UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

May 8, 2006

MEMORANDUM TO: ACRS Members

FROM: David C. Fischer, Senior Staff Engineer
Technical Support Staff
ACRS/ACNW

SUBJECT: CERTIFICATION OF THE MINUTES OF THE EARLY SITE PERMITS SUBCOMMITTEE MEETING ON CLINTON, MARCH 8, 2006, ROCKVILLE, MARYLAND

The minutes of the subject meeting were certified on May 5, 2006, as the official record of the proceedings of that meeting. A copy of the certified minutes is attached.

Attachment: As stated

cc w/o Attachment:
J. Larkins
A. Thadani
M. Snodderly
S. Duraiswamy
E. Thornsbury

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WASHINGTON, DC 20555 - 0001

May 5, 2006

MEMORANDUM TO: David C. Fischer, Senior Staff Engineer
Technical Support Staff, ACRS

FROM: Dana Powers, Chairman
ACRS Early Site Permit Subcommittee

SUBJECT: CERTIFICATION OF THE MINUTES OF THE ACRS SUBCOMMITTEE MEETING ON THE CLINTON EARLY SITE PERMIT APPLICATION, MARCH 8, 2006, ROCKVILLE, MARYLAND

I hereby certify, to the best of my knowledge and belief, that the minutes of the subject meeting on March 8, 2006, are an accurate record of the proceedings for that meeting.

Dana Powers 5/5/06

Dana Powers, Date
Early Site Permit Subcommittee Chairman

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

April 20, 2006

MEMORANDUM TO: Dana Powers, Chairman
ACRS Early Site Permit Subcommittee

FROM: David C. Fischer, Senior Staff Engineer
Technical Support Staff
ACRS/ACNW

SUBJECT: WORKING COPY OF THE MINUTES OF THE ACRS EARLY SITE PERMITS SUBCOMMITTEE MEETING ON CLINTON, MARCH 8, 2006, ROCKVILLE, MARYLAND

A working copy of the minutes of the subject meeting is attached for your review. Please review and comment on them at your earliest convenience. If you are satisfied with these minutes please sign, date and return the attached certification letter.

Attachment: Certification Letter
Minutes (DRAFT)

cc w/o Attachment:
J. Larkins
A. Thadani
M. Snodderly
S. Duraiswamy
E. Thornsbury

Working Draft

Issued: 4/20/2006

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
EARLY SITE PERMITS SUBCOMMITTEE MEETING MINUTES
MARCH 8, 2006
ROCKVILLE, MARYLAND

INTRODUCTION

The ACRS Subcommittee on Early Site Permits met on March 8, 2005, at 11545 Rockville Pike, Rockville, Maryland, in Room T-2B3. The purpose of this meeting was to hear a briefing by and hold discussions with representatives of the NRC staff and Exelon Generation Company, LLC (EGC) regarding the NRC staff's final safety evaluation report and the application submitted by EGC (the applicant) for the Clinton early site permit (ESP). The Subcommittee focused on the applicant's performance-based seismic hazard analysis methodology. The Subcommittee planned to gather information, analyze relevant issues and facts to formulate proposed positions, as appropriate, for deliberation by the full Committee. The entire meeting was open to public attendance. Michael R. Snodderly was the cognizant staff engineer and the Designated Federal Official for this meeting. The Subcommittee received no written comments, or requests for time to make oral statements from any members of the public regarding this meeting. The meeting was convened at 8:30 am and adjourned at 12:04 pm.

ATTENDEES

ACRS

D. Powers, Chairman
T. Kress, Member
W. Shack, Member Member
G. Wallis, Member
M. Snodderly, ACRS Staff
M. Bonaca, Member
O. Maynard, Member
J. Sieber, Member
W. Hinze, Consultant (ACNW)
D. Fischer, ACRS Staff

NRC

L. Dudes, NRR
J. Segala, NRR
C. Munson, NRR
G. Bagchi, NRR
C. Araguas, NRR
A. Murphy, RES
K. Manoly, NRR
T. Cheng, NRR
R. Karas, NRR
J. Trapp, NRR
S. Ali, RES
Y. Li, NRR
R. Lanksbury, RIII

Certified 5/5/06

Issued: 4/20/2006

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
EARLY SITE PERMITS SUBCOMMITTEE MEETING MINUTES
MARCH 8, 2006
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INTRODUCTION

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R. Lanksbury, RIII

ATTENDEES (CONT'D)

OTHERS

M. Kray, Exelon
E. Grant, Exelon
C. Stepp, EHS
C. Ker,r, Exelon
W. Maher,, Exelon
T. Munday, Exelon
L. Cluff, PG&E
R. Kennedy, RPK Structural Mechanics
M. Gavin, CH2M Hill
T. Cerafici, CH2M Hill
K. Hanson, Geomatrix Consultants
R. Young, Geomatrix Consultants

A complete list of attendees is in the ACRS Office file and will be made available upon request. The presentation slides and handouts used during the meeting are attached to the Office copy of these minutes.

OPENING REMARKS BY THE SUBCOMMITTEE CHAIRMAN

Dr. Dana A. Powers, Chairman of the Early Site Permits Subcommittee, stated that the purpose of this meeting was to hear presentations by and hold discussions with representatives of the NRC staff and Exelon Generation Company, LLC (EGC) regarding the NRC staff's final safety evaluation report and the application submitted by EGC (the applicant) for the Clinton early site permit (ESP). The Subcommittee focused on the applicant's performance-based seismic hazard analysis methodology. Dr. Powers said that this methodology would offer not only regulatory stability but perhaps safety advantages as well, and thus was of particular interest. The ACRS is conducting such effort to fulfill the requirement of 10 CFR 52.23, which requires that the ACRS shall report on those portions of an ESP application that concern safety.

EXELON PRESENTATION

Ms. Marilyn Kray, project executive sponsor for the Clinton early site permit application provided Exelon's introductory remarks. She mentioned industry's excitement about the prospects of building new nuclear power plants in the United States. She acknowledged the efforts of the NRC staff and the Nuclear Energy Institute (NEI) Seismic Issues Task Force for performing and reviewing this precedent setting performance-based seismic hazard analysis methodology.

Mr. Eddie Grant, Exelon's safety and emergency planning lead for the Clinton early site permit (ESP) application, briefly outlined Exelon's presentation agenda and introduced the Clinton ESP Project and Support Teams. CH2M Hill was Exelon's prime contractor. They did the environmental reviews, site redress, the geotechnical evaluation, and drafted the emergency plan. WorleyParsons did the safety evaluations. Geomatrix Consulting did the seismic evaluations, including the probabilistic seismic hazards analysis and looked at paleoliquification. Mr. Grant mentioned Exelon's Seismic Board of Review which was chaired by Dr. Carl Stepp. He also identified Mr. Bob Kennedy, with RPK Structural Mechanics Consulting, as their lead expert in the performance-based methodology. Finally, he said that Sergeant & Lundy did their application review and identified Morgan Lewis as Exelon's legal counsel.

The Clinton ESP site is located in central Illinois on Clinton Power Station property. Clinton Power Station os owned by AmerGen. The ESP applicant, Exelon Generating Station, LLC is a wholly owned subsidiary of Exelon Corporation.

The NRC staff's supplemental draft Safety Evaluation Report (DSER) addressing the geotechnical and seismic issues came out in August 2005. Mr. Grant outlined significant changes that have been made since issuance of the DSER. All open items in the DSER have been closed and all confirmatory items have been completed. Exelon described each open item and briefly explained how each was closed. Based on staff-documented criteria the number of Permit Conditions was reduced from 15 in the DSER down to 6 in the Final Safety Evaluation Report (FSER). However, the number of Combined License (COL) Action Items increased from 17 in the DSER to 32 in the FSER.

Dr. Hinze asked Dr. Powers if there was a literature search cutoff date for the ESP review. Dr. Powers indicated that the applicant's use of 2004 as their literature search cutoff date seemed reasonable to him but said that if there are insights in the 2005 literature that would make qualitative changes to the Subcommittee's perceptions, Dr. Hinze should certainly bring those insights to the Subcommittee's attention.

Exelon noted that the staff has accepted it's proposed alternative, performance-based method for the determining the Safe Shutdown Earthquake (SSE) ground motion spectrum. This alternative is based on an industry standard (ASCE 43-05) that is based on work done by the Department of Energy for the seismic safety of its facilities.

Geotechnical Approach

Mr. Grant said that Exelon looked at the available information as far as regional geology, site geology, what exploration had been done back in the '70s, and the lab testing that had been done on the soils and properties in the area. He said they also did some work specifically for the early site permit, to confirm those conditions, and they got the same answers, or close to the same answers, that the folks got back in the '70s. Exelon updated the information, particularly in the areas of the geology, and by doing a literature search to identify any new seismic sources and/or seismic methodologies that were available to evaluate those sources. Mr. Grant showed where additional soil borings had been taken at the Clinton Power Station site. Borings showed that the soils to be relatively uniform and fairly stiff. The sheer wave velocities were consistent with those seen during the initial Clinton Power Station site characterization. The laboratory data showed a good match with the assumed EPRI soil modulus and damping curves.

Seismic Evaluation

Dr. Carl Stepp explained that the applicant's seismic evaluation, used to determine the SSE ground motion, followed largely the guidance and methodologies that are laid out in Regulatory Guide 1.165 (RG 1.165). However, rather than use the reference hazard probability criterion (or target) specified in RG 1.165, the applicant used alternative performance-based criterion. The applicant updated seismic source information developed by EPRI in the mid- to late- '80s to

incorporate information up to 2004. They did sensitivity studies. A Senior Seismic Hazards Analysis Committee (SSHAC) Level 2 evaluation was conducted to update the uncertainties in the input parameters for the seismic hazard calculations and compared the new probabilistic seismic hazards analysis (PSHA) for the site with the updated information. In deriving the ground motion from the PSHA, the applicant followed the RG 1.165 guidance for de-aggregating the hazard across the spectral frequencies of interest to determine controlling earthquakes for the low and high parts of the spectrum, and then fit the ground motion to the derived spectra. They accounted for site effects and did site response analyses following the guidance in NUREG/CR-6728. EPRI work from a catalogue (1777 through 2002) was updated using USGS regional network locations from the USGS catalogue and the council on national seismic systems 1995-2002. The new information indicated: repeated large events in the New Madrid seismic zone in the last 2,000 years; larg pre-historic events in the Wabash Valley/Central Illinois region in the past 12,000 years; and one moderate event with an energy centered approximately 30 miles south west of the proposed site, near Springfield, approximately 6,000 years ago. Dr. Stepp showed a map displaying areas around the site where this new soil liquefaction information was obtained. Dr. Wallis said that he understood that the applicant had increased the magnitude of the SSE based on this new information but he questioned how much it was increased, and why. Mr. Robert Young, with GeoMatrix Consultants, explained that the weighting factors assigned to these larger earthquakes were increased (over those used in the EPRI catalogue) based on the new paleoliquefaction information. Dr. Stepp reiterated that a SSHAC Level 2 assessment procedure was used to arrive at the weighting factors for the distribution of maximum magnitude earthquakes. He explained that the SSHAC methodology is a formalized process for assessing subjective uncertainties, a process by which new information is compiled, and is assessed against the existing interpretation (in this case the EPRI interpretation). Dr. Hinze said that, as one of the members of the team that developed the SSHAC process, these numbers were not just pulled out of the air. He said that they came as a result of a lot of literature search, a lot of discussion among various disciplines, and the information on which the so-called experts were making their decision were intended to be rather soft. He also said that that is why it is important for the licensee to include the probability range in the site safety report. Dr. Hinze said that the applicant did the right and probably only reasonable thing it could do to update the EPRI information. Dr. Powers said that he was comforted by the fact that the applicant had not only recognized the major seismic zones, but they were will to adjust the assigned magnitudes to try to get them up to date, and they were willing to recognize even poorly understood seismic centers. Dr. Powers asked why there was no apparent attempt to fit a distribution (e.g., Keegan distribution) to the new paleoliquefaction information? Dr. Stepp said that using a quantified approach, like trying to fit a curve to very sparse data with extremely high uncertainty, is not particularly practical. He said that using the SSHAC process, where scientists weigh data according to their judgments, was more workable. When asked by Dr. Wallis, Dr. Stepp said that minor changes in the assumed maximum magnitude earthquake would not have a significant impact on the results (i.e., performance-based SSE response spectra).

Dr. Stepp said that in probabilistic hazards modeling, they normally define a background zone to account for earthquakes and seismicity that are not specifically associated with a specific defined source. The background zone would be a defined region that has similar geologic tectonic and seismicity characteristics that contains the site and that takes into consideration all of the seismicity in the historic record. For the ESP site, the background zone is the Illinois

basin region. Again, based on liquefaction information, the magnitude distribution for seismicity in the background zone was similarly increased.

