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MEETING MINUTES  
FEBRUARY 14-15, 1985 MEETING OF THE  
COMBINED SUBCOMMITTEE ON GESSAR-II AND  
RELIABILITY AND PROBABILISTIC ASSESSMENT

The ACRS Subcommittees on GESSAR-II and Reliability and Probabilistic Assessment met on February 14-15, 1985 at the Best Western Airport Park Hotel in Englewood, CA. The purpose of this meeting was to continue the Subcommittee review of GESSAR-II for a Final Design Approval applicable to future plants. The principle topic in these discussions was seismic risk. The Subcommittees heard presentations from representatives of NRR, BNL, Jack R. Benjamin and Associates, and General Electric Company. The meeting was begin at 8:30 am on February 14, adjourned at 6:30 pm on February 14, reconvened at 8:30 am on February 15, and adjourned at 12:00 am on February 15. Parts of the meeting were closed for the discussion of proprietary material. The principle attendees were:

D. Okrent, Subcommittee Chairman  
J. Ebersole, ACRS Member  
D. Ward, ACRS Member  
H. Etherington, ACRS Member  
C. P. Siess, ACRS Member

R. Savio, ACRS Staff

M. Bohn, ACRS Consultant

D. Scaletti, NRC Staff  
M. Rubin, NRC Staff

R. Bari, BNL  
K. Shiu, BNL

J. Reed, Jack R. Benjamin & Associates

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J. Quirk, GE  
 R. Villa, GE  
 K. Hollzclaw, GE  
 D. Hankin, GE  
 D. Foreman, GE

Highlights

1. General Electric, as part of their FDA submittal for GESSAR-II, has performed a PRA which includes an assessment of seismic risk. The seismic risk evaluation was performed as a "add-on" to the original PRA and was performed in response to a NRC Staff request. The NRC Staff is having BNL perform the technical review of both the PRA and the seismic risk appendix.
2. GESSAR-II, as a standard plant design, does not have a specific site for which a seismic hazard (i.e., the estimated frequency of occurrence for a spectrum of earthquakes) can be developed. Soil and foundation conditions could also vary for different sites. A seismic risk evaluation, to be useful, would have to establish the level of risk associated with the plant and what the significant seismic vulnerabilities existed in the design. A suitable "envelope" of seismic hazard functions and soil and foundation conditions would be required. The potential seismic risk contribution of those parts of the plant which were outside of the scope of the GESSAR-II design would need to be established and controlled via interface requirements. The intent would be to provide assurance at this stage in the licensing that the seismic design would be adequate and well conceived and to identify improvements at a preconstruction stage.
3. General Electric described the methodology which was used in their seismic risk evaluation. A seismic hazard curve was developed with the intent of encompassing most of the possible sites in the

Eastern United States. This hazard curve is shown on Figure 1 and compared to seismic hazard curves used in other industry PRA's. Figure 2 contains a more complete collection of seismic hazard curves, including a number which were generated in recent LLNL evaluation. The curves generally represent best estimates accompanied by large uncertainties and are generally based on surveys of expert opinion.

