Northern States Power Company

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September 21, 1992

Generic Letter 87-02
Supplement 1

U S Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

PRAIRIE ISLAND NUCLEAR GENERATING PLANT
Docket Nos. 50-2 , License Nos. DPR-42
50-306 DPR-60

Response to Supplement 1 to Generic
Letter 87-02 on SQUG Resolution of USI A-46

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". 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. The letter to SQUG enclosing SSER-2 requests that SQUG members provide to the NRC, within 120 days, a schedule for implementing the GIP. By letter dated August 21, 1992 to James Partlow, NRC-NRR, SQUG clarified that the 120 days would expire on September 21, 1992. This letter responds to the Staff's request.

Information concerning commitments to the GIP, in-structure response spectra, and schedule are provided in Attachment 1. The procedures and criteria which were used to generate the licensing-basis in-structure response spectra are described in Attachment 2.

A075 1/1

Please contact us if you require additional information.

Thomas M. Parker
Manager
Nuclear Support Services

cc: Regional Administrator-III, NRC
NRR Project Manager, NRC
Resident Inspector, NRC
State of Minnesota,
Attn: Kris Sanda
J Silberg

Attachment: (1) Response to Supplement 1 to GL 87-02

(2) Description of Licensing-Basis In-Structure Response Spectra for Use in Resolution of USI A-46

(3) Prairie Island Nuclear Generating Plant Earthquake Analysis: Reactor-Auxiliary-Turbine Building, John A. Blume & Associates Report JAB-PS-02, January 22, 1971

(4) Prairie Island Nuclear Generating Plant Earthquake Analysis: Reactor-Auxiliary-Turbine Building Response Acceleration Spectra, John A. Blume & Associates Report JAB-PS-04, February 16, 1971

UNITED STATES NUCLEAR REGULATORY COMMISSION

NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

DOCKET NO. 50-282
50-306

RESPONSE TO SUPPLEMENT 1 TO GENERIC
LETTER 87-02 ON SQUG RESOLUTION OF USI A-46.

Northern States Power Company, a Minnesota corporation, hereby provides the information requested by Supplement 1 to Generic Letter 87-02, titled "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)".

This letter contains no restricted or other defense information.

NORTHERN STATES POWER COMPANY

By _____
Thomas M Parker
Manager
Nuclear Support Services

On this 21st day of September 1992 before me a notary public in and for said County, personally appeared Thomas M Parker, Manager Nuclear Support Services, and being first duly sworn acknowledged that he is authorized to execute this document on behalf of Northern States Power Company, that he knows the contents thereof, and that to the best of his knowledge, information, and belief the statements made in it are true an that it is not interposed for delay.

Marcia K LaCore

MARCIA K. LaCORE
NOTARY PUBLIC—MINNESOTA
HENNEPIN COUNTY
My Commission Expires Sept. 24, 1993

Attachment 1

Response to Supplement 1 to Generic Letter 87-02

I COMMITMENT TO GIP

GIP Commitments: As a member of SQUG, Northern States Power commits to use the SQUG methodology as documented in the GIP, where "GIP" refers to GIP Revision 2, corrected on February 14, 1992, to resolve USI A-46 at Prairie Island. 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. Northern States Power recognizes that the Staff's position in SSER-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, Revision 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, Northern States Power hereby commits to the SQUG commitments set forth in the GIP in their entirety, including the clarifications, interpretations, and exceptions identified in SSER-2 as clarified by the August 21, 1992, SQUG letter responding to SSER-2.

GIP Guidance: Northern States Power 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. Northern States Power will notify the NRC as soon as practicable, but no later than the final USI A-46 summary report, of significant or programmatic violations 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.

II IN-STRUCTURE RESPONSE SPECTRA

For defining seismic demand, Northern States Power 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 the 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, as described in Section 12.2.1.4.3 of the Prairie Island Updated Safety Analysis Report, are consistent with standards and guidance applicable to the plant at the time of licensing, and are considered to be Conservative Design. The procedures and criteria which were used to generate the licensing-basis in-structure response spectra are described in Attachment 2.