Dr. Hinze questioned the location of the Springfield earthquake, and indicated that there appeared to be some inconsistency in estimating the location of this seismic source based on liquefaction data. He asked if the applicant was using Obermeier or McNulty & Obermeier? Ms. Catherine Hanson, with GeoMatrix Consulting, indicated that for the Springfield event, they started with McNulty & Obermeier's paper, and summarized their current work at that time. She said that a complete discussion of the paleoliquefaction analysis could be found in an attachment to Appendix A of the Safety Analysis Report. Ms. Hanson said that while they have shown the Springfield energy center in their assessment, they do not rely on its specific location. However, they have analyzed it in subsequent analyses to look at the impact of an event of that magnitude at the ESP site. Ms. Hanson acknowledged that there is uncertainty in the actual location of these events and that the evidence of liquefaction may actually be the result of more distant earthquake sources. However, she said that they have captured that in their alternative seismic source zone models that account for possible larger events to the south and elsewhere in the Illinois-Indiana region.

Dr. Hinze also asked about the size and shape of the figure depicting the central Illinois seismic zone. Mr. Young, with GeoMatrix Consulting, said that they used the simplified rectangular model to do sensitivity analysis, to compare the effects of changes in the maximum magnitude, and so forth, as part of the evaluation of what information might need to be updated. He said that in the actual hazards analysis that was conducted for the site, they used all of the EPRI source zones, encompassing the entire region.

Dr. Stepp then compared the RG 1.165 reference hazard approach to the performance-based American Society of Civil Engineers (ASCE) 43-05 approach that Exelon used. The reference probability approach, which is described in Appendix B to RG 1.165, sets the annual probability such that 50% of the set of most modern design currently operating plants have an annual median probability of exceeding the SSE that is below this level (1E-5) determined at an average of the 5 and 10 Hz SSE spectra with 5% damping. Rather, Exelon's component-by-component performance-based alternative uses a target mean frequency of 1E-5 per year for seismically induced onset of significant inelastic deformation of SSCs. This provides significant margin against SSC failure that might lead to core damage. He said it also leads to seismically-induced core damage frequency (CDF) significantly less than for existing plants.

Dr. Bonaca questioned why this performance-based criteria necessarily leads to seismically induced CDFs significantly less than existing plants. Mr. Bob Kennedy, with RPK Structural Mechanics, explained that ASCE 4305 was written to replace DOE Standard 1020, and was to cover a wide variety of facilities that had different risks and, therefore, different levels of potential safety goals. The standard basically assigns five different quantitative performance goals in terms of annual frequency of unacceptable performance (1E-3 to 1E-5), and then defines four different levels of unacceptable performance. The most restrictive unacceptable performance is that SSCs must remain essentially elastic (i.e., translated to the "onset of significant inelastic deformation"). The word "essentially" is used because even when you are at code allowable stresses, there can some local inelasticities and strike concentration points, but the overall structural system and component behavior remains elastic. Dr. Wallis asked

about inelastic or brittle structures. Mr. Kennedy explained that the in this level of performance, you stay within the code allowables, and structures behave as a linear elastic system. He said that not behaving that way is unacceptable performance. For brittle structures, he said behaving as an essentially elastic system, even within code allowables, may put you on the verge of failure. He said that for a ductile system, there could be a lot of margin beyond that point. Mr. Kennedy identified the other levels of performance used in ASCE 4305 [e.g., continue to serve as a confinement barrier (which allows some inelastic failure so long as the failure mode is ductile), large inelastic deformation (or collapse prevention)]. Dr. Shack noted that while Dr. Bonaca's question related to CDF, the same criteria would apply to the containment. Mr. Kennedy agreed and said that advanced light water reactor submittals must demonstrate what is called a high confidence of a low probability of failure (HCLPF) seismic margin. He said that this corresponds to a one percent probability of unacceptable performance on the mean or composite fragility curve. He said that the HCLPF seismic margin against seismic core damage needed to be at least 1.67. The ASCE 4305 code aims at a HCLPF seismic margin of 1.0. So, the onset of significant inelastic deformation is defined in terms of a HCLPF of 1.0. He said that you would also have to demonstrate for an advanced light water reactor that you have a margin of 1.67 against seismic core damage. Dr. Bonaca asked why the 1E-5 core damage was introduced in this context? Mr. Kennedy said that if you hold essentially elastic behavior to mean 1E-5, where the seismic core damage frequencies for existing plants average about 1E-5, and where you know there is margin beyond this essentially elastic behavior, you will be achieving seismic core damage frequencies substantially less than 1E-5. Dr. Shack asked if the 1.67 margin against core damage was also maintained for containment? Mr. Kennedy said that this same margin is maintained, but in the case of containment, it is against large early release frequency (LERF) as opposed to CDF. Dr. Goutam Bagchi said that containments have substantial margin against a seismic event because they are designed for combined internal pressure and SSE loads to meet the code allowable minimums. He added that SECY-93-087 requires that containments remain within the ASME service level C limits under severe accident loading. Mr. Kennedy agreed and said that containments have always had substantially higher HCLPF seismic margin capacities than those items that were critical to core damage.

Mr. Kennedy said that the idea of having performance-based seismic design criteria began in 1985 when seismic probabilistic hazards were being developed. These seismic hazard curves defined ground motion as a function of an annual frequency of exceedance. He said that this raised the obvious question, what annual frequency of exceedance should we be aiming at? What should be the target performance goal? He said that if we knew that, then we could back calculate what annual frequency of exceedance ground motion level we should design for, given our target performance goal and the level of conservatism in our design criterion. Mr. Kennedy said that this approach was first documented in a Lawrence Livermore Lab report UCRL-15910 in 1990. This report identified four performance levels as a function of how much risk was considered acceptable. This report was upgraded to a DOE Standard (DOE-std-1020) in 1994, and was subsequently updated in 2004. In 2001, the NRC published NUREG/CR-6728, "Technical Basis for Revision of Regulatory Guidance on Design Ground Motion: Hazard- and Risk-Consistent Ground Motion Spectra Guidelines." He said that using a uniform hazard response spectrum does not lead to uniform risk because different sites have different slopes to their hazard curve. With a steep slope on the hazard curve, you would want to design for an earthquake with a higher uniform hazard annual frequency of exceedance, than with a very

shallow slope. After 2002, the Defense Nuclear Facilities Safety Board (DNFSB) wanted a professional committee consensus code as opposed to DOE having its own standard. That led to the development of ASCE 4305, primarily to address DOE facilities. ASCE-4305 has five different quantitative performance goals that range from an annual frequency of exceedance of unacceptable performance of 1E-3 to 1E-5. Exelon used the highest, or most conservative, value of 1E-5. ASCE-4305 has four different limit states, the most limiting being that SSCs remain essentially elastic. That is, for nuclear power plants and for the Exelon ESP submittal, the applicant used the criteria associated with the most severe of the ASCE categories, seismic design category "5D." The risk goal is established by a combination of the quantitative annual frequency of unacceptable performance (1E-5/yr) and what constitutes acceptable performance (remains essentially elastic). The ASCE seismic design criteria associated with remaining essentially elastic is very similar to the seismic design criteria of the NRC in NUREG-0800.

Mr. Kennedy said that once you have established the quantitative performance goal, you also need to decide on a reference seismic hazard curve to define a uniform hazard response spectra (UHRS), all at the same annual frequency of exceedance. The hazard curve of values are then adjusted by a design factor (DF) to hit the risk goal or performance goal. The adjustment factor is based on a couple of assumptions. The first assumption is that the design criteria will meet upper limit on the probability of unacceptable performance if the design earthquake were to occur. For both the ASCE standard and NUREG-0800, basically for the onset of significant inelastic deformation. There is less than a one percent probability of that occurring with an SSE. There is less than a ten percent probability of that occurring with an earthquake with magnitude 1.5 times the SSE. He said that with these two criteria, you can create appropriate seismic fragility curves that can then be convolved with the hazard curve.

Mr. Kennedy said the 1E-5 (mean) was selected in both DOE 1020, and then subsequently in ASCE 43-05, because the average seismic core damage frequency reported for plants that have done a seismic PRA has been a mean of 1E-5 (with a range of 1E-7 to 1E-4). And the median of the means is about 1E-5. Dr. Powers expressed concern that the results from additional seismic PRAs could alter, or change, the basis for the 1E-5 acceptance criteria. Dr. Powers said that choosing a criteria based on the results of seismic PRAs invites instability. Mr. Kennedy agreed that the number is arbitrary, but said it was chosen as a policy decision, and that stability is the number, and not how we arrived at the number. He added that if the seismic PRAs were redone today they might produce larger seismic CDFs because the EPRI hazard curve is significantly higher than the curve used when those numbers were computed. Dr. Kress asked if the implied assumption is that SSCs need to fail in order to get core damage? Mr. Kennedy explained that it is the seismic failure of various SSCs coupled with random failures or operator errors that can lead to seismically induced core damage. Dr. Kress asked how SSCs are defined in this context because the actual plant has not yet been built. Mr. Kennedy responded that all advanced light water reactors will be required to maintain a 1.67 HCLPF seismic margin against both CDF and LERF.

Mr. Kennedy explained that the purpose here is to define the SSE design spectra. Once that is defined, the plant has to be designed in accordance with NUREG-0800 with the seismic design margin requirements in it. In the ASCE 43-05 approach, the UHRS is defined at 1E-4. Mr. Kennedy said that this methodology works well when the UHRS is an order of magnitude less than the performance goal probability of 1E-5. The UHRS is multiplied by design (scale) factors

depending on how much the UHRS exceeds the performance goal (in this case a factor of 10), the seismic margin conservatism factor (in this case 1), and the slope of the hazard curve. With the relatively steep slope of the hazard curve for the Clinton ESP site, the design factors ranged from about 1.04 to 1.30. Mr. Kennedy said they did perform a probabilistic convolution of the hazard and fragility curves. For the fragility curve they used the minimum HCLPF seismic margin factor of 1.67, and demonstrated that for the ESP site the seismic core damage frequency is $\leq$ 2E-6/yr, which is significantly less than the median of existing plants. Mr. Kennedy said that the seismic core damage frequency could dominate the overall core damage frequency for some plant sites/designs. Mr. Kennedy next provided the subcommittee with a table that defined the 1% probability of failure point on the fragility curve for different hazard curve frequencies (from 1 Hz to 10 Hz) and as a function of the standard deviation of the fragility curve (from 0.3 to 0.6) using the ASCE methodology. He said that the seismic core damage frequency typically depends on the hazard curve in the 5 to 10 Hz range. Based on this, the seismic core damage frequency for the Clinton ESP site is expected to be in the range of 1E-6 to 2E-6. He compared this to the ASCE values for all 28 sites, which ranged from 1E-6 to about 5E-6.

Dr. Powers asked if the applicant had a list of things that were randomized in the development of the ground motion spectra, and asked how they knew they were all independent? Mr. Young said that in the site response analysis, in which they calculated the amplification of the motions from rock up to the soil surface, they randomized the soil properties, principally the velocities in the soil layer. They generated correlated velocity profiles for the site as a part of that randomization. Mr. Young said that they did not perform any randomization as part of the probabilistic seismic hazards analysis in which they used probability models for the location and size of earthquakes and for the ground motions that they produce to generate the hazard curve. Mr. Kennedy said that it is better to define the ground motion probabilistic seismic hazard curve in terms of a reference rock, and the reference rock in EPRI-03 is 9,200 ft/sec sheer wave velocity. He said that this then had to be convolved up through the soil layer to get the motion at the ground surface. He said that in this convolution process you don't want to work with a single soil profile because there is a lot of uncertainty on the soil information. So they went through a process of selecting a best estimate soil profile, and variability about that best estimate, and then they did a number of randomized samples to get a mean amplification function. And, as indicated by Mr. Young, Mr. Kennedy said that they did correlation. Mr. Kennedy said that this leads to a broader frequency and more realistic response spectra at the ground surface. Dr. Hinze asked for and got a clarification of Mr. Kennedy's use of the terms "variability" and "uncertainty."

