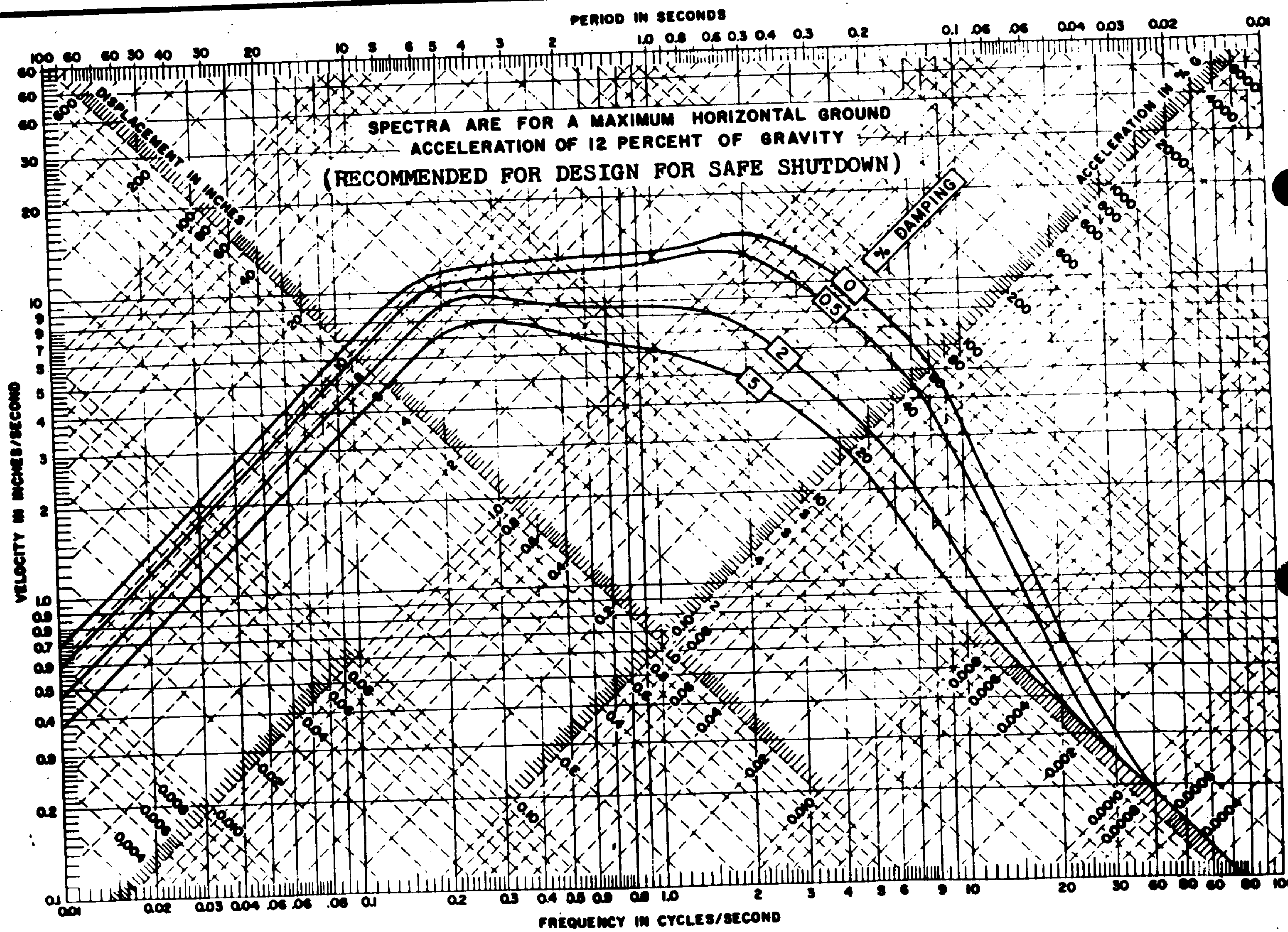
MAY 3 1968 PLATE 8-A (REV.1

FIGURE NO. 1

FILE 4707.006

BY ________ DATE ________
CHECKED BY ________ DATE ________

REVISIONS
BY ________ DATE ________
BY ________ DATE ________
PLATE ________ OF ________



RECOMMENDED RESPONSE SPECTRA

(MAXIMUM CREDIBLE EARTHQUAKE)

