
Division Coordinators:
A.H. HADJIAN, Bechtel Power Corporation, Los Angeles, Ca., U.S.A.
H. SHIBATA, University of Tokyo, Tokyo, Japan
## TABLE OF CONTENTS

### Division K. SEISMIC RESPONSE ANALYSIS OF NUCLEAR POWER PLANT SYSTEMS

#### K(a) Session K1. Ground Motion

<table>
<thead>
<tr>
<th>Paper Number</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>K 1/1*</td>
<td>Analyses on Various Parameters for the Simulation of Three-dimensional Earthquake Ground Motions</td>
<td>M. Watabe, Building Research Institute, Ibaraki, M. Tohdo, Toda Construction Co., Ltd., Tokyo, Japan</td>
</tr>
<tr>
<td>K 1/2</td>
<td>Generation of Simulated Three-dimensional Earthquake Ground Motions</td>
<td>M. Watabe, Building Research Institute, Ibaraki, O. Chiba, M. Tohdo, Toda Construction Co., Ltd., Tokyo, Japan</td>
</tr>
<tr>
<td>K 1/3</td>
<td>Primary Variables Influencing Generation of Earthquake Motions by a Deconvolution Process</td>
<td>I.M. Idriss, M.R. Akky, Woodward-Clyde Consultants, San Francisco, California, U.S.A.</td>
</tr>
<tr>
<td>K 1/4</td>
<td>Phase Characteristics of Earthquake Accelerogram and Its Application</td>
<td>Y. Ohsaki, R. Iwasaki, I. Ohkawa, University of Tokyo, Tokyo, T. Masao, Nuclear Power Plant Division, Fujita Corporation, Tokyo, Japan</td>
</tr>
<tr>
<td>K 1/5</td>
<td>Artificial Accelerograms for Multiaxial Earthquake Excitation</td>
<td>P. Degen, Motor-Columbus Consulting Engineers, Inc., Baden, Switzerland withdrawn</td>
</tr>
<tr>
<td>K 1/7</td>
<td>Hysteresis Behaviour of Soils and Rocks</td>
<td>T. Hueckel, Polish Academy of Sciences, Institute of Fundamental Technological Research, Warsaw, Poland</td>
</tr>
<tr>
<td>K 1/8</td>
<td>A Model for Soil Behavior under Monotonic and Cyclic Loading Conditions</td>
<td>Y.F. Dafalias, University of California, Davis, California, U.S.A.</td>
</tr>
<tr>
<td>K 1/10</td>
<td>A Class of Models for Identification and Simulation of Earthquake Ground Motions</td>
<td>R.M. Oliver, K.S. Pister, University of California, Berkeley, California, U.S.A.</td>
</tr>
</tbody>
</table>

### Notes:
- The sign (*) designates Invited Lectures.
- A title mentioned on the Table of Contents but not followed by a summary or a paper means that the paper was not available at the time of finishing of the book.
- A paper number missing in the numeral order means that the paper was cancelled or withdrawn.
Session K 2. Risk Analysis I

K 2/1* Probabilistic Seismic Safety Study of an Existing Nuclear Power Plant
R.P. Kennedy, R.D. Campbell, Engineering Decision Analysis Company, Irvine, California,
C.A. Cornell, Massachusetts Institute of Technology, Cambridge, Massachusetts,
H.F. Perla, Pickard, Lowe and Garrick, Inc., Irvine, California, U.S.A.

K 2/2 Probabilistic Approach of Reference Seismic Ground Motions
D. Costes, C.E.A./CEN-DSN, Fontenay-aux-Roses, France

K 2/3 Probabilistic Evaluation of the SSE Design Spectrum for a Nuclear Power Plant Site: A Case Study
R. Wheaton, A. Vaish, EDS Nuclear, Inc., San Francisco, California,
C.B. Crouse, Fugro, Inc., Long Beach, California,
R. Guzman, Consultant, Long Beach, California, U.S.A.

K 2/4 A Method for the Estimation of the Probability of Damage due to Earthquakes

K 2/5 Probability of Failure of Piping Designed to Seismically Induced Emergency and Faulted Condition Limits
M. Gorman, Case Western Reserve University, Cleveland, Ohio,
J.D. Stevenson, J.D. Stevenson Consultants, Cleveland, Ohio, U.S.A.

K 2/6 On a Method of Evaluation of Failure Rate of Equipment and Pippings under Excess-Earthquake Loadings
H. Shibata, Institute of Industrial Science, University of Tokyo, Tokyo,
H. Okamura, University of Tokyo, Tokyo, Japan

K 2/7 KTA 2201 – Seismic Design Standards in the Federal Republic of Germany

K 2/8 The MCE (Maximum Credible Earthquake) – An Approach to Reduction of Seismic Risk
G.J.K. Asmis, R.J. Atchison, Atomic Energy Control Board, Ottawa, Ontario, Canada

Session K 3. Risk Analysis II

K 3/1* An Overview of the Seismic Safety Margins Research Program
R.D. Smith F.J. Tokarz, Lawrence Livermore Laboratory, Livermore, California, U.S.A.

