Docket file

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 31, 1994

Docket No. 50-336

LICENSEE: Northeast Nuclear Energy Company

FACILITY: Millstone, Unit 2

SUBJECT: SUMMARY OF PUBLIC MEETING OF MARCH 18, 1994, WITH REPRESENTATIVES OF NORTHEAST UTILITIES TO DISCUSS A PROPOSED SEISMIC RESPONSE SPECTRA FOR USE IN A-46 EVALUATIONS FOR MILLSTONE UNIT NO. 2 (TAC NO. M69459)

INTRODUCTION

On March 18, 1994, representatives of the NRC and Northeast Nuclear Energy Company (NNECO) met in the NRC offices in Rockville, Maryland, to discuss a proposed method to develop seismic response spectra for use in A-46 evaluations for Millstone Unit No. 2. NNECO's purpose for the meeting was to present a technical justification of an approach to be used at Millstone Unit No. 2 for developing realistic in-structure response spectra for the Auxiliary Building equipment located at elevations 40 feet or greater above ground level. The attendance list is provided in Enclosure 1. Enclosure 2 provides the agenda and copies of the viewgraphs supporting the licensee's presentation.

DISCUSSION

The auxiliary building that houses much of the electrical and mechanical equipment of concern is founded on rock at elevations -45'-6" and -25'-6". Because of the effective separation of the foundation walls from the backfill with a 1/2 inch crushable Homasote material, the effective grade is at elevation -25'6". The electrical equipment of concern is above elevation 14'0" which would place the equipment 40 ft. above the effective grade. The GIP-2 criteria (Section 4.2) only allows equipment to be evaluated within 40 ft. of grade. NNECO proposes to use realistic median-centered in-structure response spectra to define the demand level as allowed by the GIP. NNECO would develop these curves in compliance with the Standard Review Plan and the GIP and treat them as median-centered response spectra. It appears that it might be a slight reduction in ground motion. Most structures are in the 5-10 hz range. Because the diesel generators and associated equipment are founded on earth material, the staff suggested the evaluation in the 1 hz range be included. NNECO indicated that the results will be at least as good as the average of the 69 eastern sites. NNECO emphasized that the use of this methodology for the A-46 analysis would not modify or reduce the design basis. NNECO'smain concern is the qualification of electrical equipment such as relays. They believe all anchorages of larger equipment are very conservative.

The staff indicated no immediate objection but would expect a more formal and detailed proposal of the total scope including specific examples of the application of the proposed methodology. The staff emphasized that there could be no reduction in margin.

NNECO indicated that the walkdowns will be performed during the next refueling outage which is scheduled for July 1994 and the final report will be issued 180 days following the end of the outage (approximately March 1995). NNECO proposes to submit a formal request for staff review and acceptance of their proposed methodology in June 1994.

Original signed by:

Guy S. Vissing, Senior Project Manager
Project Directorate I-4
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Enclosures:
1. Attendees
2. Agenda and Viewgraphs

cc w/enclosures:
See next page

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WRussell/FMiraglia
LReyes
SVarga
JCalvo
SNorris
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GBagchi
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VMcCree, EDO

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|---|---|---|---|---|---|
| NAME: | SNorris | GVissing:bp | JStolz | | |
| DATE: | 3/31/94 | 3/31/94 | 3/31/94 | | |

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Project Directorate I-4
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

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cc w/enclosures:
Sec next page

Millstone Nuclear Power Station
Unit 2

cc:

Gerald Garfield, Esquire
Day, Berry and Howard
Counselors at Law
City Place
Hartford, Connecticut 06103-3499

J. M. Solymossy, Director
Nuclear Quality and Assessment Services
Northeast Utilities Service Company
Post Office Box 270
Hartford, Connecticut 06141-0270

Kevin T. A. McCarthy, Director
Monitoring and Radiation Division
Department of Environmental Protection
79 Elm Street
Hartford, Connecticut 06106-5127

Allan Johanson, Assistant Director
Office of Policy and Development
Policy Development and Planning Division
80 Washington Street
Hartford, Connecticut 06106

S. E. Scace, Vice President
Nuclear Operations Services
Northeast Utilities Service Company
Post Office Box 270
Hartford, Connecticut 06141-0270

G. H. Bouchard, Nuclear Unit Director
Millstone Unit No. 2
Northeast Nuclear Energy Company
Post Office Box 128
Waterford, Connecticut 06385

Nicholas S. Reynolds
Winston & Strawn
11400 L Street, NW
Washington, DC 20005-3502

Mr. John F. Opeka
Executive Vice President, Nuclear
Connecticut Yankee Atomic Power Company
Northeast Nuclear Energy Company
Post Office Box 270
Hartford, Connecticut 06141-0270

R. M. Kacich, Director
Nuclear Planning, Licensing & Budgeting
Northeast Utilities Service Company
Post Office Box 270
Hartford, Connecticut 06141-0270

J. P. Stetz, Vice President
Haddam Neck Plant
Connecticut Yankee Atomic Power Company
362 Injun Hollow Road
East Hampton, Connecticut 06424-3099

Regional Administrator
Region I
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, Pennsylvania 19406

First Selectmen
Town of Waterford
Hall of Records
200 Boston Post Road
Waterford, Connecticut 06385

P. D. Swetland, Resident Inspector
Millstone Nuclear Power Station
c/o U.S. Nuclear Regulatory Commission
Post Office Box 513
Niantic, Connecticut 06357

Charles Brinkman, Manager
Washington Nuclear Operations
ABB Combustion Engineering
Nuclear Power
12300 Twinbrook Pkwy, Suite 330
Rockville, Maryland 20852