Realistic, median-centered in-structure response spectra may be used as an additional option as provided in the GIP for resolution of USI A-46.

III SCHEDULE

Given the magnitude of the effort required to achieve resolution of USI A-46, final implementation must be carefully integrated with outage schedules and the seismic IPEEE response, the completion of which may be affected by the A-46 implementation start date. Considering the workload set forth by the criteria of the GIP, a Seismic Evaluation Report summarizing the results of the A-46 program at Prairie Island will be submitted to the NRC by November 20, 1995. This date reflects the fact that Prairie Island is a Category 3 plant, as described in Table A of SSER-2, and assumes that the Staff approves the in-structura response spectra of Attachment 2 within 60 days. However, the A-46 program completion schedule may be affected by coordination with the seismic IPEEE response, 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, it is our understanding, based on the May 22, 1992 NRC letter transmitting SSER-2, that if the Staff does not respond by accepting, questioning, or rejecting the spectra within 60 days of this letter, we may assume the Staff has accepted our spectra and we may proceed with implementatic . We further understand that if a rejection or question is received from the Staff, we will provide additional information to the Staff to resolve the problem, and if the Staff does not respond by accepting, questioning, or rejecting the information within 60 days, we may interpret this to mean the staff has accepted our resolution and proceed with implementation. We endorse the approach described in the August 21, 1992 SQUG letter responding to SSER-2 (i.e., that rejection of a licensee's position after 60 days should be considered a changed Staff position requiring 10 CFR 50, Section 50.109 considerations).

Attachment 2

Description of Licensing Basis In-Structure Response Spectra For Use In Resolution of USI A-46

The procedures and criteria used to generate the licensing basis in-structure response spectra which may be used by Northern States Power to resolve USI A-46 at the Prairie Island Nuclear Generating Plant are described below. The licensing basis spectra is described in Prairie Island Updated Safety Analysis Report Section 12.2.1.4.3 and is further defined in the John A. Blume reports referenced by the Updated Safety Analysis Report and provided as Attachments 3 and 4 to this response.

Input Motion

For the Prairie Island Nuclear Generating Plant, Dames and Moore Consulting Engineers in the Applied Earth Sciences developed a report entitled "... of Environmental Studies Geology, Hydrology, and Seismology" which is found Appendix E of the Prairie Island Updated Safety Analysis Report. This report developed the ground design response spectra for the Operating Basis (OBE) and the Design Basis (DBE/SSE) earthquakes. These spectra are presented in Plates 4.5 and 4.6 of Appendix E to the Updated Safety Analysis Report, which are attached to this response as Figures 1 and 2. The horizontal ground acceleration values for the OBE and the DBE which represent the zero period acceleration (ZPA) of the corresponding response spectra were established at 6 and 12 percent of gravity respectively after a thorough review of the seismicity of the region. Discussions on the seismology of the region are presented in Section 2 and Appendix E of the Updated Safety Analysis Report.

The amplification spectra were developed to indicate the amplification of the earthquake wave motion between the basement rock and the foundation soils for wave motion of varying periods. Further details of the methodology used in the development of the response spectra for the Prairie Island site are described in the Dames and Moore report given in Appendix E of the Updated Safety Analysis Report.

Dynamic Models

The major structures at the Prairie Island site include the Reactor Building, Auxiliary Building, Turbine Building and Screen House. The dynamic models (mathematical models) developed as part of the design basis seismic analysis were used to genetrate OBE in-structure response spectra for each floor and roof level. See Figures 3 and 4, attached. The results of the analyses presented in Attachments 3 and 4 to this response are for the OBE (0.06g) earthquake. Values for the SSE (design basis)(0.12g) earthquake can be obtained by doubling the presented results.

The mathematical model of the Prairie Island structure is a discrete mass system which represents the combined Reactor-Auxiliary-Turbine Building complex. The model has 109 degrees of freedom representing horizontal and rotational degrees of freedom of the discrete mass points. Each of the major structures is represented by a stick model. These sticks are connected at specific elevations to represent the continuity of the various building structures at the foundation and certain floor elevations. These connecting links provided continuity, as appropriate, in the two horizontal translations and the rotation about the vertical axis only.