MAY 3 1966

PLATE 8-B (RE

FIGURE NO. 2

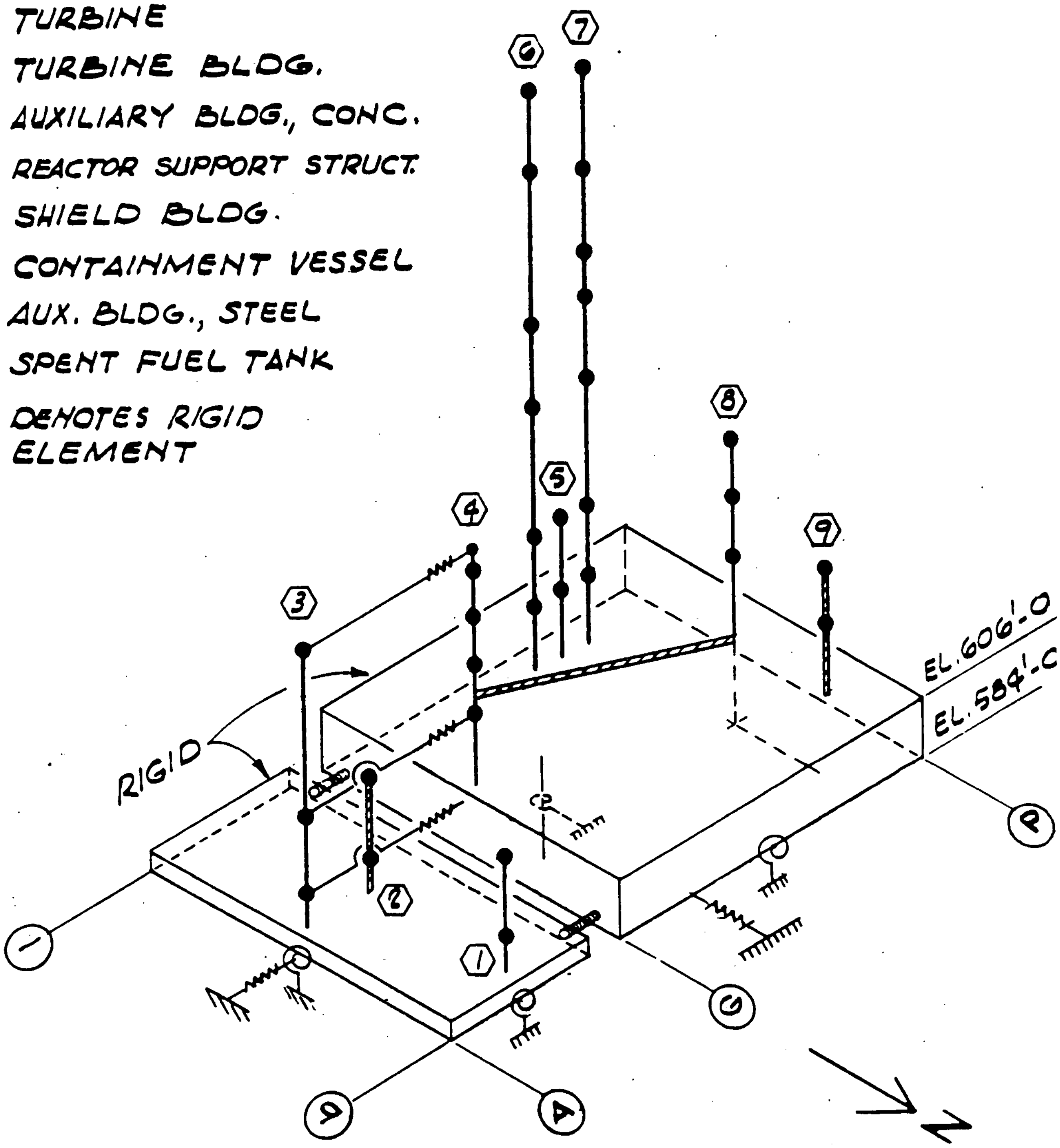
KEWAUNEE NUCLEAR POWER PLANT

MATHEMATICAL MODEL
NORTH EAST VIEW

CODE:

1. BATTERY RM. AREA
2. TURBINE
3. TURBINE BLDG.
4. AUXILIARY BLDG., CONC.
5. REACTOR SUPPORT STRUCT.
6. SHIELD BLDG.
7. CONTAINMENT VESSEL
8. AUX. BLDG., STEEL
9. SPENT FUEL TANK

DENOTES RIGID ELEMENT



SCALES:

HORIZ. 1" = 100'
VERT. 1" = 60'

8-12-68

FIGURE NO. 3

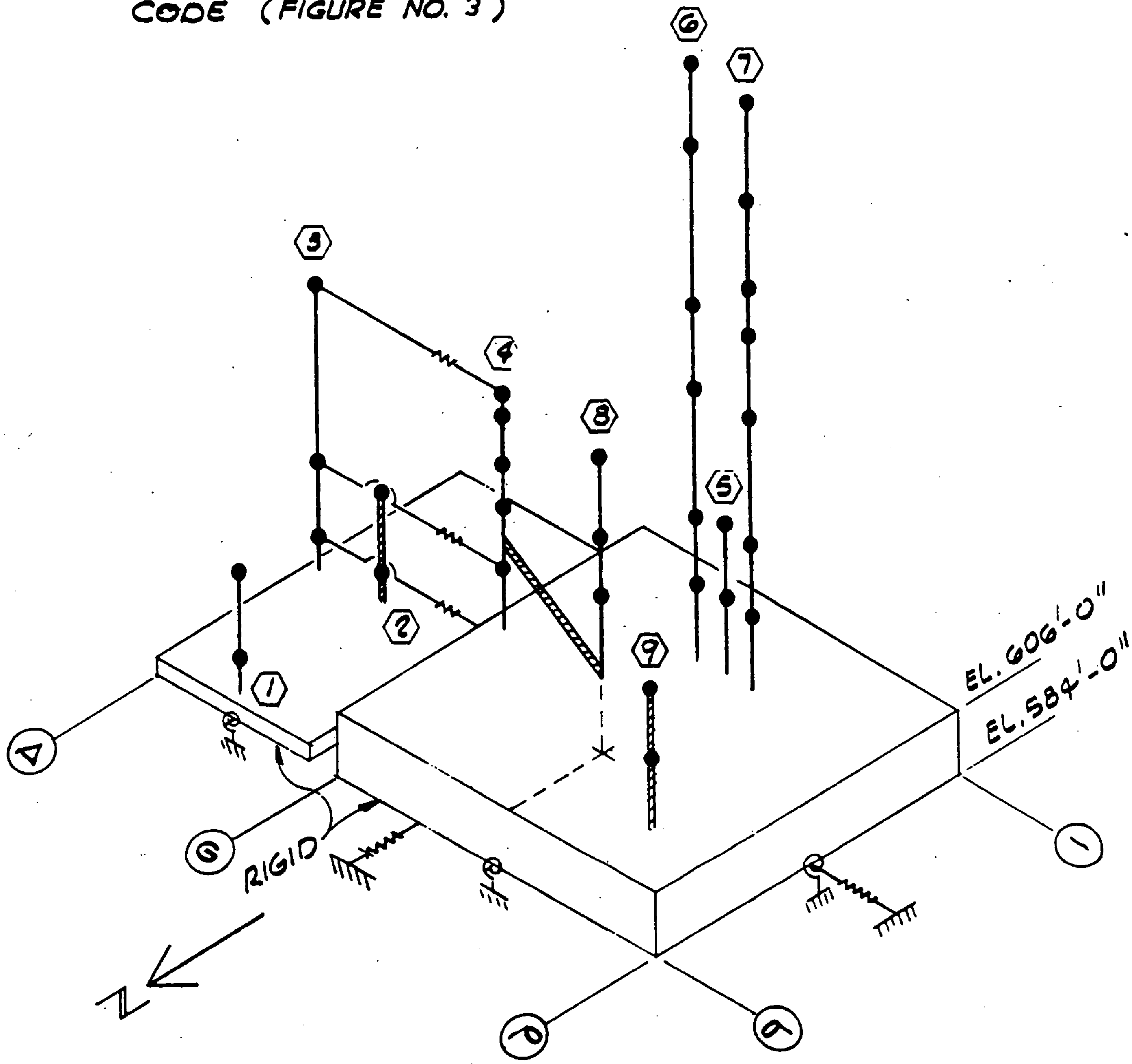
JOHN A. BLUME & ASSOCIATES, ENGINEERS

KEWAUNEE NUCLEAR POWER PLANT

MATHEMATICAL MODEL

NORTH WEST VIEW

⬡ = SEE NORTH EAST VIEW FOR CODE (FIGURE NO. 3)



SCALES :

HORIZ. 1" = 100'
VERT. 1" = 50'