Donald B. Miller, Jr.
Senior Vice President
Millstone Station
Northeast Nuclear Energy Company
Post Office Box 128
Waterford, Connecticut 06385

Enclosure 1

ATTENDANCE LIST
FOR
A MEETING WITH REPRESENTATIVES
OF
NORTHEAST NUCLEAR ENERGY COMPANY
TO DISCUSS
SEISMIC ANALYSIS FOR MILLSTONE 2
DOCKET NO. 50-336

| NAME | ORGANIZATION |
|---|---|
| Guy S. Vissing | NRC/NRR/PDI-4 |
| Goutam Bagchi | NRC/NRR/DE |
| Robert Rothman | NRC/NRR/DE |
| Steve Wainid | Northeast Utilities |
| Sombat Pornprasert | Northeast Utilities |
| Everett P. Perkins, Jr. | Northeast Utilities |
| Charbel M. Abou-Jadude | Vectra Technologies/Nu |
| Robert P. Kennedy | Struct. Mech. Consulting |

Enclosure 2

# DEVELOPMENT OF IN-STRUCTURE SPECTRA FOR USE IN A-46 EVALUATIONS MILLSTONE UNIT 2

Docket No. 50-336

PRESENTED TO:
U. S. NUCLEAR REGULATORY COMMISSION

PRESENTED BY:
NORTHEAST NUCLEAR ENERGY COMPANY

MARCH 18, 1994

## MEETING PARTICIPANTS

### NORTHEAST NUCLEAR ENERGY COMPANY

**S. W. WAINIO**
Supervisor, Mechanical Engineering
**E. P. PERKINS**
Supervisor, Nuclear Licensing
**G. PAPANIC JR.**
Senior Engineer, Nuclear Licensing
**S. PORNPRASERT**
Senior Engineer, Stress Analysis Eng.

### VECTRA TECHNOLOGIES INC.

**C. M. ABOU-JAOUDE**
**Dr. S. N. DERMITZAKIS**

### RPK STRUCTURAL MECHANICS CONSULTING

**Dr. R. P. KENNEDY**

# PURPOSE OF MEETING

* Update the NRC Staff on the current status of the implementation of the GIP-2 methodology at Millstone Unit No. 2, and

* Present a technical justification of an approach for developing realistic in-structure response spectra for the Auxiliary Building equipment excluded from the GIP-2 methodology due to the 40 foot criteria.

# AGENDA

* **Introduction**
  G. Papanic

* **Objective and Background**
  S. W. Wainio

* **Development of In-Structure Spectra for Use in A-46 Evaluations, Millstone Unit 2**
  R. P. Kennedy