The two reactor buildings along with the steel containment and internal structures are modeled and connected to the overall model at the foundation level only. Soil structure interaction effects are accounted for through soil springs as described in the response to the next item. The moments of inertia and effective shear areas of the vertical elements between the mass points were determined by cutting a horizontal section and computing the properties of the wall sections thus intersected. The stiffness of the braced steel structures were computed by considering the axial deformation of the bracing members. The dynamic seismic analysis along with a detailed description of the mathematical modeling are described in Attachment 3.

The mathematical model for vertical response is a single mass system representing the entire complex resting on a flexible soil medium. Soil structure interaction in the vertical direction is described in the next item.

Soil Structure Interaction

Soil structure interaction analyses have been carried out for the Prairie Island Nuclear Plant facilities. The Reactor-Auxiliary-Turbine Building structure is founded on densified granular soil. The soil-structure interaction under seismic conditions, based geo-physical data collected at the site, is represented by translational and rotational springs as shown in Figure 4, attached. The Reactor-Auxiliary-Turbine Building Complex was modeled in 1968 as a multi-degree-of-freedom lumped mass system with foundation springs representating the flexibility of the underlying soil layer. The two horizontal translational and the torsional rotational flexibility of the soil for the entire structure, along with the two rocking flexibilities for each of the two Reactor Buildings, the Auxiliary Building and the Turbine Building represented the nine soil springs used in the dynamic analysis. The spring constants were obtained by using the equations developed for the case of a rigid plate on semi-infinite elastic half-space. The following soil material properties developed by the soil consultant were used in the computation of the soil springs:

Elastic Modulus	9000 kips/ft^2
Shear Modulus	3100 kips/ft^2
Poisson's Ratio	0.40

The resulting three-dimensional dynamic model was analyzed by the normal time-history method using a ground acceleration time-history motion developed from the ground response acceleration spectra specified for the Prairie Island Plant as shown in Figures 1 and 2.

Vertical seismic analysis of the Reactor-Auxiliary-Turbine Building Complex was also carried out using vertical soil spring to represent the vertical deformation of the underlying soil.

The Screen House, which is a separate structure, was modeled for the soil structure interaction analysis in a similar manner.