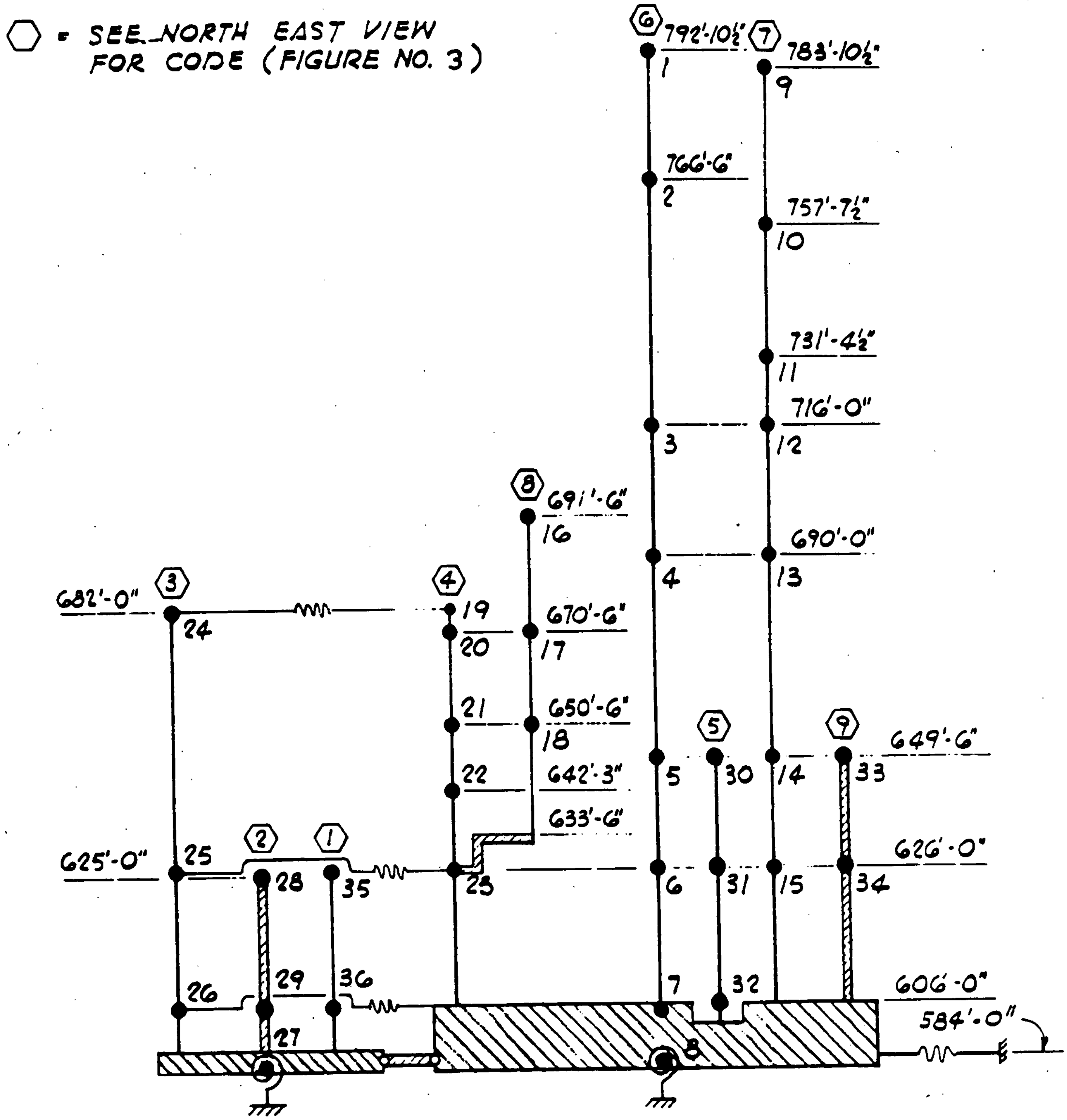
8-12-68

FIGURE NO. 4

JOHN A. BLUME & ASSOCIATES, ENGINEERS

KEWAUNEE NUCLEAR POWER PLANT

MATHEMATICAL MODEL
NORTH ELEVATION



BUILDING :Reactor-Auxiliary-Turbine
MOTION :Dames & Moore(0.12G)
DIRECTION :Horizontal, NS and EW
MASS POINTS :5,6,7,8,11,12,13,14,15
22,23,21,27,33,34,36