* **Conclusion**
  S. W. Wainio

* **Questions and Answers - Open Discussion**

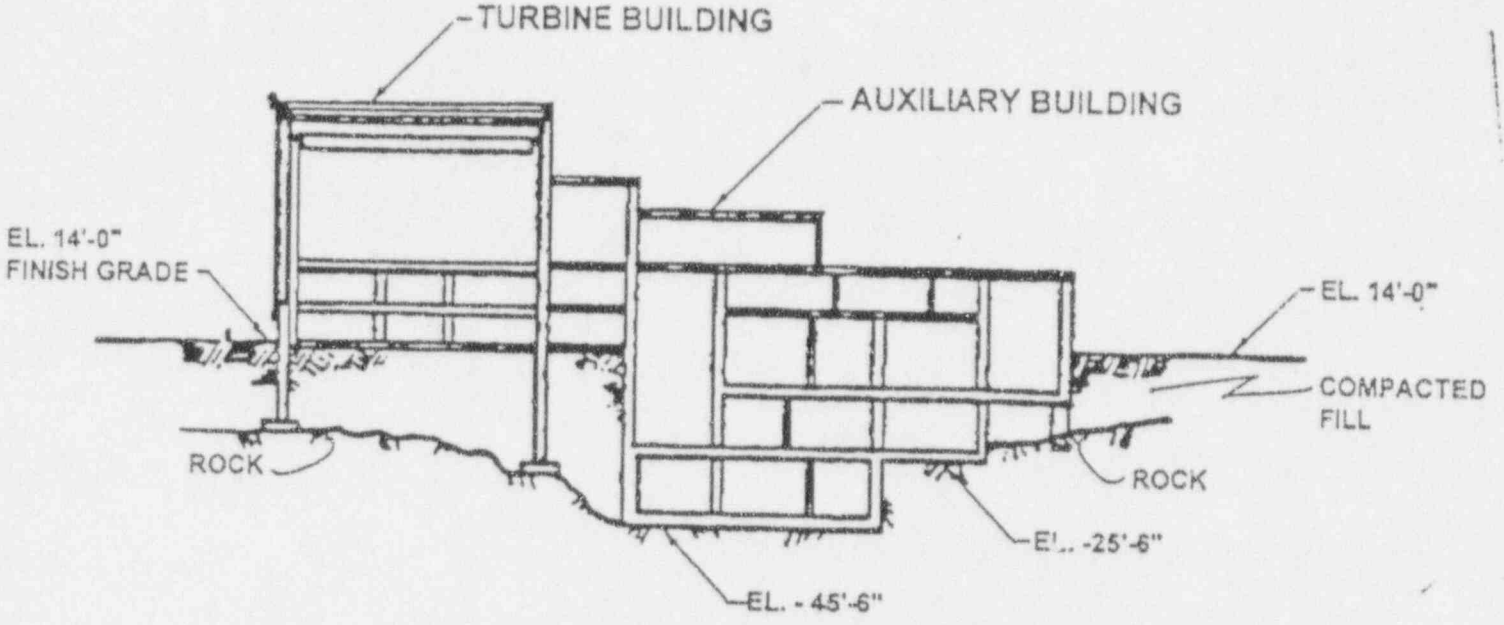
* **Final Summary**
  G. Papanic

## OBJECTIVE

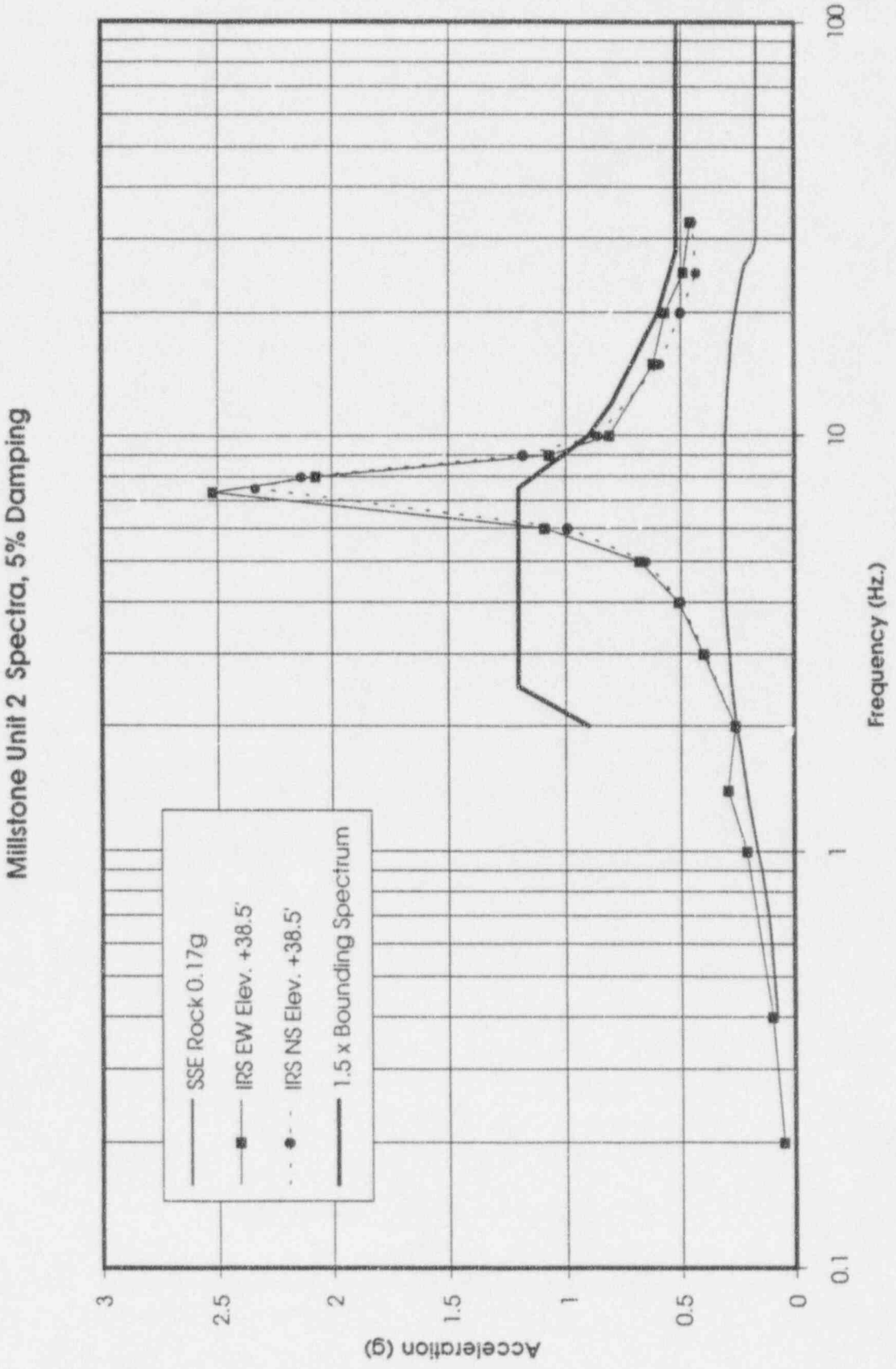
* Develop new realistic in-structure response spectra for Millstone Unit 2 A-46 evaluations.

* The generated in-structure response spectra will be utilized as median spectra.

* Need to re-evaluate ground response for purposes of generating in-structure response spectra.




SECTION THROUGH TURBINE AND
AUXILIARY BUILDING LOOKING NORTH


Millstone Unit 2 Spectra, 5% Damping
SSE Rock 0.17g
IRS EW Elev. +38.5'
IRS NS Elev. +38.5'
1.5 x Bounding Spectrum
Acceleration (g)
Frequency (Hz.)
0
0.5
1
1.5
2
2.5
3
0.1
1
10
100

# BACKGROUND

* Site Profile:

  - Rock site with approximately 40 feet of backfill soil.

  - Backfill soil has low-strain shear wave velocity of 1000 ft/sec at the ground surface. Rock shear wave velocity is between 5500-7500 ft/sec.

  - Nuclear Island structures are founded on rock (40 feet below ground surface)

* The Design SSE ground motion at Millstone Unit 2 is 0.17g.

* There are two free-field spectra defined for SSE:

  - Free-field Motion at Foundation Level (on Rock)

    Housner-type shape enriched in high frequencies and anchored at 0.17g

  - Free-field Motion at Surface of Soil

    Spectral shape shown anchored at 0.17g

* Comments on SSE Design spectra when compared to modern criteria:

  - The Housner-type spectrum enriched in high frequencies is a reasonable spectral shape for Eastern U.S. sites.