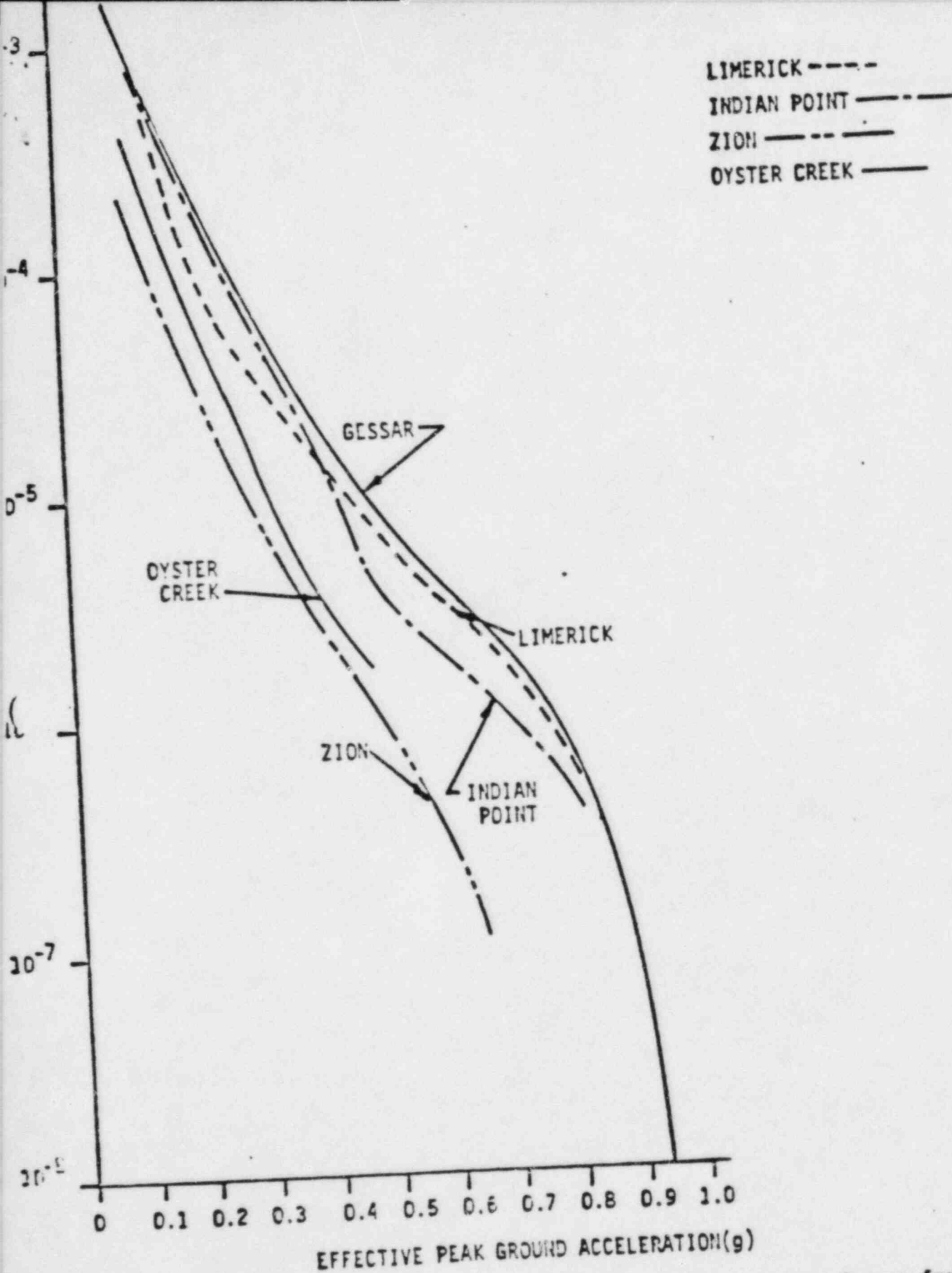
4. General Electric has, based on expected performance, developed fragility requirements for critical structures and components in the GESSAR-II design and has established these values as specification requirements. BNL in their evaluation of GESSAR-II has concluded that the fragility of the GESSAR structures and components could in many cases be expected to be lower than what GE has established. The NRC Staff is proposing that the Applicant referencing GESSAR-II either use the BNL estimates in their seismic evaluation or provide additional justification that the use of the GE estimates is appropriate. A comparison of the BNL and GE fragilities is given in Figure 3.
5. BNL has nearly completed their review of the GE GESSAR-II seismic risk analysis. They have concluded that the GE analysis is less detailed than other seismic risk evaluations which have been performed and that additional work needs to be performed before the GE evaluation is useful in representing the core damage risk from a seismic event. The seismic hazard, fragility, and systems analysis areas were all found to be deficient in some ways. BNL performed their own analysis and concluded that the core damage frequency varies from  $10^{-6}$ /reactor year to  $10^{-3}$ /reactor for the range of fragility estimates and seismic hazard curves used to describe sites in the Eastern United States. This would leave earthquakes as a potentially significant contributor to the frequency of core melt for some sites. BNL identified two potential suppression pool

bypass sequences (collapse of part of the suppression pool wall and draining of the suppression pool through a failed RHR heat exchanger) which were not considered by GE. GE is currently reviewing the implications of BNL findings on potential suppression pool bypass.

6. The NRC Staff and BNL have evaluated the differences between the GE and BNL results. GE has calculated the frequency of core melt from an earthquake (using the GESSAR-II hazard curve) at  $6 \times 10^{-7}$ /reactor year (point estimate). The BNL modifications of the GE system analysis would increase the core melt reactor year frequency to  $6.3 \times 10^{-6}$ /reactor year. Using the BNL fragilities would increase the core melt frequency by about a factor of 10, from  $6.3 \times 10^{-6}$ /reactor year to  $6.7 \times 10^{-5}$ /reactor year. The use of "worst-case" fragility values and unfavorable siting conditions could increase this point estimate to approximately  $10^{-3}$ /reactor year (which would exceed the proposed Commission Safety Policy core melt guideline of  $10^{-4}$ /reactor year for all contributors). The inclusion of relay chatter in the analysis accounted for much of the increase BNL's in estimates of core melt frequency.
7. The significance of relay chatter was discussed to some extent. Relay chatter has been treated either superficially or not at all in the seismic PRA's which have been performed to date. The degree to which relay chatter will affect the performance of the reactor is dependent on the configuration of the individual circuits. Circuits which well "trip" or "latch" with a single relay contact accuation would have the most serious effect. Solid state relay may also malfunction in an earthquake.