Kewaunee Floor Response Spectra

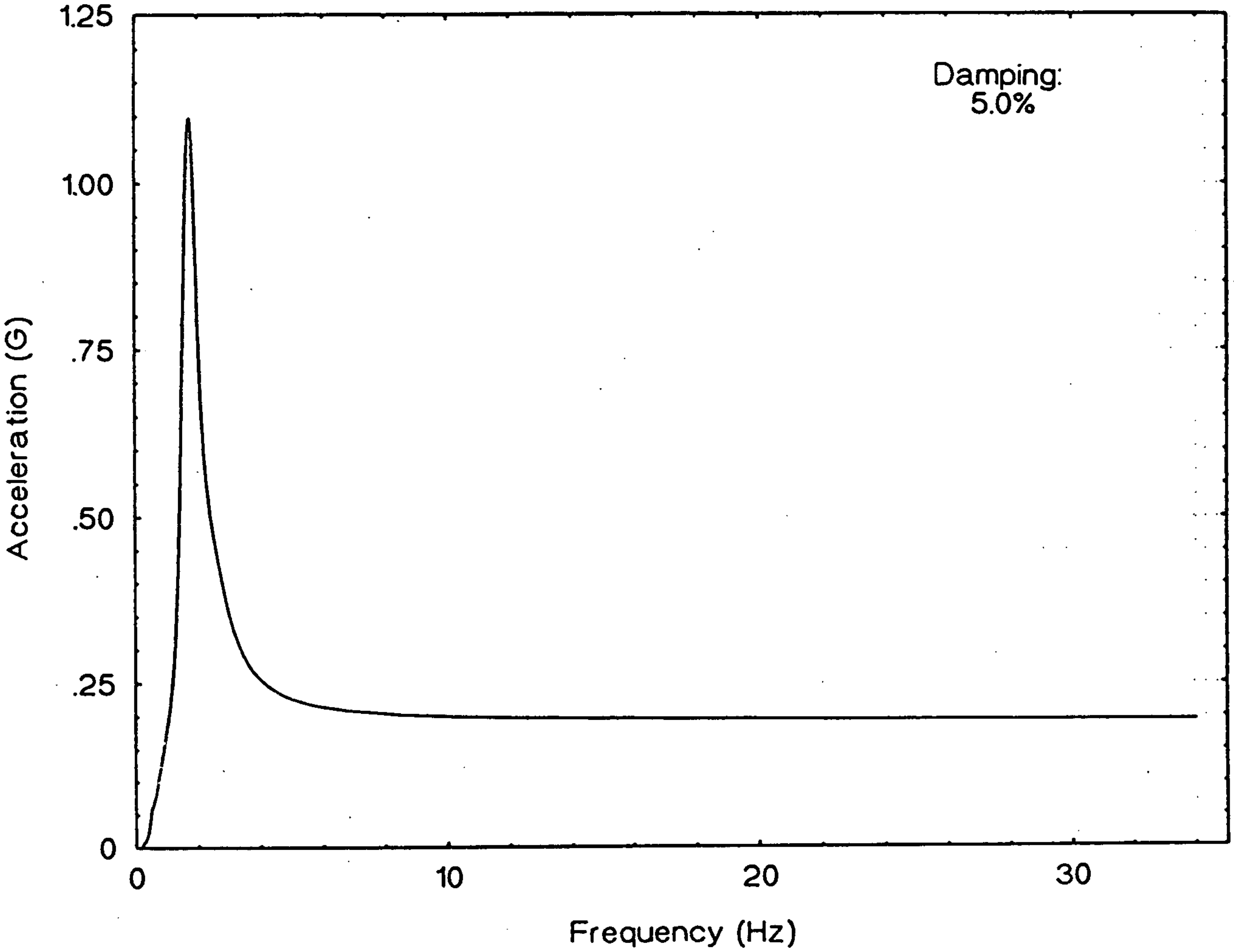


FIGURE NO. 6

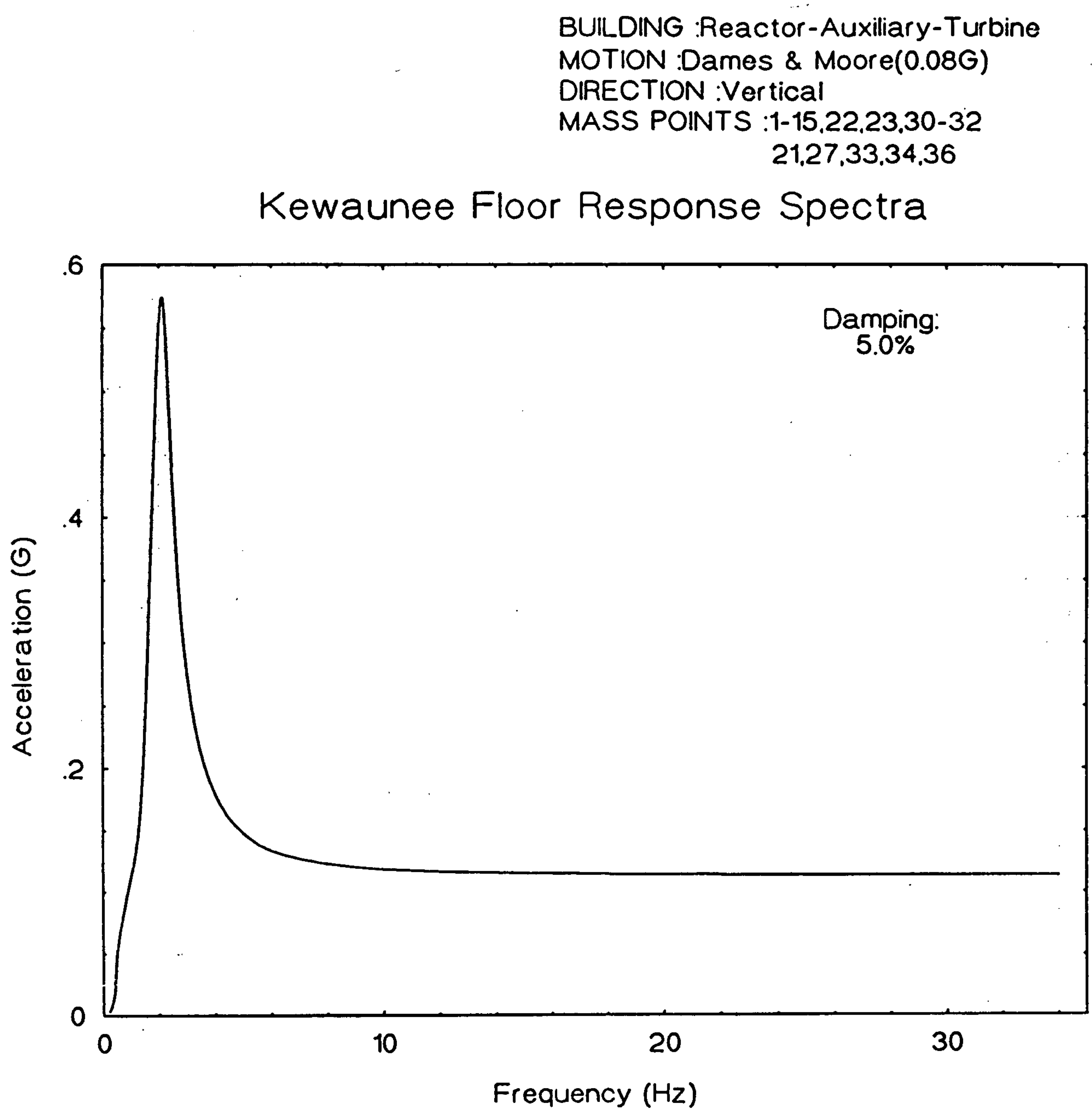

BUILDING :Reactor-Auxiliary-Turbine
MOTION :Dames & Moore(0.08G)
DIRECTION :Vertical
MASS POINTS :1-15,22,23,30-32
21,27,33,34,36
Kewaunee Floor Response Spectra
Damping:
5.0%
Acceleration (G)
.6
.4
.2
0
0
10
20
30
Frequency (Hz)

FIGURE NO. 7

TABLE NO. 1

PERIODS OF VIBRATION

Mode	Period, Seconds	Damping value, Percent of Critical
1	0.759	2
2	0.695	2
3	0.592	5
4	0.565	5
5	0.519	2
6	0.409	5
7	0.257	2
8	0.251	2
9	0.244	2
10	0.230	2
11	0.224	2
12	0.211	2
13	0.184	2
14	0.179	2
15	0.136	1
16	0.136	1
17	0.130	2
18	0.121	2
19	0.109	2
20	0.107	2
21	0.099	2
22	0.099	2
23	0.082	2
24	0.076	2
25	0.075	2
26	0.074	2
27	0.072	2
28	0.067	2
29	0.056	2
30	0.053	2