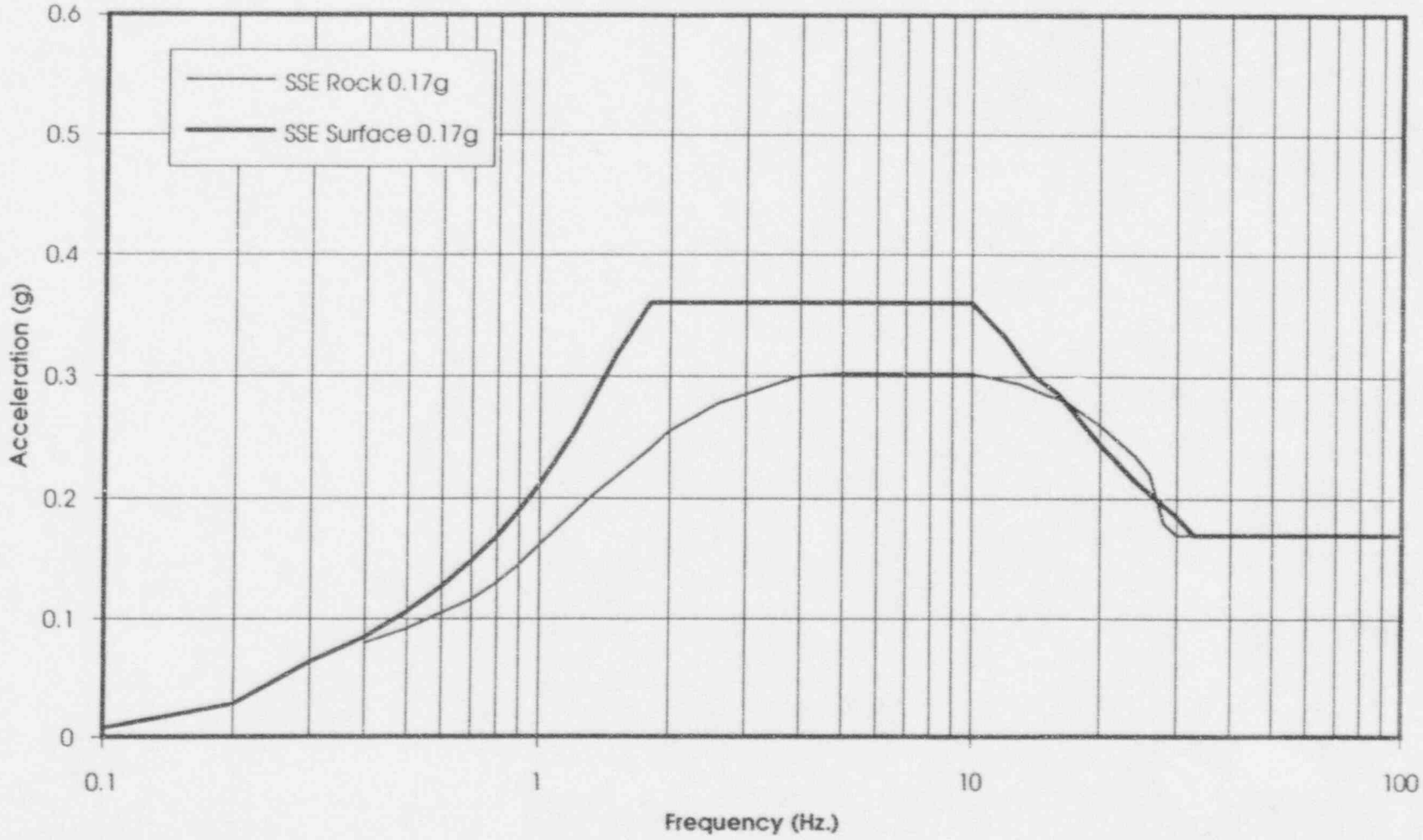
  - If the free-field motion at the foundation level (rock) is 0.17g, the free-field motion at the ground surface cannot be 0.17g. Therefore, one of the two motions is not consistent.

  - The free-field motion at the ground surface has low frequency content for a site with 40 feet of backfill material on top of rock.