Finally, Dr. Stepp showed a plot of the site-specific performance-based ground motion spectra for the vertical and horizontal ground motion and compared them to RG 1.60 general, site-independent response spectra anchored at 0.3 g. In an effort to explain where the magnitude 6.5 came from, Mr. Young referenced figure 2-12 of the FSER and said that the process for defining the seismic hazard curve considers a combination of large events at some distance from the site as well as smaller, more frequent earthquakes closer to the site. So, the amplitude of the peaks on the curve represent the relative contribution of earthquakes of different magnitudes and distances from the site at 1E-4, and the controlling earthquake is basically the weighted average of that histogram (i.e., magnitudes and distances weighted by their relative contribution). The said that the weighted average came out to be 6.5 with an

average distance close to the Wabash Valley distance. Then, the applicant used time histories of earthquakes of that size to run the site response analysis to develop the amplification of the rock motions to the soil surface. The NRC's reviewed the applicant's methodology and found the SSE ground motion spectra for the Clinton ESP site to be acceptable. This motion will be compared to the actual design response spectra at the COL stage.

Dr. Stepp noted that all 7 open items in the draft SER have now been closed and all confirmatory items have been completed. He summarized each open item and outlined the action taken by the applicant to resolve it.

Dr. Powers asked why the applicant partitioned the three New Madrid faults evenly (i.e., ⅓, ⅓, ⅓). Mr. Young responded that Tuttle, et. al. indicated that one of the three events was appreciably smaller than the other two but that all three were at least as large as magnitude 7. Dr. Powers asked if the applicant had considered the possibility of having multiple earthquakes. Dr. Stepp said that the New Madrid strain release behaved as a cluster release (3 earthquakes within a little less than 3 months). However he said that the professional preference is to model them as separate events in hazard studies. Dr. Powers said that he thought seismologists were discovering more and more of these clusters (and referenced faults along the Black Sea in Turkey). Dr. Stepp said that while a clustered type strain release may occur along some fault line (e.g., tectonic release over a period of 100 years or more), it is not typical for interplate regions. Dr. Powers asked if the fragility analysis is still good if the plant experiences a second earthquake 3 months after a first? Mr. Kennedy said that if an SSC remains essentially elastic during the first earthquake, it should behave basically the same during the second earthquake. Referencing a paper written by Hughs, et. al., Dr. Hinze asked if field triggering of earthquakes was taken into consideration. Dr. Stepp said that far field triggering was not specifically addressed. He said that it may be reasonable to consider one large earthquake occurring in the Mississippi with two earthquakes of comparable size being triggered by that first one. But he said that there is no observational evidence of more distant triggering of earthquakes in the stable continental region. Again, referring to the paper written by Hughs, et. al., as well as a paper by Mueller, et. al., Ms. Hanson said that there is a lot of controversy about whether there is really evidence for paleoliquefaction of the magnitude cited in southern Illinois. Dr. Hinze agreed.

Dr. Wallis said that the applicant's performance-based seismic analysis made sense to him. Mr. Maynard asked the applicant if, in going through the ESP process, whether they gained any insights or raise any potential safety questions for the existing power plant site? Mr. Grant responded that the two methodologies are distinctly different and can not be compared to each other.

NRC STAFF PRESENTATION

Ms. Laura Dudes introduced the staff presenters. She said that the staff's review of the Clinton ESP application was delayed 7 months so the staff could develop an agency-wide conclusion on the adequacy of the applicant's proposed performance-based approach for defining the SSE ground motion spectra. She said that the staff's review of this approach will inform other generic work that the staff is undertaking (e.g., other ESP applications, revision to RG 1.165).

John Segala stated that the purpose of the staff's presentation was to provide the ACRS with an overview of the Exelon ESP application seismic review and to answer any of the Subcommittee's questions. He outlined past and future milestones associated with the review of the Clinton ESP application. Mr. Segala said there were a total of 7 seismology and geology open items addressed in the supplemental draft SER (2 related to the performance-based approach for defining the SSE, 2 related to other seismic issues, and 3 related to geo-technical issues). He summarized all but the two performance-based approach open items and described the basis on which they were closed. For example, the open item on the "site response model not adequately representing the variability of the soil properties" was closed because the applicant said that they were going to remove the top 60 feet of the soil, and the staff made this a permit condition in the final SER. Mr. Segala provided an overview of the staff's experience with the performance-based methodology. He said that the staff was first introduced to this method in 2002 by NUREG-6728. He said that the staff participated in the development of ASCE 43-05. Finally, he said that the staff formed a seismic technical advisory group (TAG) made up of seismic and civil engineering experts from NRR, NMSS, and RES. The seismic TAG is headed by Dr. Andrew Murphy and served in an advisory role to NRR for the review of Exelon's performance-based approach.

Dr. Clifford Munson described the staff's review of Exelon's performance-based approach. The NRC staff had technical support from the U.S. Geologic Survey and Brookhaven National Laboratory. Dr Munson stated the staff's three major conclusions, and proceeded to explain the staff's basis for reaching each conclusion. The three conclusions were: 1) the performance-based method is based on a sound technical approach, 2) seismic design using the performance-based SSE achieves a level of safety generally higher than operating plants, and 3) the performance-based SSE adequately reflects local ground motion hazard from a Springfield-type earthquake. Dr. Powers asked if the Springfield earthquake is a relatively unknown or mysterious seismic source? Dr. Munson said that there is no remnant seismicity in the Springfield area that would indicate a seismic source. He said the staff just wanted to do a sanity check to make sure the ground motion from a Springfield earthquake, given its magnitude and distance from the site, would be enveloped by the applicant's performance-based SSE. Dr. Powers questioned: "This surely cannot be the only seismic event that is not associated with a seismic structure of some sort." Dr. Munson said it wasn't and explained that that is why they define central Illinois as a background source zone, because there is no structure that can be directly correlated to a Springfield earthquake. Dr. Munson said they used a uniform distribution for the central Illinois source zone so they didn't limit the Springfield earthquake to that particular location.

Dr. Munson said that the performance-based SSE can be determined by two approaches: 1) the design factor method outlined in ASCE 43-05 and used by the applicant or 2) by direct integration of the risk equation which the staff used to verify the applicant's modeling assumptions. Dr. Munson summarized the applicant's performance-based approach and showed a graphical depiction of its results. He also said that the staff planned to use the direct integration of the risk equation approach, in the future, as a check on any performance-based approaches the staff gets from industry. Dr. Munson showed an example of a hazard curve and a fragility curve. He explained that these two curves are multiplied together and then integrated to determine the SSE that meets the target. He went on to discuss the performance goal of 1E-5/yr for the onset of inelastic behavior and stressed that it is conservative when

compared to the median IPEEE value of 1E-5/yr for seismic core damage (a much more serious end state). Therefore, the staff was comfortable with the proposed performance goal even though it was somewhat of an arbitrary number. Dr. Munson said that one of the basic premises of the applicant's approach is that the hazard curves are linear between 1E-4 and 1E-5. He explained why this assumption was conservative. Dr. Munson said that another assumption in the applicant's approach is that the seismic fragilities have a log normal distribution. Dr. Powers questioned the basis for this assumption. Dr. Munson said that a log normal distribution has been used to model fragilities forever. Mr. Kennedy said that the demand in the structures fits wonderfully to a log normal distribution in the central region (i.e., 1% to 99%). He added that when you convolve the hazard and fragility curves you are only interested in the 1% to 70% range. Dr. Munson said that the important step is to quantify the 1% capacity (HCLPF) in terms of SSE times the seismic margin. And once we have the SSE written in the fragility probability distribution function, we can determine the SSE that meets the target performance goal. The SSE is back-calculated by assuming a target performance frequency (i.e., 1E-5/yr), a linear hazard curve, $\beta = 0.4$, and a seismic margin equal to 1. [Note: In solving for the SSE , the seismic margin appears in the denominator of the integral. So, assuming a higher seismic margin would result in a lower SSE.]

Dr. Munson concluded that the performance-based approach used by Exelon is technically sound because it achieves both a high and consistent level of seismic safety, it takes no credit for seismic margin, it utilizes a conservative performance target (i.e., mean target frequency of 1E-5 per year for seismically induced onset of significant inelastic deformation of SSCs), and it is based on conservative parameter and modeling assumptions.

Dr. Munson explained that the performance-based approach used by Exelon achieves a safety level generally higher than currently operating plants because the median seismic core damage frequency for IPEEEs, as represented in RG 1.165, is 1E-5/yr whereas Exelon's performance-based approach uses this same frequency as the target for the onset of inelastic deformation. This target provides a rather substantial margin to core damage and containment failure. The seismic core damage frequency that can be inferred from the proposed ground motion spectrum (~$2X10^{-6}$/yr) is significantly less than the median found in seismic probabilistic risk assessments for 29 existing nuclear power plants. Thus, the performance-based alternative method yields results that are in concert with the Commission's expectation that future reactors be safer than currently operating reactors.

Dr. Munson said that the performance-based approach used by Exelon adequately reflects local ground motion hazards in that it considered large events in the New Madrid seismic zone in the past 2,000 years; large events in the Wabash Valley/Southern Illinois seismic zone in the past 12,000 years; as well as a moderate energy event near Springfield, Illinois which occurred approximately 6,000 years ago and had a magnitude of 6.2 to 6.8 on the Richter scale. Exelon also conducted paleoliquification surveys on streams near the ESP site and found no evidence of repeated moderate to large earthquakes comparable to the Springfield earthquake. The applicant also determined that the ground motion at the ESP site from the Springfield earthquake was enveloped by the SSE determined by both the uniform hazard response spectra (UHRS) at 1E-4 and by the applicant's performance-based approach. Dr. Powers asked the staff why it felt that the Springfield earthquake represented an upper bound on the magnitude of an earthquake that might occur at the ESP site? Dr. Munson responded that this

was just a deterministic check on the applicant's probabilistic seismic hazards approach. Dr. Hinze said that he would have liked to have gotten better geological information, better definition of the central Illinois seismic zone, to assess whether there is a structure or not.

Dr. Munson said that he hoped that he had demonstrated to the Subcommittee that the staff did a thorough review of the applicant's performance-based approach. He said the staff wanted to make sure that the parameter and modeling assumptions the applicant made were conservative and that the staff was comfortable with the SSE ground motion that came out of the process. The staff found that the performance-based SSE generally gives a higher level of seismic safety than existing nuclear power plants. Overall, the NRC staff concluded that the site is acceptable from a geologic and seismologic standpoint and meets the requirements of 10 CFR 100.23.

General Questions and Observations from the Subcommittee Members

1. Dr. Powers asked if the staff plans to endorse this performance-based approach in a regulatory guide? Dr. Murphy said that the staff is anticipating revising RG 1.165 to endorse important parts of ASCE 43-05 that are relevant to nuclear power plant siting.

2. Mr. Maynard asked whether newer plants will have to built to higher seismic design standards or whether the seismic response spectra just comes out lower with the performance-based approach? Dr. Bagchi said that the response spectra will come out higher. He said that the hazard has gone up. Dr. Powers said it was a phenomenological fact that earthquakes are now more frequent and in some cases have a higher magnitude. Dr. Bagchi said, that aside, the best part of this approach is that it targets performance (i.e., as opposed to targeting a reference probability which could change). And while the hazard and seismic response spectra may be higher than for existing plants, the performance-based methodology produces a lower seismic response spectra than would be produced by using the RG 1.165 methodology.

3. Dr. Shack asked what implications the higher hazard has for existing plants? Dr. Bagchi responded that the Office of Research is addressing this question as part of Generic Issue 199.

Subcommittee's Action

The staff and the applicant plan to provide a briefing regarding this matter to the full Committee during the March 9 -11, 2006, ACRS meeting.

Documents Provided to the Subcommittee

1. Status Report by G. Taylor, February 2006.

2. ACRS Interim Letter, Exelon Generation Company, LLC, Application for Early Site Permit and the Associated NRC Staff's Draft Safety Evaluation Report, dated September 22, 2005.

3. EDO response to ACRS Interim Letter, " Interim Letter: Exelon Generation Company, LLC, Application for Early Site Permit and the Associated NRC Staff's Draft Safety

Evaluation Report on the Clinton Early Site Permit Site," dated October 26, 2005.

4. Draft Final Safety Evaluation Report for EXELON Early Site Permit Application Section 2.5, Geology, Seismology, and Geotechnical Engineering, dated February 17, 2006.

5. Exelon Generation Company, LLC, letter to the U. S. Nuclear Regulatory Commission Subject: "Seismic Risk (Performance Goal) Based Approach Primer Revision (TAC No. MC1122)" dated January 14, 2005.

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NOTE : Additional details of this meeting can be obtained from a transcript of this meeting available for downloading or viewing on the Internet at http://www.nrc.gov/reading-rm/adams.html or http://www.nrc.gov/reading-rm/doc-collections/ can be purchased from Neal R. Gross and Co., 1323 Rhode Island Ave., N.W., Washington, DC 20005 (202) 234-4433.

present oral comments at the meeting by contacting Mr. Bo M. Pham, by telephone at 1–800–368–5642, extension 8450, or by e-mail at *PalisadesEIS@nrc.gov* no later than March 28, 2006. Members of the public may also register to provide oral comments within 15 minutes of the start of each session. Individual, oral comments may be limited by the time available, depending on the number of persons who register. If special equipment or accommodations are needed to attend or present information at the public meeting, the need should be brought to Mr. Pham's attention no later than March 28, 2006, to provide the NRC staff adequate notice to determine whether the request can be accommodated.