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NOTE: Additional meeting details can be obtained from a transcript of this meeting available in the NRC Public Document Room, 1717-H Street, N.W., Washington, D.C., or can be purchased from ACE-Federal Reporters, 444 North Capitol Street, Washington, D.C., 20001, (202) 347-3700.



GESSAR II Seismic Hazard Curve Compared to Hazard Curves from other Studies.

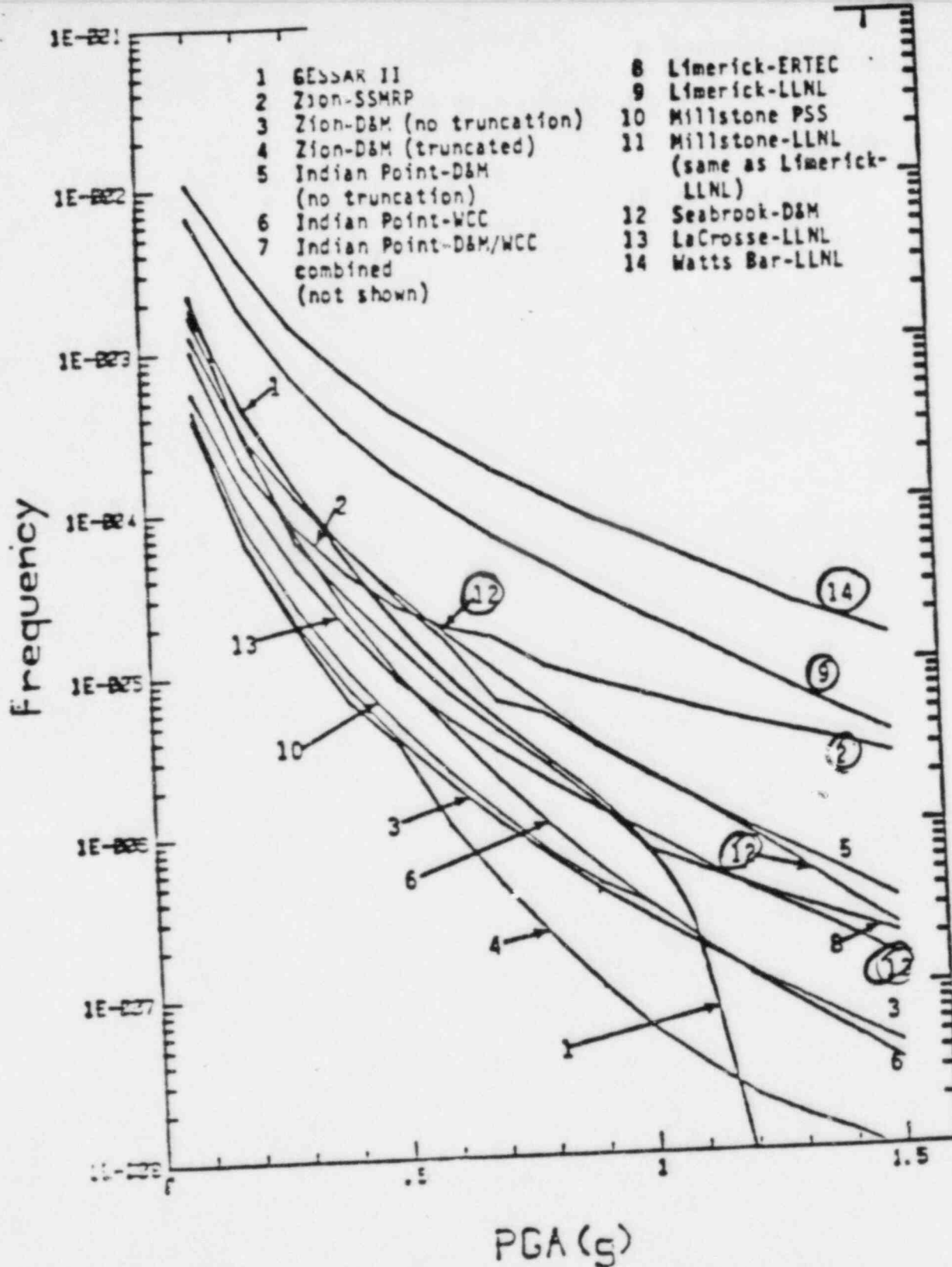


Figure 2-2. Comparison of the GESSAR II best-estimate hazard curve to the results of other scientific hazard studies.



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