K 3/2 Systems Analysis Methods Used in the Seismic Safety Margins Research Program
G.E. Cummings, J.E. Wells, Lawrence Livermore Laboratory, Livermore, California, U.S.A.
K 3/3 Development of Seismic Input for Use in the Seismic Safety Margins Research Program
D.L. Berreuter, D.H. Chung, Lawrence Livermore Laboratory, Livermore, California, U.S.A.

K 3/4 Expert Opinion Encoding in Seismic Hazard Analysis
C.P. Mortgat, K.W. Campbell, TERA Corporation, Berkeley, California.
D.L. Berreuter, Lawrence Livermore Laboratory, Livermore, California, U.S.A.

K 3/5 Attenuation Relationships of Peak Ground Acceleration Versus Magnitude and Distance Considering Magnitude and Distance as Random Variables
C. P. Mortgat, TERA Corporation, Berkeley, California,
D.L. Berreuter, Lawrence Livermore Laboratory, Livermore, California, U.S.A.

K 3/6 Soil Structure Interaction Analysis for the US NRC Seismic Safety Margins Research Program
J.J. Johnson, Lawrence Livermore Laboratory, Livermore, California, U.S.A.

K 3/7 Major Structural Response Methods Used in the Seismic Safety Margins Research Program
C.K. Chou, T.Y. Lo, V.N. Vagliente, Lawrence Livermore Laboratory, Livermore, California, U.S.A.

K 3/8 Subsystem Response Determination for the US NRC Seismic Safety Margins Research Program
J.J. Johnson, Lawrence Livermore Laboratory, Livermore, California, U.S.A.

K 3/9 Definition of Component and Structural Fragility for Use in the Seismic Safety Margins Research Program
R.G. Dong, Lawrence Livermore Laboratory, Livermore, California, U.S.A.

K 3/10 Reserve Seismic Capacity Determination of a Nuclear Power Plant Braced Frame with Piping
T.A. Nelson, Lawrence Livermore Laboratory, Livermore, California, U.S.A.

Session K 4. Design Concepts

K 4/1* On Fundamental Concept of Anti-Earthquake Design of Equipment and Pipings
H. Shibata, Institute of Industrial Science, University of Tokyo, Tokyo,
M. Kato, Japan Atomic Power Company, Tokyo, Japan

K 4/2 Integrated Structural Design of Nuclear Power Plants for High Seismic Areas
K 4/3 Concepts for Seismic Response Attenuation of Nuclear Power Plant Containments
P.J. Richter, *Fluor Engineers and Constructors, Inc., Irvine, California,*
W.A. von Riesemann, *Sandia Laboratories, Albuquerque, New Mexico, U.S.A.*

K 4/4 Alternative Structural Systems for High Density Fuel Storage Racks in Existing Facilities
J.W. Reed, F.A. Webster, *Engineering Decision Analysis Co., Inc., Palo Alto, California,*
P.C. Sun, *Nuclear Energy Operation, General Electric Co., San Jose, California, U.S.A.*

K 4/5 Considerations in the Design of Nuclear Power Plants in High Seismic Regions. Part 1: Station Arrangements. Part 2: Component Qualification
A.K. Banerjee, M.B. Stetson, C.F. Reeves, *Stone & Webster Engineering Corporation, Boston, Massachusetts, U.S.A.*

K 4/6 An Investigation into Seismic Design Feasibility of Pool-Type LMFBR's
N. Pal, M. Dostal, *General Electric Company, Advanced Reactor Systems Department, Sunnyvale, California, U.S.A.*

K 4/7 Probabilistic Seismic Fluid-Structure Interaction of Floating Nuclear Plants Platforms
M. Arockiasamy, P.V. Thangam Babu, D.V. Reddy, *Memorial University of Newfoundland, St. Johns, Newfoundland, Canada*

**Session K 5. Soil-Structure Interaction I**

K 5/1* Travelling Wave Effects in Soil-Structure Interaction
J.P. Wolf, P. Obernhuber, *Electrowatt Engineering Services Ltd., Zürich, Switzerland*

K 5/2 Seismic Input for Soil Structure Interaction Analysis
E. Berger, *Dames & Moore, Inc., San Francisco, California,*
H.B. Seed, University of California, Berkeley, California, U.S.A.,
J.D. Renard, Electrobel S.A., Bruxelles, Belgium

K 5/3 Soil-Structure Interaction: Modeling Effects on Structural Response

K 5/4 Investigation of the Treatment of Damping in Soil-Structure Interaction Analysis
Comparison of Soil-Structure Interaction by Different Ground Models
T. Takemori, Y. Kuwabara, Y. Ogiwara, A. Suwabe, Taisei Corporation, Tokyo,
K. Tanaka, Kyushu Electric Power Company, Kyushu, Japan

Torsional Structural Response from Free-Field Ground Motion
P.C. Lam, General Motors Institute, Detroit, Michigan,
R.J. Scavuzzo, The University of Akron, Akron, Ohio, U.S.A.