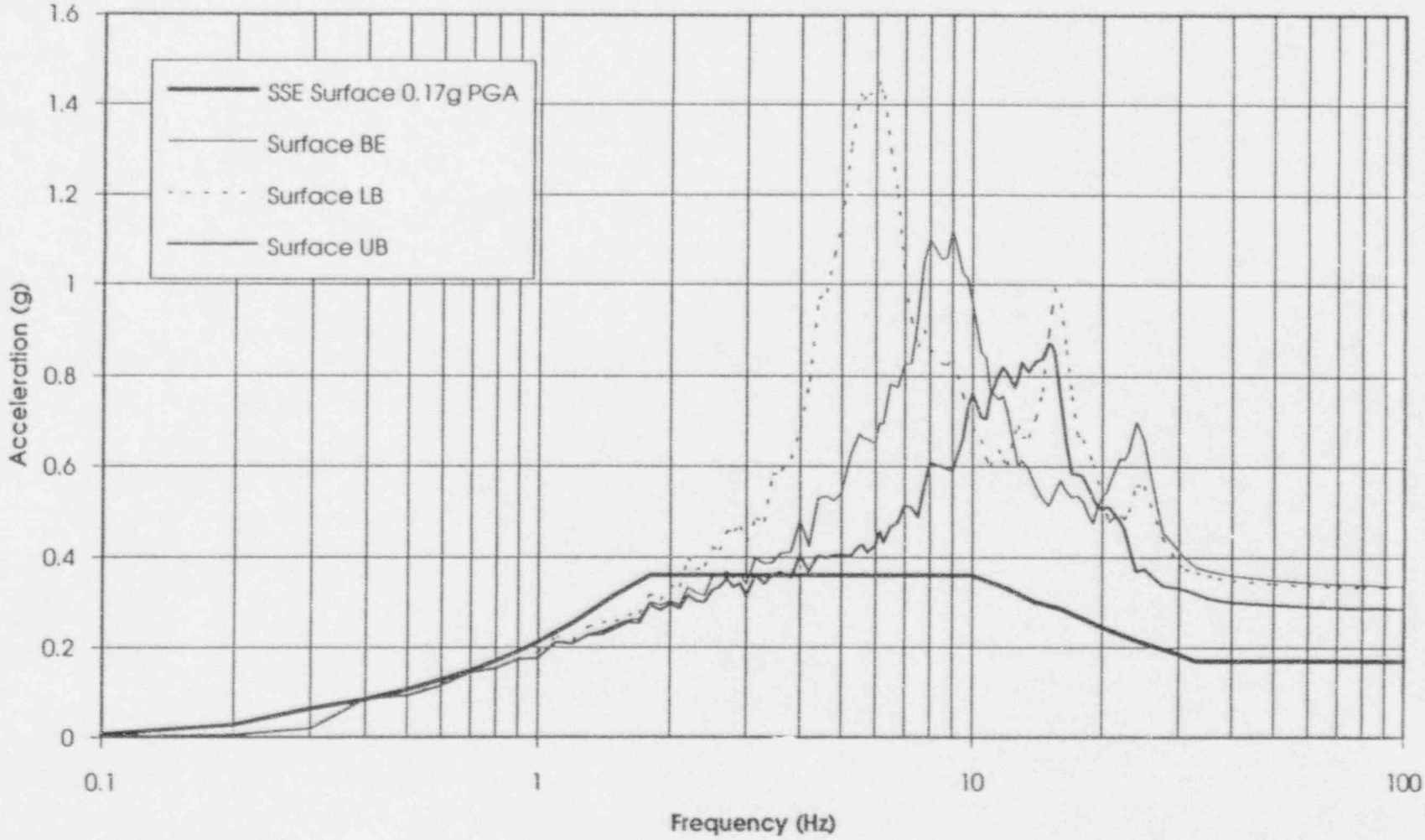
* For A-46 evaluations, need to re-evaluate the ground motions for use in the generation of in-structure spectra.

  The control motions considered in A-46 are <u>not</u> being proposed as a change in the current Millstone <u>licensing</u> requirements. They will <u>only</u> be used in the A-46 program.

## Millstone Unit 2 Site, Free-field Spectra, 5% Damping



## Millstone Unit 2 Site, Free-Field Spectra, 5% Damping



## GROUND MOTION FOR A-46

* Criteria used in establishing a ground motion for A-46:

  - Re-evaluate motion for rock.

  - Evaluate the rock motion as a rock outcrop motion conforming to the following two criteria:

    1. Assess whether, when this motion is used as a rock outcrop for this site, the resulting surface motion exceeds the NUREG/CR-0098 84th percentile spectrum anchored to 0.17g over the frequency range of interest (5 to 33 Hz).

       Note that the NUREG/CR-0098 84th percentile spectrum anchored to 0.17g exceeds the Design basis SSE spectrum of the ground surface.

    2. Assess whether the annual probability of exceedence over the 5 Hz and 10 Hz spectral accelerations is no more than the median of the 69 Eastern U.S. sites studied by LLNL and EPRI.

       (Compute the average acceleration between 5 and 10 Hz and take higher of two studies)

* Results from two criteria:

1. Soil analysis performed by using proposed motion as rock outcrop motion and convolution to ground surface. Also performed soil variation analyses by considering UB and LB soil properties as twice and half the BE soil stiffness.

   Seed & Idriss upper bound stiffness degradation and lower bound damping curves were used for strain-iteration of soil properties.