FOR FURTHER INFORMATION, CONTACT: Mr. Bo M. Pham, Environmental Branch B, Division of License Renewal, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, DC 20555–0001. Mr. Pham may be contacted at the aforementioned telephone number or e-mail address.

Dated at Rockville, Maryland, this 14th day of February, 2006.

For the Nuclear Regulatory Commission.

Frank P. Gillespie,

Director, Division of License Renewal, Office of Nuclear Reactor Regulation.

[FR Doc. E6–2589 Filed 2–22–06; 8:45 am]

BILLING CODE 7590–01–P

NUCLEAR REGULATORY COMMISSION

Advisory Committee on Reactor Safeguards, Subcommittee Meeting on Planning and Procedures; Notice of Meeting

The ACRS Subcommittee on Planning and Procedures will hold a meeting on March 8, 2006, Room T–2B1, 11545 Rockville Pike, Rockville, Maryland.

The entire meeting will be open to public attendance, with the exception of a portion that may be closed pursuant to 5 U.S.C. 552b(c)(2) and (6) to discuss organizational and personnel matters that relate solely to the internal personnel rules and practices of the ACRS, and information the release of which would constitute a clearly unwarranted invasion of personal privacy.

The agenda for the subject meeting shall be as follows:

Wednesday, March 8, 2006, 2 p.m.–3:30 p.m.

The Subcommittee will discuss proposed ACRS activities and related matters. The Subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions, as appropriate, for deliberation by the full Committee.

Members of the public desiring to provide oral statements and/or written comments should notify the Designated Federal Official, Mr. Sam Duraiswamy (telephone: 301–415–7364) between 7:30 a.m. and 4:15 p.m. (ET) five days prior to the meeting, if possible, so that appropriate arrangements can be made. Electronic recordings will be permitted only during those portions of the meeting that are open to the public.

Further information regarding this meeting can be obtained by contacting the Designated Federal Official between 7:30 a.m. and 4:15 p.m. (ET). Persons planning to attend this meeting are urged to contact the above named individual at least two working days prior to the meeting to be advised of any potential changes in the agenda.

Dated: February 15, 2006.

Michael R. Snodderly,

Acting Branch Chief, ACRS/ACNW.

[FR Doc. E6–2556 Filed 2–22–06; 8:45 am]

BILLING CODE 7590–01–P

NUCLEAR REGULATORY COMMISSION

Advisory Committee on Reactor Safeguards, Meeting of the Subcommittee on Early Site Permits; Notice of Meeting

The ACRS Subcommittee on Early Site Permits will hold a meeting on March 8, 2006, Room T–2B3, 11545 Rockville Pike, Rockville, Maryland.

The entire meeting will be open to public attendance.

The agenda for the subject meeting shall be as follows:

Wednesday, March 8, 2006—8:30 a.m. until 1 p.m.

The Subcommittee will review the application for an early site permit for the Clinton site, and the associated NRC staff's Final Safety Evaluation Report. The Subcommittee will focus on the applicant's performance-based seismic hazard analysis methodology. The Subcommittee will hear presentations by and hold discussions with representatives of the NRC staff, Exelon Generation Company, LLC, and other interested persons regarding this matter. The Subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions, as appropriate, for deliberation by the full Committee.

Members of the public desiring to provide oral statements and/or written comments should notify the Designated Federal Official, Mr. Michael R. Snodderly (telephone 301/415–6927) five days prior to the meeting, if possible, so that appropriate arrangements can be made. Electronic recordings will be permitted.

Further information regarding this meeting can be obtained by contacting the Designated Federal Official between 7:30 a.m. and 4:15 p.m. (ET). Persons planning to attend this meeting are urged to contact the above named individual at least two working days prior to the meeting to be advised of any potential changes to the agenda.

Dated: February 15, 2006.

Michael R. Snodderly,

Acting Branch Chief, ACRS/ACNW.

[FR Doc. E6–2588 Filed 2–22–06; 8:45 am]

BILLING CODE 7590–01–P

SECURITIES AND EXCHANGE COMMISSION

Submission for OMB Review; Comment Request

Upon Written Request, Copies Available from: Securities and Exchange Commission, Office of Filings and Information Services, Washington, DC 20549.

Extension:

Rule 12f–3; SEC File No. 270–141; OMB Control No. 3235–0249.

Notice is hereby given that, pursuant to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 *et seq.*), the Securities and Exchange Commission ("Commission") has submitted to the Office of Management and Budget requests for extension of the previously approved collection of information discussed below.

• Termination or suspension of unlisted trading privileges.

Rule 12f–3 under the Securities Exchange Act of 1934 (the "Rule"), which was originally adopted in 1934 pursuant to Sections 12(f) and 23(a) of the Act, as modified in 1995, prescribes the information which must be included in applications for and notices of termination or suspension of unlisted trading privileges for a security as contemplated in Section 12(f)(4) of the Act. An application must provide, among other things, the name of the applicant; a brief statement of the applicant's interest in the question of termination or suspension of such unlisted trading privileges; the title of the security; the name of the issuer; certain information regarding the size of the class of security and its recent trading history; and a statement

ACTUAL MARKED-UP COPY

Advisory Committee on Reactor Safeguards
Subcommittee Meeting on Early Site Permits
March 8, 2006
Rockville, MD

-PROPOSED SCHEDULE-

Cognizant Staff Engineer: Michael Snodderly MRS1@NRC.GOV (301) 415-6927

	Topics	Presenters	Presentation Time
I	Opening Remarks	D. Powers, ACRS	8:30 am - 8:35 am
II	Staff Introduction - Identification of significant changes since last ACRS Subcommittee meeting	NRR/Exelon	8:35 am - 8:45 am
III	Exelon Presentation A. Overview of the performance-based seismic hazard analysis methodology B. Overview of open items	Exelon Generation Company, LLC - Eddie Grant - Dr. Carl Stepp	8:45 am - ~~10:30~~ 10:40 am 10:40 – 10:55am
	Break		10:~~30~~ am - 10:45 am
IV	NRC Staff Presentation A. Staff's evaluation and conclusion of the performance-based seismic hazard analysis methodology B. Resolution of seismic open items	NRR - John Segala - Dr. Clifford Munson	10:45 am - 12:~~45~~ 12:03 pm 12:03 12:15
V	Subcommittee Discussion	D. Powers, ACRS	12:~~45~~ pm - ~~1:00~~ pm

NOTE:

- Presentation time should not exceed 50 percent of the total time allocated for a specific item. The remaining 50 percent of the time is reserved for discussion.

- 35 copies of the presentation materials to be provided to the Subcommittee.

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

SUBCOMMITTEE MEETING ON EARLY SITE PERMITS

March 8, 2006
Date

PLEASE PRINT

	NAME	AFFILIATION
1	Lloyd S. Cluff	PG&E
2	Bob Kennedy	ABK Struct Mech.
3	Matt Gavin	CH2M Hill
4	Chris Kerr	Exelon
5	Carl Stepp	EMS
6	Kathryn Hanson	Geomatrix Consultants.
7	Thomas P Mundy	Exelon
8	Bill Maher	Exelon
9	TAMAR CERAFICI	CH2M HILL/EXELON
10	Robert Youngs	Geomatrix Consultants
11	Marilyn Kray	Exelon
12	Eddie R Grant	Exelon
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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

SUBCOMMITTEE MEETING ON EARLY SITE PERMITS

March 8, 2006
Date

NRC STAFF SIGN IN FOR ACRS MEETING

PLEASE PRINT

	NAME	NRC ORGANIZATION
1	GOUTAM BAGCHI	NRR/DE
2	Laura Dudes	NRR/DNRL
3	Thomas Cheng	NRR/DE/EGCB
4	Rebecca Karas	NRR/DE/EGCB
5	Cliff Munson	NRR/DE/EGCB
6	Jeremy Tapp	NRR/DSS
7	Syed Ali	RES/NRC
8	John Segala	NRR/DNRL
9	Christian Araguas	NRR/DNRL
10	YONG LI	NRR/DE/EGCB
11	Andrea VJ Murphy	RES/DFRA/ERA
12	Roger Lanksbury	NRC/Rgn 3/DRS
13	KAMAL MANOLY	NRC/NRR/DE/EEMB
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UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

ACRSR-2182

March 24, 2006

The Honorable Nils J. Diaz
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

SUBJECT: FINAL REVIEW OF THE EXELON GENERATION COMPANY, LLC, APPLICATION FOR EARLY SITE PERMIT AND THE ASSOCIATED NRC STAFF'S FINAL SAFETY EVALUATION REPORT

Dear Chairman Diaz:

During the 530th meeting of the Advisory Committee on Reactor Safeguards, March 9-11, 2006, we completed our review of the early site permit application for the Clinton site and the associated final Safety Evaluation Report (SER) prepared by the NRC staff. We reviewed the application and the final SER to fulfill the requirement of 10 CFR 52.23 that the ACRS report on those portions of an early site permit application that concern safety. We issued an interim letter on this application and the associated draft SER on September 22, 2005. This matter was also discussed during our Subcommittee meeting on March 8, 2006. During these reviews, we had the benefit of discussions with representatives of the NRC staff and Exelon Generation Company, LLC (Exelon). We also had the benefit of the documents referenced.

CONCLUSIONS AND RECOMMENDATIONS

- The early site permit application and the staff's final SER show that the proposed nuclear power plant site adjacent to the existing Clinton Nuclear Power Station is an acceptable site for nuclear power plants that meet the plant parameter envelope proposed by the applicant.

- The staff has thoroughly reviewed a performance-based method proposed by the applicant for determining the safe shutdown earthquake (SSE) ground motion. This method is an attractive alternative to methods endorsed in current regulatory guides.

- The staff should consider development of a regulatory guide dealing with the alternative, performance-based, method for assessing the seismic hazard of a site.

DISCUSSION

Exelon has applied for an early site permit for locating nuclear power plants or modules having a total power generation rate of 2400 to 6800 MWt on a site adjacent to the currently operating Clinton plant, which is a BWR 6 within a Mark III containment. The early site permit application is based on the now familiar "plant parameter envelope" approach since the applicant has not identified the particular reactor technology that will be adopted. The plant parameter envelope is based on the characteristics of certified designs such as the AP1000 and Advanced Boiling

Water Reactor (ABWR) as well as other designs such as the International Reactor Innovative and Secure (IRIS), Economic Simplified Boiling Water Reactor (ESBWR), Gas-Turbine Modular Helium Reactor (GT-MHR), and Pebble Bed Modular Reactor (PBMR).

The staff's review of this application included a detailed review of the alternative, performance-based method proposed by the applicant for determining the SSE ground motion spectrum. The staff identified six permit conditions for the proposed site. The staff has used technically sound, objective criteria for identifying these permit conditions. The staff and the applicant have agreed to 32 combined license (COL) action items. The action items for the proposed Clinton site can be compared to 30 action items for the North Anna early site permit and 26 action items for the Grand Gulf early site permit.

Nature of the Site

The proposed site is located in a rural setting in central Illinois. The terrain is essentially flat with some rolling hills. Nearby populations centers with populations in excess of 25,000 include Springfield (74 km), Peoria (75 km), Champaign (49 km), Urbana (66 km), Decatur (36 km), and Bloomington (36 km). Near the site (<16 km) are the small towns Clinton (population 7,000), as well as DeWitt, Weldon, and Wapella each with a population of less than 1,000.

Population trends in the larger cities near the site have been estimated based on census data. Modest growth in population is anticipated in these cities over the next 60 years. Interestingly, data obtained from other sources led the applicant to anticipate that populations in the rural regions around the site will decline modestly over the next 60 years.

Weather

Weather at the proposed site is well characterized in recent years as would be expected for a site with an operating nuclear power plant. The weather is marked by rather warm summer periods and harsh winters. Weather extreme characteristics of the site have been based on historical data. Neither the applicant nor the staff has considered the potential for cycles in weather that may complicate the prediction of future weather extremes based on historical records. Nevertheless, we believe that the applicant has adequately characterized the site weather for the purposes of an early site permit.