Seismic Design Method for Arbitrary Propagating Waves
M.M. Ettouney, J.A. Brennan, A.A. Aguero, Burns and Roe, Inc.,
Woodbury, New York, U.S.A.

Session K 6. Soil-Structure Interaction II

Soil Structure Interaction Analyses by Different Methods

Dynamic Interaction of Adjacent Structures Founded on Layered Soil
G. Waas, Hochtief AG, Frankfurt am Main, Fed. Rep. Germany

The Influence of Uplift and Sliding Nonlinearities on Seismic Response of a Small Test Reactor Building
L.J. Cofer, H. Kamil, R.L. Sharpe, Engineering Decision Analysis Company, Inc., Palo Alto, California,
D. Hoggatt, General Electric Company, Vallecitos Nuclear Center,
Pleasanton, California, U.S.A.

Structure-to-Structure Interaction Analysis for a Nuclear Power Plant
C. Mueller, H. Furrer, Motor Columbus Consulting Engineers, Inc.,
Baden, Switzerland

Building-Soil-Building Interaction in Seismic Analysis of Nuclear Power Plants
A. Del Grosso, D. Stura, C. Vardanega, Università di Genova,
Genova, Italy

The Finite Element Complex Response Method for Solving Problems of Embedded Multiple Structures
J.V. Parker, K.M. Ahmed, Nuclear Power Company (Risley) Limited,
Risley, Warrington, Cheshire, U.K.

Investigation of the Influence of Interaction of Two Adjacent Structures on Their Responses
A. Gantayat, H. Kamil, G. Kost, Engineering Decision Analysis Company, Palo Alto, California, U.S.A.,
N. Krutzik, Kraftwerk Union AG, Offenbach,

Nonlinear Analysis of a Deeply Embedded Power Plant Building Subjected to Earthquake Load
S.N. Mukherjee, Brown, Boveri & Cie, Baden, Switzerland
Session K 7. Underground Structures

K 7/1* Earthquake Response of Nuclear Reactor Building Deeply Embedded in Soil
T. Masao, Y. Takasaki, Fujita Corporation, Yokohama,
S. Yamamoto, Y. Koori, Chiyoda Chemical Engineering & Construction Corporation, Kawasaki, Japan

K 7/2 Seismic Response Comparisons for an Embedded High Temperature Gas-Cooled Reactor (HTGR) on a High Seismic Site
W. Schlafer, III, D. Tow, General Atomic Company, San Diego, California,
J.J. Johnson, Lawrence Livermore Laboratory, Livermore, California, U.S.A.

K 7/3 Seismic Stresses in Buried Piping of Arbitrary Configuration
J.J. Deans, J.H.K. Tang, Ontario Hydro, Toronto, Ontario, Canada

K 7/4 Seismic Design of Long Underground Structures
S.N. Pagay, F. Loceff, Westinghouse Electric Corporation, PWR System Division, Pittsburgh, Pennsylvania, U.S.A.

K 7/5 Analytical and Experimental Investigation of the Dynamic Response of Underground Nuclear Power Plants
G.E. Howard, P. Ibáñez, ANCO Engineers, Inc., Santa Monica, California, U.S.A.

K 7/6 Seismic Response Analysis for a Deeply Embedded Nuclear Power Plant
W.W.H. Chen, Bechtel National, Inc., San Francisco, California,
M. Chatterjee, Bechtel Power Corporation, San Francisco, California,
S.M. Day, Systems, Science, and Software, La Jolla, California, U.S.A.

K 7/7 Inelastic Seismic Analysis of a Deeply Embedded Reinforced Concrete Reactor Building
M. Celebi, M. Chatterjee, Bechtel Power Corporation, San Francisco, California,
K. Mark, Bechtel National, Inc., San Francisco, California, U.S.A.

K 7/8 Experimental and Analytical Studies of a Deeply Embedded Reactor Building Model Considering Soil-Building Interaction (Part I)
H. Tanaka, Tokyo Electric Power Co., Ltd., Tokyo,
T. Ohta, S. Uchiyama, Kajima Institute of Construction Technology, Tokyo, Japan

K 7/9 Seismic Response of the 'Cut-and-Cover' Type Reactor Containments Considering Nonlinear Soil Behavior
H. El-Tahan, D.V. Reddy, Memorial University of Newfoundland, St. John's, Newfoundland, Canada