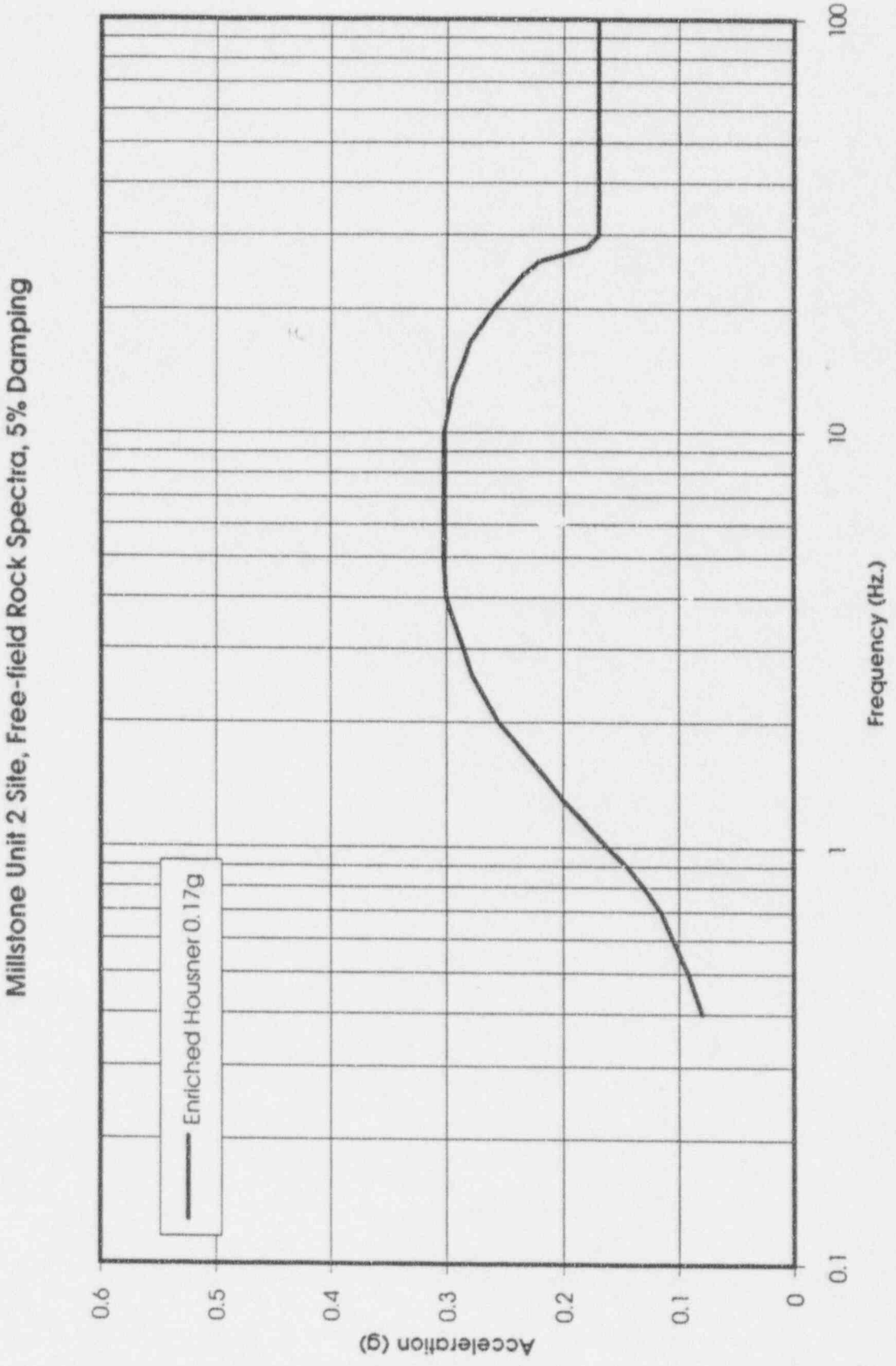
   Ground surface motion is generated from 0.17g enriched Housner motion applied at rock outcrop.

## 2. Results from LLNL and EPRI

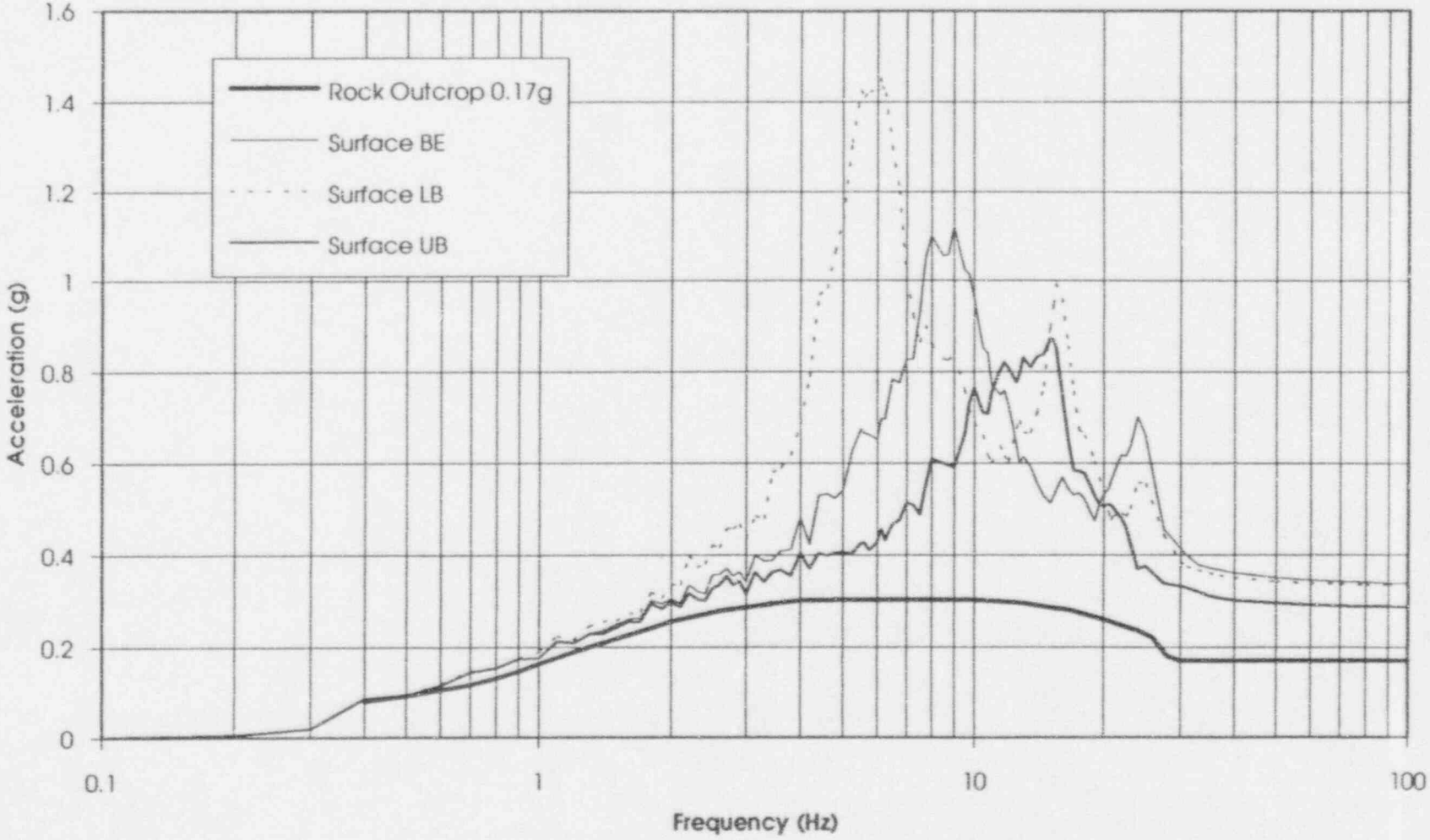
| Hazard Analysis | Annual Probability of Exceedance Limits for Median Hazard Estimates |
|---|---|
| LLNL | $10^{-4}$ |
| EPRI | $3 \times 10^{-5}$ |