Seismicity

The proposed site is affected by the New Madrid seismic zone and the Wabash Valley seismic zone. Since the nuclear power plant at the Clinton site was licensed, the estimated frequency of major earthquakes at the New Madrid seismic zone has been increased. The estimate of the maximum potential magnitude of earthquakes at the Wabash Valley seismic zone has also been increased. There is a background seismicity of the site represented by the Springfield earthquake estimated to have occurred at a location about 70 km from the site, approximately 6,000 years ago and to have had a magnitude of 6.2 to 6.8 on the Richter scale.

In other applications for early site permits, the applicants have adopted the methods recommended in Regulatory Guide 1.165 to estimate the SSE ground motion spectrum. Exelon has adopted an alternative method. This alternative is based on an industry standard (ASCE 43-05) that itself is based on work done by the Department of Energy for assessing the seismic safety of its nuclear facilities. The alternative is considered "performance based" because it uses a target probability for the maximum acceptable facility damage from an earthquake.

Exelon has selected the frequency of 10^{-5}/yr for the onset of significant inelastic deformation of systems, structures, and components. This target provides a rather substantial margin to core damage and containment failure.

The staff has reviewed thoroughly the proposed alternative method for estimating the seismic hazard at the proposed site. The staff's review included examination of the credibility of parametric quantities in the models and an independent assessment of the analysis results by direct integration of the seismic risk equation. Also, the staff has reviewed carefully the applicant's assessment of the local seismic hazard. We concur with the staff that the alternative approach adopted by Exelon for this application provides a high level of safety. The seismic core damage frequency that can be inferred from the proposed ground motion spectrum (~$2x10^{-6}$/yr) is significantly less than the median found in seismic probabilistic risk assessments for 29 existing nuclear power plants. The performance-based alternative method yields results that are in concert with the Commission's expectation that advanced reactors will provide enhanced margins of safety and/or utilize simplified, inherent, passive, or other innovative means to accomplish their safety functions.

The alternative, performance-based, method uses a target frequency that does not change with time as new information on the seismicity of power plant sites changes. In this sense, the alternative method provides some additional regulatory stability. For this reason, if no other, we expect that the alternative method will be attractive to licensees and applicants for a variety of purposes. The staff may want to consider developing a regulatory guide on the use of the alternative methodology. Certainly, the detailed review of the method conducted by the staff for this early site permit would provide a substantial technical basis for the development of such a regulatory guide.

Sincerely,

/RA/

Graham B. Wallis
Chairman

References:

1. Exelon Generation Company, LLC, Early Site Permit Application, September 23, 2003.
2. ACRS Interim Letter, Exelon Generation Company, LLC, Application for Early Site Permit and the Associated NRC Staff's Draft Safety Evaluation Report, dated September 22, 2005.
3. EDO response to ACRS Interim Letter, "Interim Letter: Exelon Generation Company, LLC, Application for Early Site Permit and the Associated NRC Staff's Draft Safety Evaluation Report on the Clinton Early Site Permit Site," dated October 26, 2005.
4. Final Safety Evaluation Report for Exelon Early Site Permit Application, dated February 17, 2006.
5. Exelon Generation Company, LLC, letter to the U.S. Nuclear Regulatory Commission Subject: "Seismic Risk (Performance Goal) Based Approach Primer Revision," dated January 14, 2005.
6. NRC Regulatory Guide 1.165, "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion," March 1997.
7. American Society of Civil Engineers, Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities, ASCE/SEI 43-05 (ASCE Standard 43-05), 2005.

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Sincerely,

Graham B. Wallis
Chairman

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1. Exelon Generation Company, LLC, Early Site Permit Application, September 23, 2003.
2. ACRS Interim Letter, Exelon Generation Company, LLC, Application for Early Site Permit and the Associated NRC Staff's Draft Safety Evaluation Report, dated September 22, 2005.
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5. Exelon Generation Company, LLC, letter to the U.S. Nuclear Regulatory Commission Subject: "Seismic Risk (Performance Goal) Based Approach Primer Revision," dated January 14, 2005.
6. NRC Regulatory Guide 1.165, "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion," March 1997.
7. American Society of Civil Engineers, Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities, ASCE/SEI 43-05 (ASCE Standard 43-05), 2005.

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NAME	DFischer		CSantos		MSnodderly		AThadani		JLarkins		JTL for GBW	
DATE	03/23/06		03/23/06		03/24/06		/ /06		03/24/06		03/24/06	

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

May 2, 2006

Dr. Graham B. Wallis, Chairman
Advisory Committee on Reactor Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: FINAL REVIEW OF THE EXELON GENERATION COMPANY, LLC, APPLICATION FOR EARLY SITE PERMIT AND THE ASSOCIATED NRC STAFF'S FINAL SAFETY EVALUATION REPORT

Dear Chairman Wallis:

Thank you for your letter dated March 24, 2006, regarding the final safety evaluation report (FSER) for the Exelon Generation Company, LLC, (EGC) early site permit (ESP) application. The staff of the U.S. Nuclear Regulatory Commission (NRC) will reproduce your letter as Appendix E to the FSER for the EGC ESP, which will be issued as a final NRC technical report, a NUREG, on May 1, 2006. In your letter, the Advisory Committee on Reactor Safeguards (ACRS) agreed with the NRC staff's conclusions that the EGC ESP site is adequate for the proposed use when subject to the six proposed permit conditions, and the ACRS recognized that the NRC staff has thoroughly reviewed EGC's new performance-based method for determining the safe shutdown earthquake ground motion (SSE). On this basis, the NRC staff has updated the FSER to reflect the ACRS conclusions.

In your letter, you also stated that the NRC staff should consider development of a regulatory guide to address the performance-based method for assessing the seismic hazard of a site. As discussed in the March 9, 2006, ACRS meeting, the staff has been interacting with industry representatives since summer 2005 to further develop the generic technical bases for the performance-based approach for determining the SSE. In parallel with these interactions, the NRC staff has initiated the process for revising Regulatory Guide 1.165, "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion," to allow for the use of the performance-based approach, as well as to address other seismic related technical issues. The current plan calls for a draft revision of Regulatory Guide 1.165 by the end of 2006. After the NRC staff has developed the draft regulatory guide, we plan to discuss the proposed revisions with the ACRS.

The NRC staff appreciates the insights that the ACRS has provided concerning the sections on safety in the EGC ESP. These insights are a valuable contribution to the NRC staff's review and development of the FSER.

Sincerely,

Luis A. Reyes
Executive Director
for Operations

cc: Chairman Diaz
Commissioner McGaffigan
Commissioner Merrifield
Commissioner Jaczko
Commissioner Lyons
SECY

Exelon Early Site Permit
Seismic Review Status

March 8, 2006

Advisory Committee on Reactor Safeguards
Early Site Permit Subcommittee Meeting

John Segala, Senior Project Manager
Office of Nuclear Reactor Regulation

Purpose

- To provide the ACRS an overview of the Exelon early site permit (ESP) application seismic review
- Answer the Subcommittee's questions

Meeting Agenda

- Schedule Milestones
- Seismic Open Items
- Presentation Conclusions
- Discussion / Subcommittee questions

Completed Milestones

- Received Exelon ESP application - September 25, 2003
- FRN published announcing acceptance – October 31, 2003
- FRN published for mandatory hearing – December 12, 2003
- RAIs issued to the Applicant – July, 27, 2004
- Draft SER issued – February 10, 2005
- Applicant responds to Draft SER open items – April 26, 2005
- Supplemental Draft SER issued – August 26, 2005
- ACRS Full Committee Meeting - September 8, 2005
- ACRS interim letter – September 22, 2005
- Staff provided Final SER to ACRS – February 9, 2006
- **Staff issued Final SER – February 17, 2006**

Remaining Milestones

- ACRS Full Committee Meeting – March 9, 2006
- ACRS letter assumed – March 30, 2006
- Final SER issued as NUREG – May 1, 2006
- Mandatory hearings begin Fall 2006
- Commission decision assumed mid 2007

Seismic Open Items

- 7 Seismology and Geology Open Items
  - 2 - Performance-based (PB) approach for determining safe shutdown earthquake (SSE)
  - 2 – Seismic
  - 3 - Geotechnical

Seismic Open Items

- 2.5.1-1, Incorporate most recent New Madrid seismic source model into the PSHA and SSE

- 2.5.2-1, Clarify the EPRI ground motion attenuation study distance-conversion method

Geotechnical Open Items

- 2.5.2-2, Site response model does not adequately represent variability of soil properties
- 2.5.2-3, Site response analysis should use appropriate shear modulus and damping curves
- 2.5.4-1, Further soil exploration needed for COL

NRC Experience with the Performance-Based Methodology

- NUREG/CR-6728 (April 2002) first introduced the staff to the performance-based approach
- NRC staff participated on the Committee that developed ASCE 43-05
- Use of a performance-based approach for determining the SSE first identified in Exelon's application in September 2003
- NRC formed a Seismic Technical Advisory Group
  - Seismic & Civil Engineers from NRR, NMSS, and RES
  - Served in an advisory role to NRR for review of performance-based approach

Exelon's Performance-Based (PB) Safe Shutdown Earthquake (SSE)

NRC staff concluded:

1. PB method based on sound technical approach
2. Seismic design using PB SSE achieves safety level generally higher than operating plants
3. PB SSE adequately reflects local ground motion hazard from Springfield earthquake

Conclusion 1

PB method based on sound technical approach

- Overriding Goal: Achieve both high and consistent level of seismic safety in the design of future NPPs
- PB approach is risk-based
  - Incorporates both site specific seismic hazard and structural fragility model
- PB approach requires structures be designed to achieve target performance goal

Conclusion 1 (Cont.)

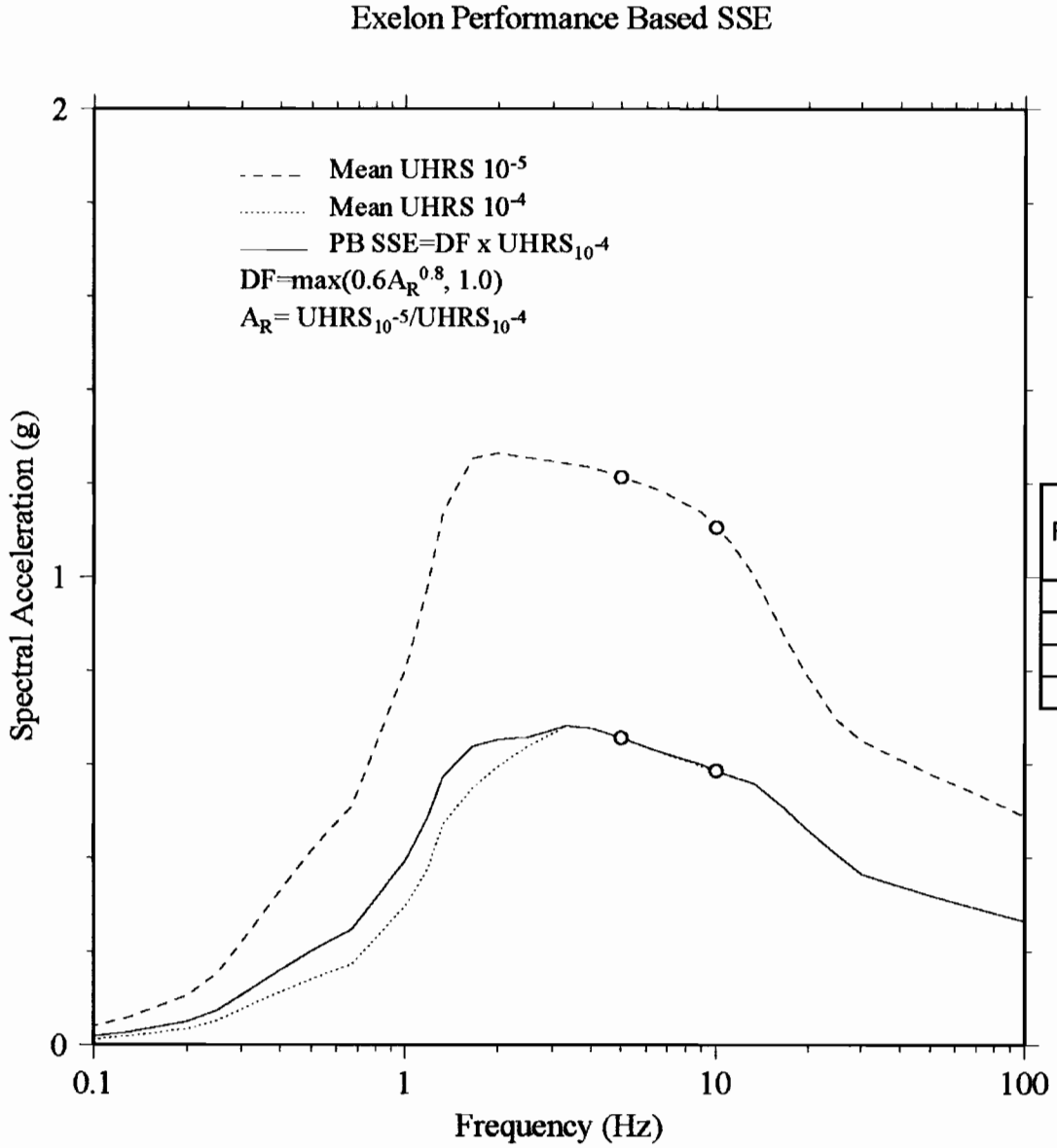
- PB SSE determined by two approaches:
  - Design Factor Method (ASCE 43-05)
  - Direct Integration of Risk Equation
- Design Factor Method
  - PB SSE determined by multiplying 10^{-4} UHRS by design factor to achieve target performance goal

$$PB\ SSE = DF \times UHRS_{10^{-4}}$$

$$DF = \mathrm{Max}\left(0.6 A_R^{\ 0.8}, 1.0\right)$$

$$A_R = \frac{UHRS_{10^{-5}}}{UHRS_{10^{-4}}}$$

Conclusion 1 (Cont.)