In-Structure Response Spectra

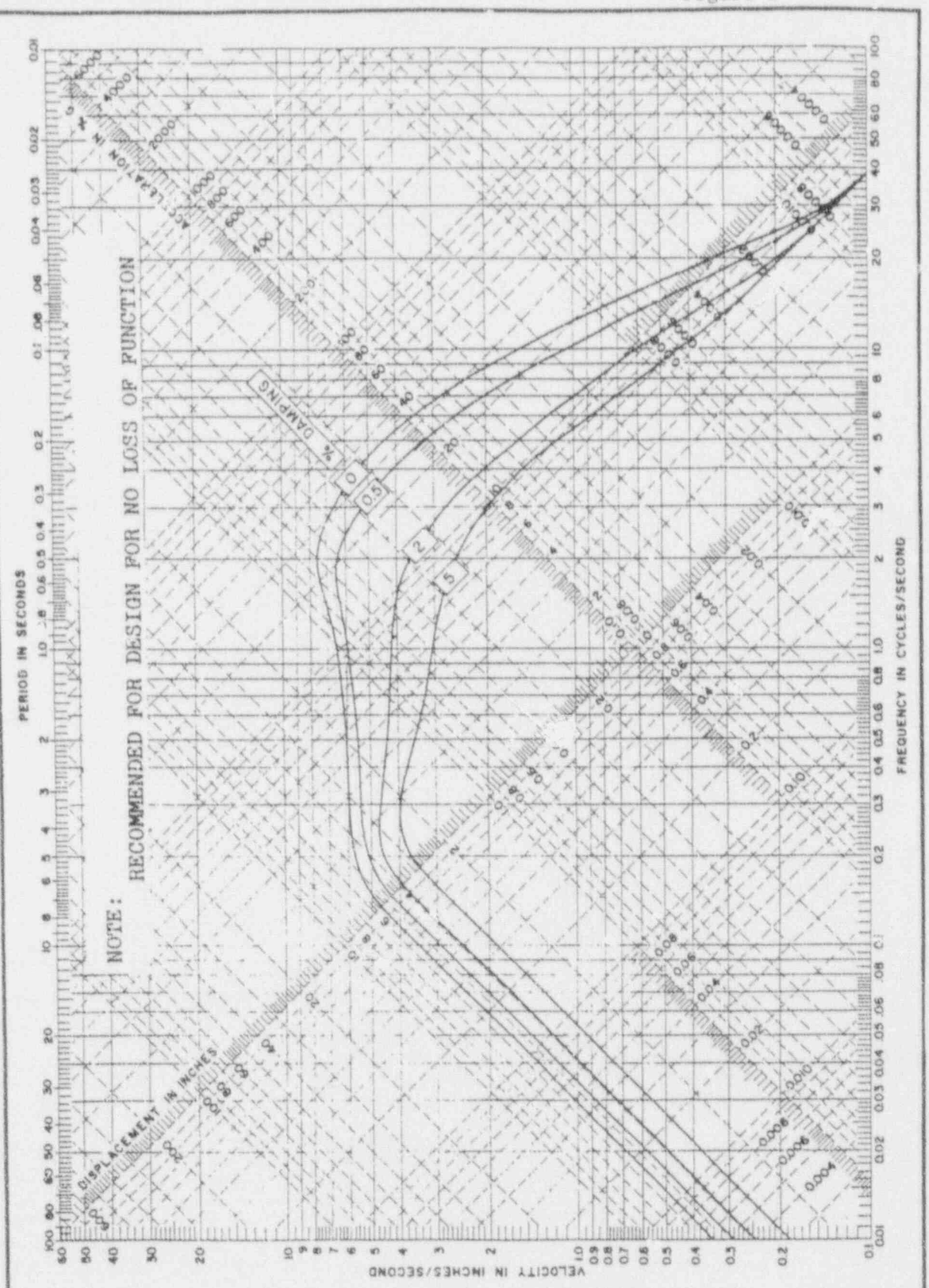
The mathematical model was subjected to the developed ground acceleration time-history acting in the north-south and in the east-west directions, and the time-history of the horizontal acceleration at each mass point of the mathematical model was generated. Using the generated acceleration time-histories at selected mass points, the response acceleration spectra for the desired damping values were calculated. The response in the vertical direction was similarly determined using the developed horizontal ground acceleration time-history normalized to 0.04g.

The results of the analyses are described in Attachments 3 and 4. The results of the analyses presented are for the OBE (0.06g) earthquake. Values for the SSE (design basis)(0.12g) earthquake can be obtained by doubling the presented results.

Peak Floor Acceleration Values

Attachments 3 and 4 provide complete details on the floor response spectra for the OBE earthquake.