| Hazard Analysis | Spectral Velocity @ 5 Hz (cm/s) | Spectral Velocity @ 10 Hz (cm/s) | Spectral Accel. @ 5 Hz (g) | Spectral Accel. @ 10 Hz (g) | Avg Accel. @ 5 Hz & 10 Hz (g) |
|---|---|---|---|---|---|
| LLNL @ $10^{-4}$ exceedance probability | 8.18 | 5.18 | 0.26 | 0.33 | 0.30 |
| EPRI @ $3 \times 10^{-5}$ exceedance probability | 5.28 | 4.62 | 0.17 | 0.30 | 0.23 |

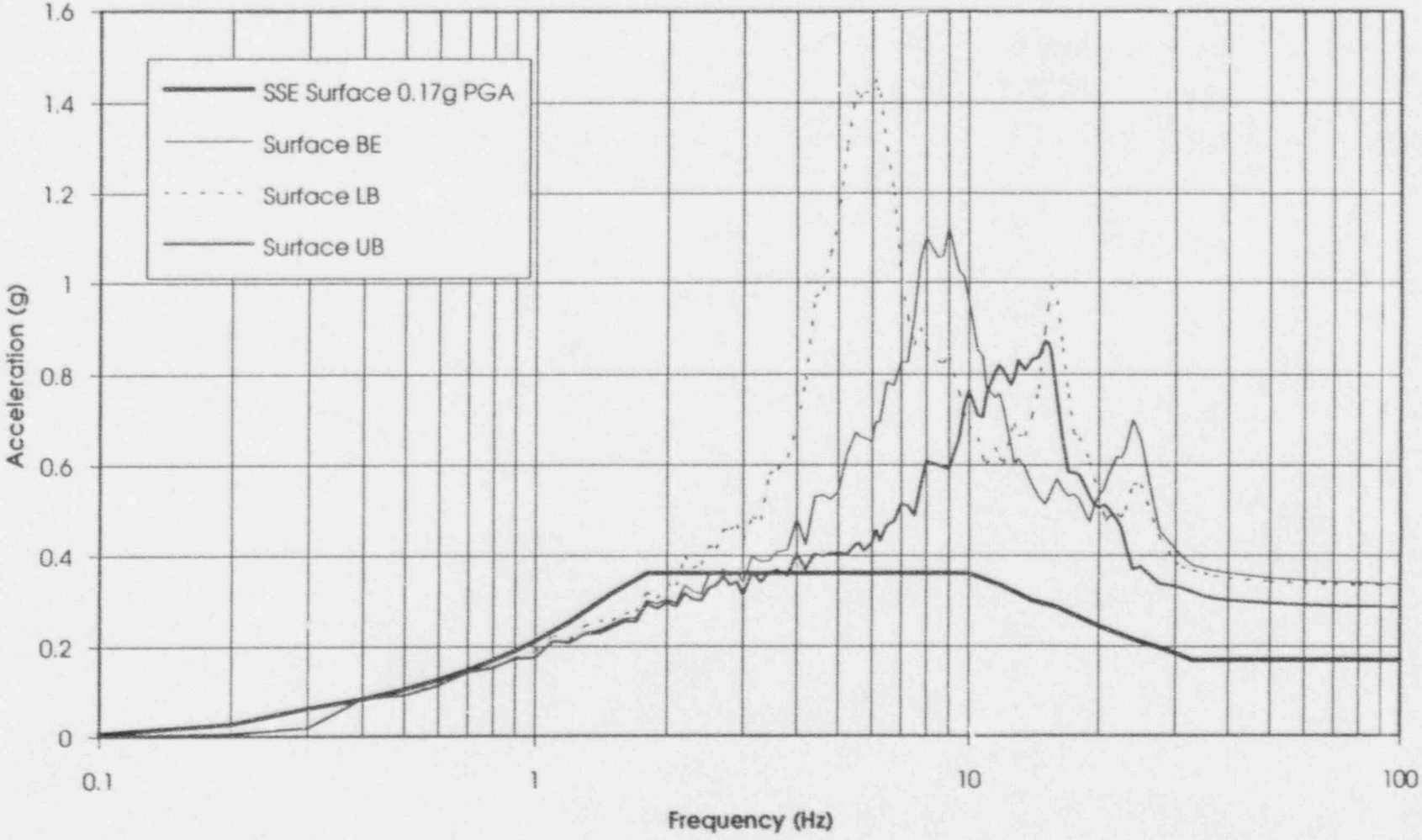
**Accel. from LLNL & EPRI @ 5 and 10 Hz = 0.30g**
**Accel. from enriched Housner @ 5 and 10 Hz = 0.30g**


Millstone Unit 2 Site, Free-field Rock Spectra, 5% Damping
Enriched Housner 0.17g
Acceleration (g)
0.6
0.5
0.4
0.3
0.2
0.1
0
0.1
1
10
100
Frequency (Hz.)