Spectral Frequency (Hz)	10-4 Mean UHRS (g)	10-5 Mean UHRS (g)	AR	DF	Horiz. SSE (g)
1	0.297	0.802	2.700	1.328	0.395
2.5	0.638	1.256	1.968	1.031	0.658
5	0.657	1.215	1.849	1.000	0.657
10	0.586	1.107	1.887	1.000	0.586

Conclusion 1 (Cont.)

- Direct Integration

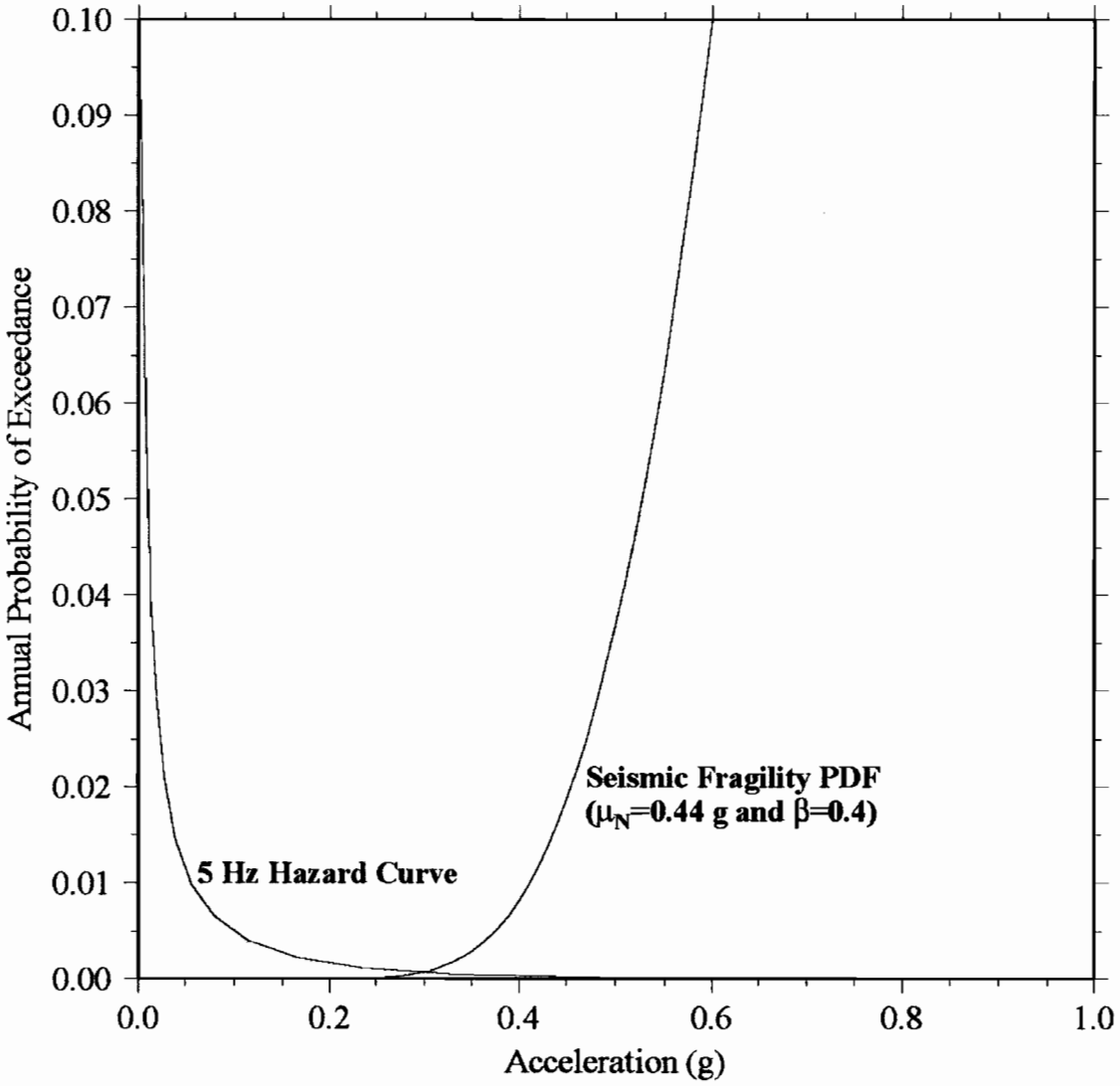
$$P_{fT} = \int H(a) f_c(a) da$$

P_{fT} = Target Performance Frequency

$H(a)$ = Seismic Hazard Curve

$f_c(a)$ = Probability Density Function for SSC Seismic Fragility

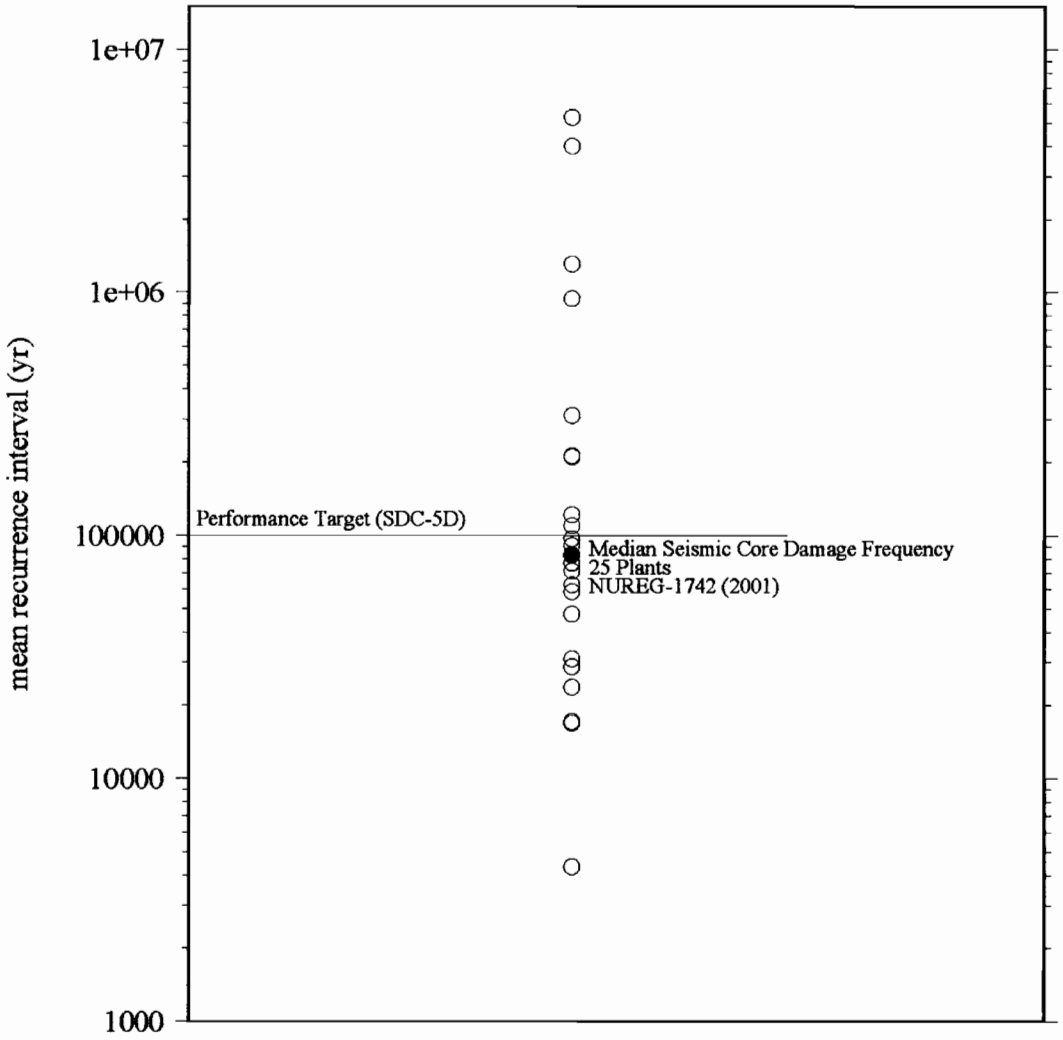
Conclusion 1 (Cont.)



Conclusion 1 (Cont.)

- Performance Target (P_{FT}) is $1x10^{-5}$ per year
  - Implies probability of onset of inelastic behavior shall be less than 10^{-5}/yr
- Basis for P_{FT} 10^{-5}/yr:
  - IPEEE Seismic PRAs conducted for 25 NPPs during mid/late 1990s determined annual seismic CDF values
  - Median SCDF is 1.2x10-5/yr
- P_{FT} corresponds to minimum damage state
- SCDF implies a higher damage state

Conclusion 1 (Cont.)

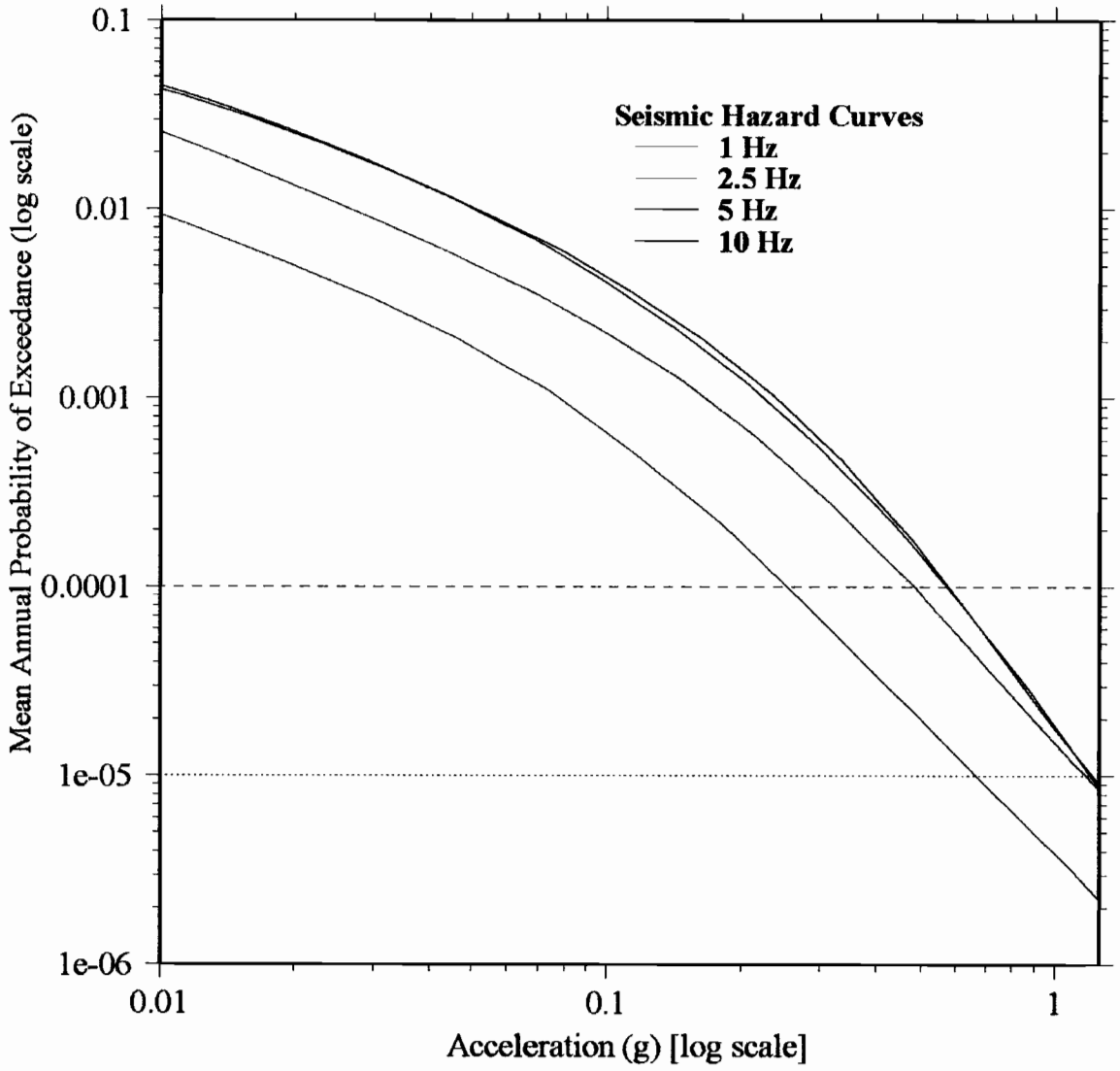


Conclusion 1 (Cont.)