Attachment 2
Figure 1



RECOMMENDED RESPONSE SPECTRA

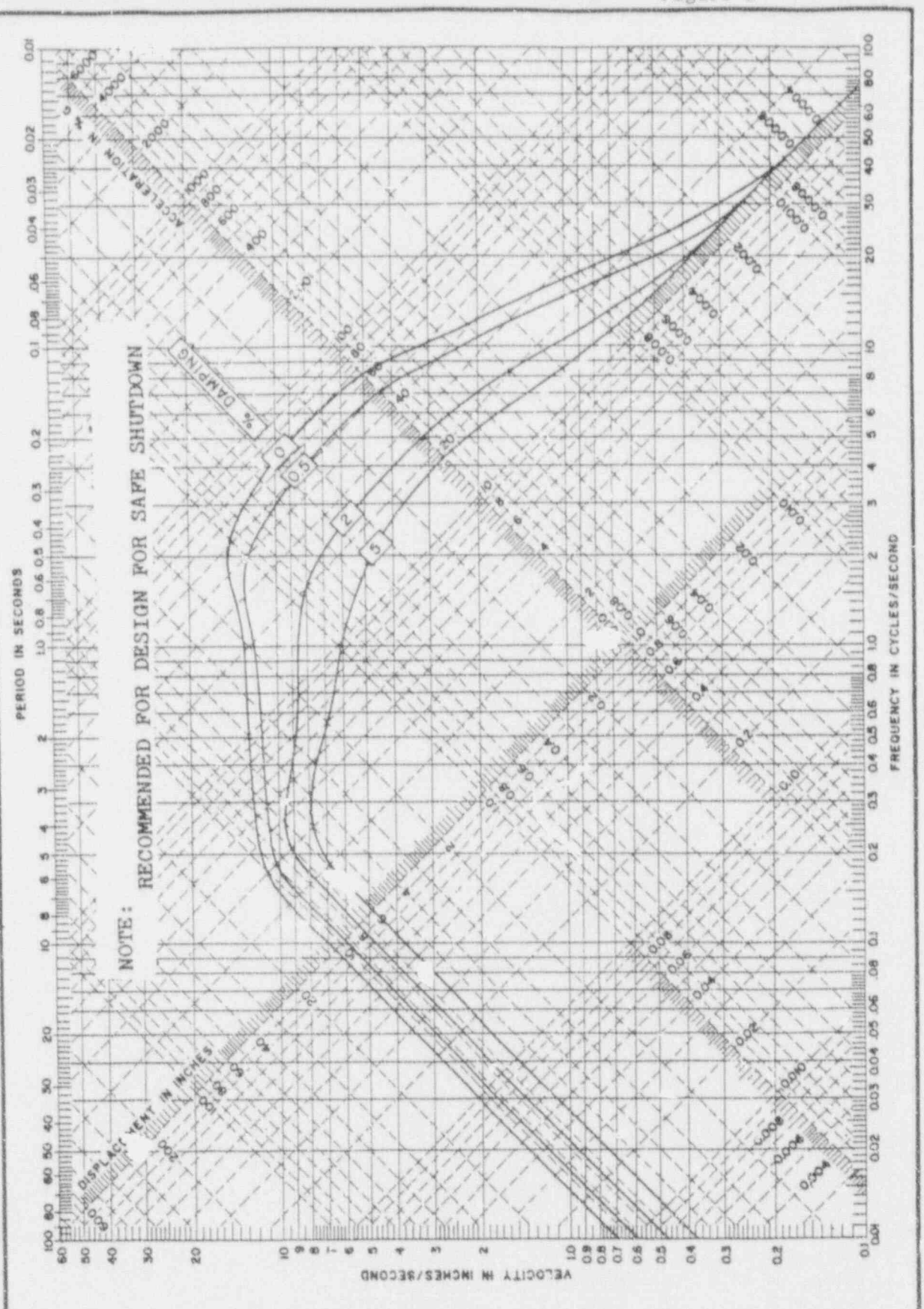
DESIGN EARTHQUAKE - 6% ACCELERATION
(OBE)

GAMES & MOORE

PLATE 4.5 (Rev.)

Ref. PINGP-USAR, APPENDIX E

Attachment 2
Figure 2



RECOMMENDED RESPONSE SPECTRA

(DBE) MAXIMUM CREDIBLE EARTHQUAKE - 12% ACCELERATION DAMES & MOORE

PLATE H 4.6 (Rev. 1)