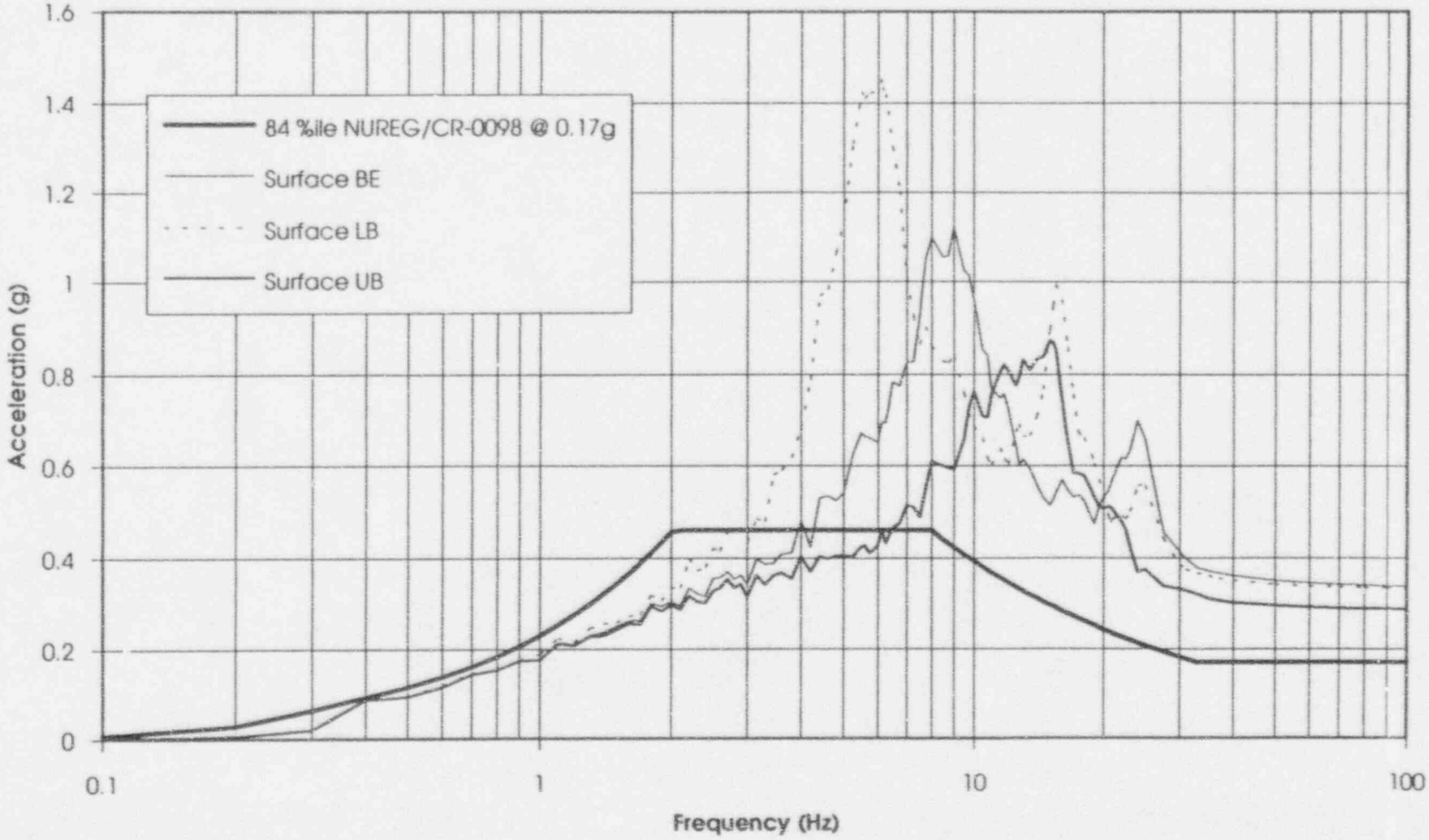
## Millstone Unit 2 Site, Free-Field Spectra, 5% Damping



## Millstone Unit 2 Site, Free-Field Spectra, 5% Damping



## Millstone Unit 2 Site, Free-Field Spectra, 5% Damping



* Therefore, using the enriched Housner shape anchored at 0.17g as the rock motion, all the criteria are met.

  At the ground surface, the motion is significantly higher than both the SSE and the NUREG/CR-0098 84th percentile anchored at 0.17g at all frequencies above 3 Hz.

* The rock outcrop motion will be directly applied to the structure in a fixed-base analysis. No radiation through the embedment will be considered.

## CONCLUSION

* The proposed control motion is the enriched Housner at 0.17g applied at the rock.

* The proposed motion is similar in conservatism to the average of the 69 U.S. sites studied by LLNL and EPRI.

* The proposed rock motion is acceptable for A-46 utilization.

## AUXILIARY BUILDING SEISMIC ANALYSIS FOR A-46

* Perform fixed-base analysis. No SSI effects will be considered.

* Use the rock outcrop motion as direct input to the base of the Auxiliary Building.

* Use a suite of 30 time histories. The median 5% damped spectra of the 30 time histories will closely approximate the target rock outcrop motion. The in-structure spectra will be the median in-structure spectra generated from the analyses using the suite of 30 time histories.

* For the structures assume lognormal distribution of properties with the following variability in model parameter values:

  - Median Structural Damping of 7% with $\beta$=0.35

  - Best Estimate Stiffness with Struct. Frequency $\beta$=0.25