- Seismic Hazard Curve
  - ASCE 43-05 assumes a linear hazard curve between 10^{-4} and 10^{-5}
  - Slight downward curvature of hazard curve

	SSE	
Frequency (Hz)	Risk Integral (g)	Risk Equation (g)
1	0.337	0.395
2.5	0.574	0.658
5	0.604	0.657
10	0.559	0.586

Conclusion 1 (Cont.)



Conclusion 1 (Cont.)

- Seismic Fragility
  - PB approach models SSC seismic fragility using lognormal distribution

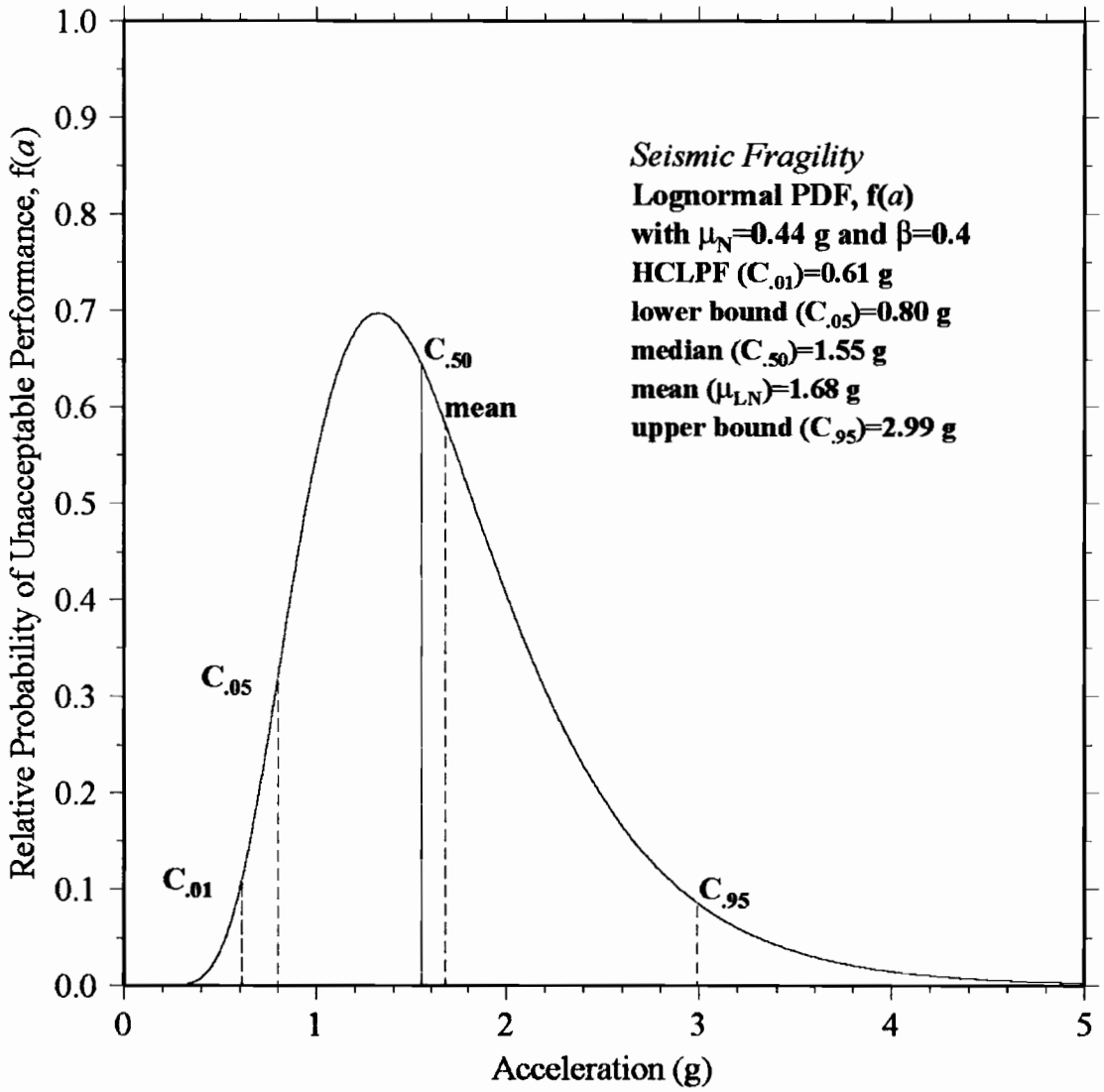
$$f_c(a) = \frac{1}{\sqrt{2\pi}\beta a} \exp\left[-\frac{1}{2}\left(\frac{\ln a - \mu}{\beta} \right)^2 \right], a > 0$$

  - Fragility Parameters: Mean (μ), SD (β)
    - Mean expressed in terms of $C_{1\%}$ or HCLPF
    - HCLPF corresponds to 1% capacity level on mean fragility curve

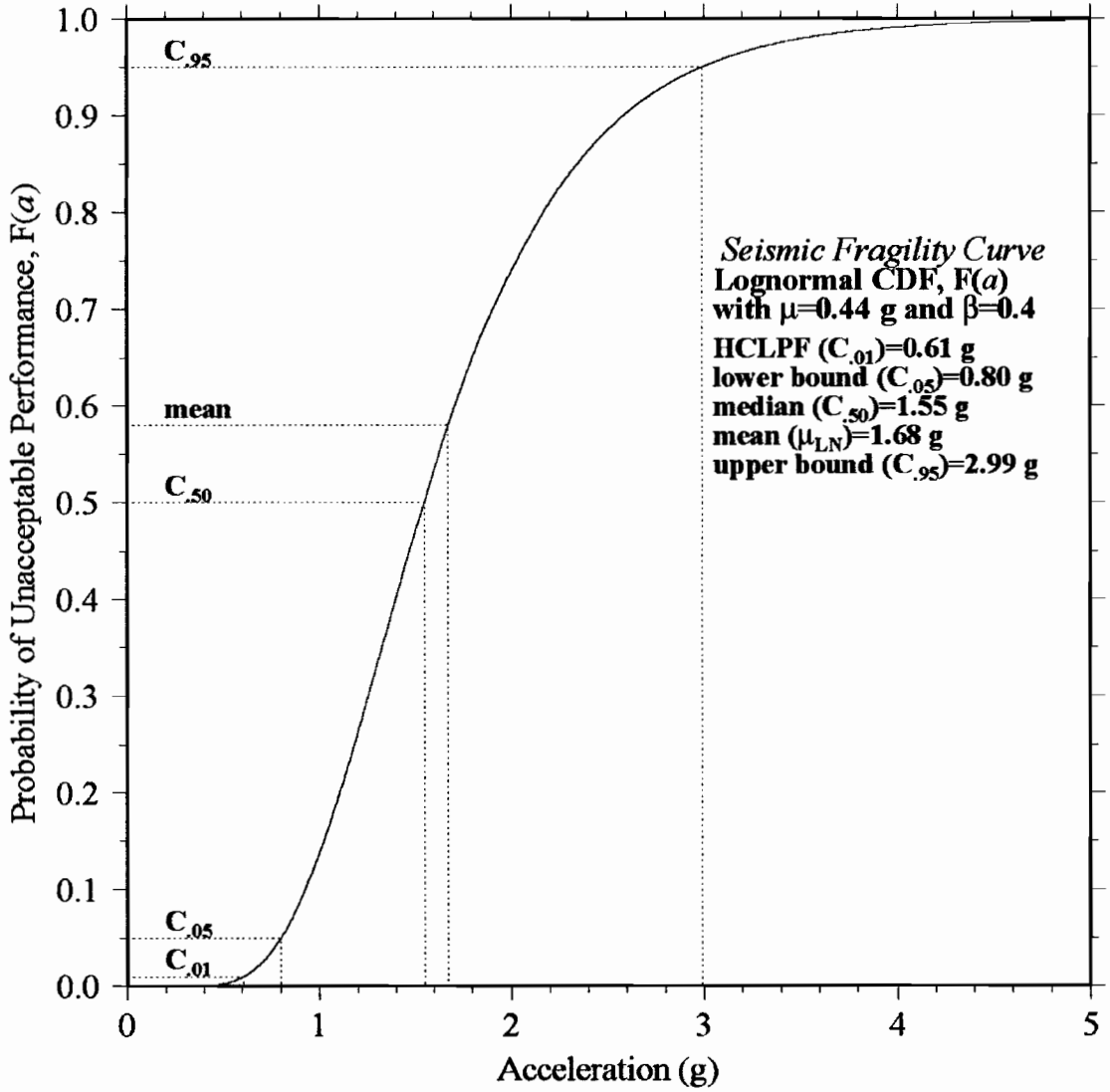
$$\mu = \ln HCLPF + 2.32\beta$$

$$HCLPF = SSE \times M_s$$

Conclusion 1 (Cont.)



Conclusion 1 (Cont.)



Conclusion 1 (Cont.)

- Parameter Assumptions
  - SSE is back-calculated by assuming:
    - Target $P_{FT} = 1x10^{-5}/yr$
    - Linear Hazard Curve
    - $\beta = 0.4$
    - Seismic Margin = 1

Conclusion 1 (Cont.)

Target Performance Frequency for $\beta = 0.4$

		PFT*10-5/yr			
Freq (Hz)	SSE (g)	β=0.3	β=0.4	β=0.5	β=0.6
1	0.395	1.08	0.95	0.7	0.55
2.5	0.658	1.05	0.97	0.73	0.59
5	0.657	1.03	0.96	0.71	0.58
10	0.586	1.02	0.91	0.65	0.52

Conclusion 1 (Cont.)

- Seismic Margin (M_s)
  - SECY 93-087 requires an overall HCLPF Seismic Margin of 1.67
  - ASCE 43-05 does not take credit for Seismic Margin ($M_s = 1$)
    - Higher M_s results in lower SSE

$$SSE = \frac{1}{M_s}(\ldots)$$

Conclusion 1 (Cont.)