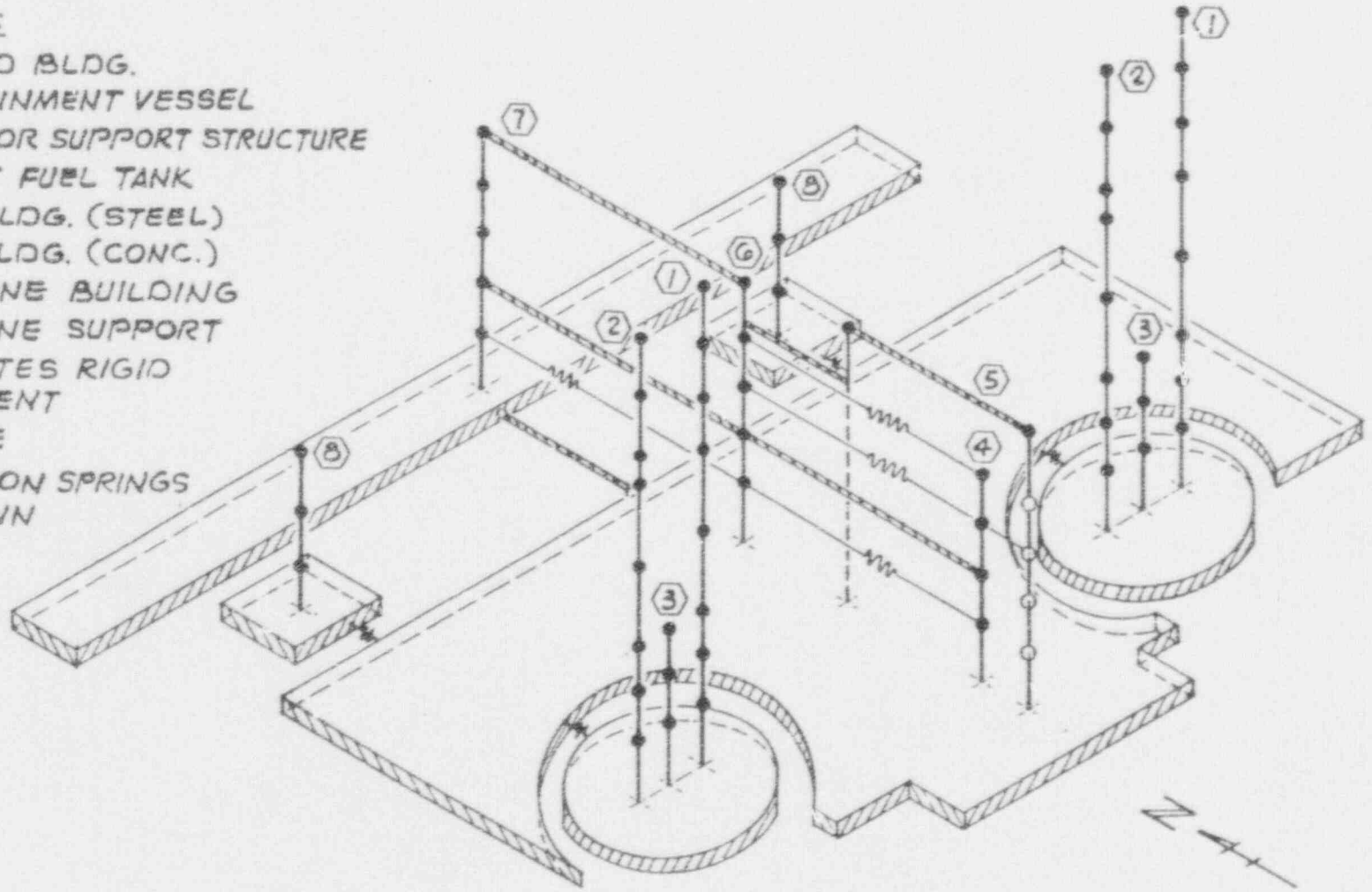
Ref. PINGP-USAR, APPENDIX E

CODE:

(1) SHIELD BLDG.
(2) CONTAINMENT VESSEL
(3) REACTOR SUPPORT STRUCTURE
(4) SPENT FUEL TANK
(5) AUX. BLDG. (STEEL)
(6) AUX. BLDG. (CONC.)
(7) TURBINE BUILDING
(8) TURBINE SUPPORT
‖ DENOTES RIGID ELEMENT

NO SCALE

FOUNDATION SPRINGS NOT SHOWN



JOHN A. BLUME AND ASSOCIATES, ENGINEERS

PRAIRIE ISLAND NUCLEAR PLANT

MATHEMATICAL MODEL

SOUTHWEST VIEW

Attachment 2
Figure 3

JOHN A. BLUME AND ASSOCIATES, ENGINEERS

PRAIRIE ISLAND NUCLEAR PLANT
MATHEMATICAL MODEL
WEST ELEVATION

⬡ - SEE FIGURE NO. 3 FOR CODE

NO SCALE