Summary of Conclusion 1:

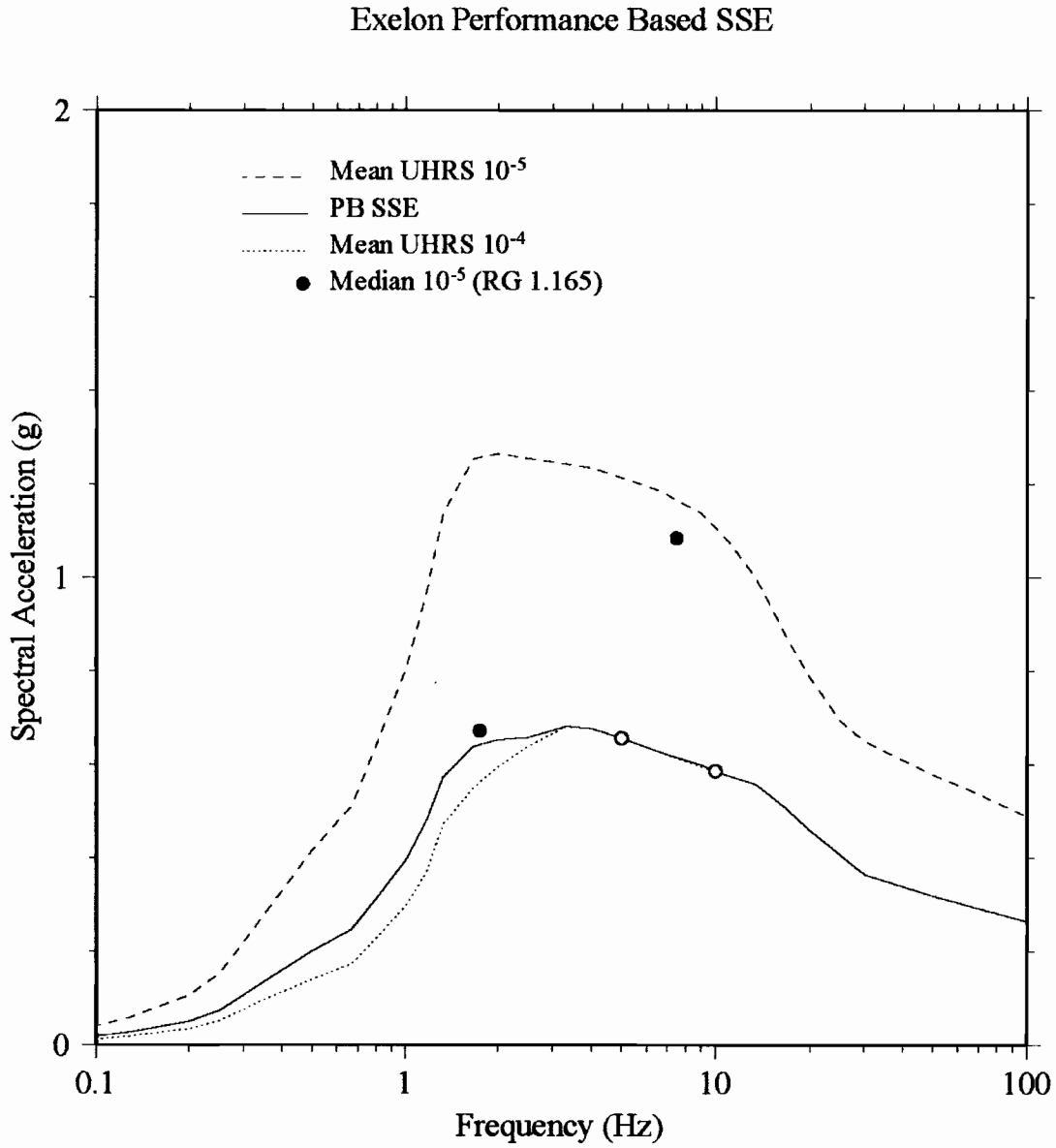
- PB Approach
  - Achieves both high and consistent level of seismic safety
  - No credit for seismic margin
  - Equates performance target to SCDF for existing NPPs
  - Based on conservative parameter and modeling assumptions

Conclusion 2

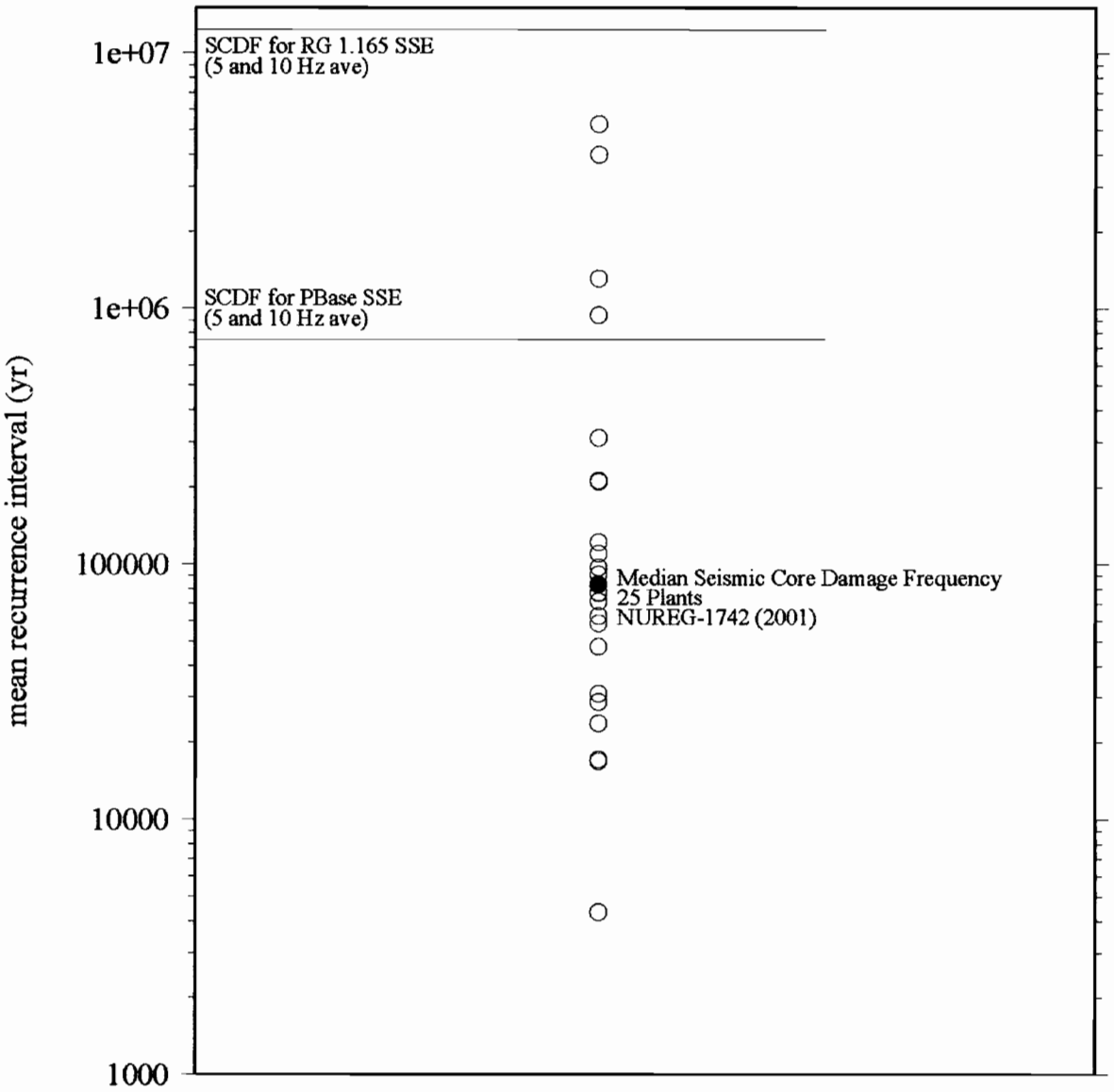
PB SSE achieves safety level generally higher than operating NPPs

- Commission Policy on Advanced RXs
  - Advanced RXs same degree of protection as operating NPPs
  - Advanced RXs provide enhanced margins of safety
- Using Clinton PB SSE values and HCLPF seismic margin of 1.67 (SECY 93-087)
  - What are SCDF values?
  - How do Clinton PB SCDF values compare to current NPPs?

Conclusion 2 (Cont.)



Conclusion 2 (Cont.)

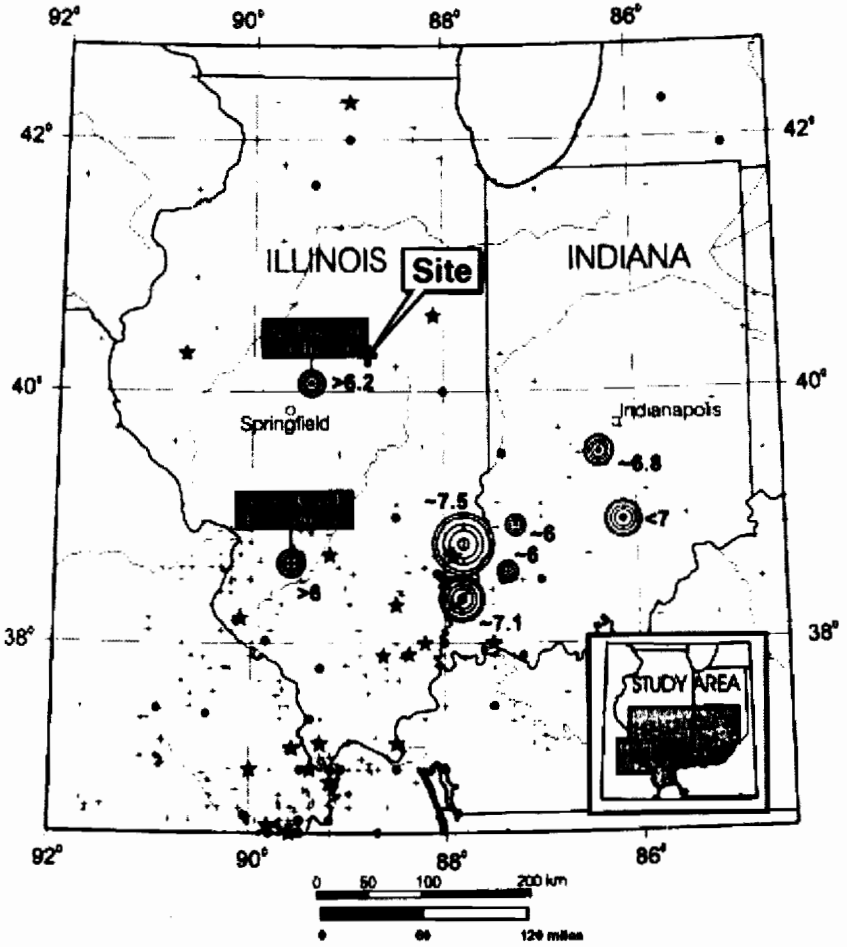


Conclusion 3

PB SSE adequately reflects local ground motion hazard

- Staff reviewed SSE to ensure it reflects local seismic hazards
- Greatest seismic hazard for central Illinois from Springfield earthquake
  - Prehistoric earthquake (5900 to 7400 years ago)
  - Near Springfield (60 km SW of ESP site)
  - Magnitude estimates (6.2 to 6.8)
    - Recent Study (M6.3)

Conclusion 3 (Cont.)



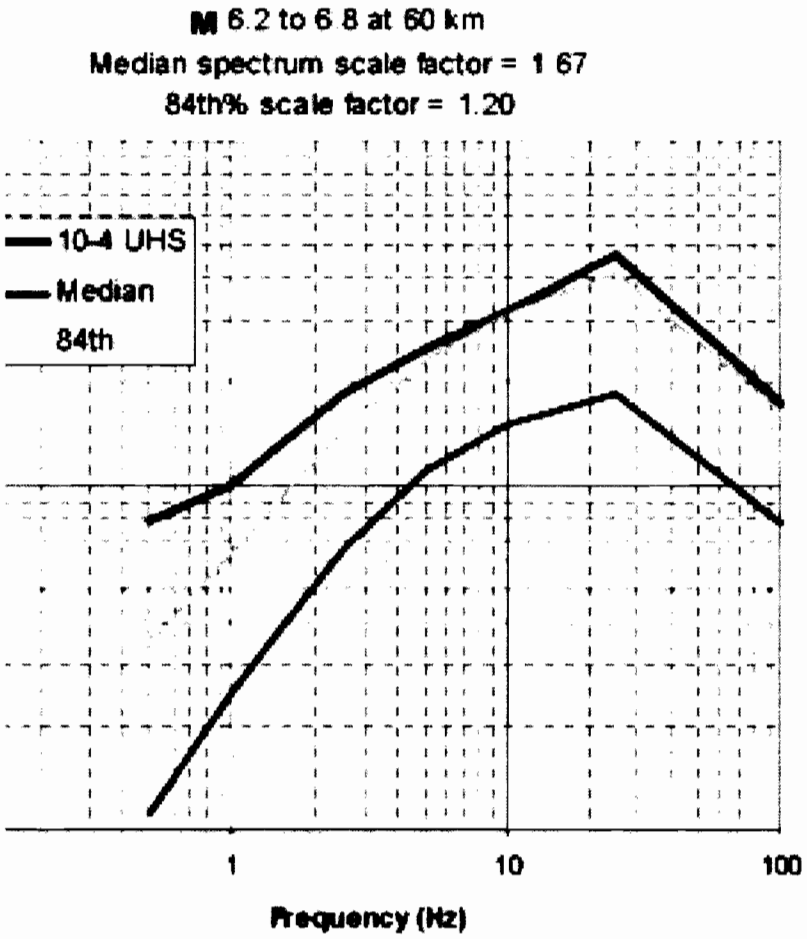
A star represents a magnitude of 5 or higher. A solid circle represents a magnitude between 4.5 and 5. A plus sign represents a magnitude between about 2.3 and 4.5. Historical earthquake data are from USGS/NEIC Global Hypocenter Data Base CD-ROM (Version 3.0). Concentric circles show estimated energy centers of large prehistoric earthquakes. The estimated moment magnitude M for a prehistoric earthquake is located near the circle

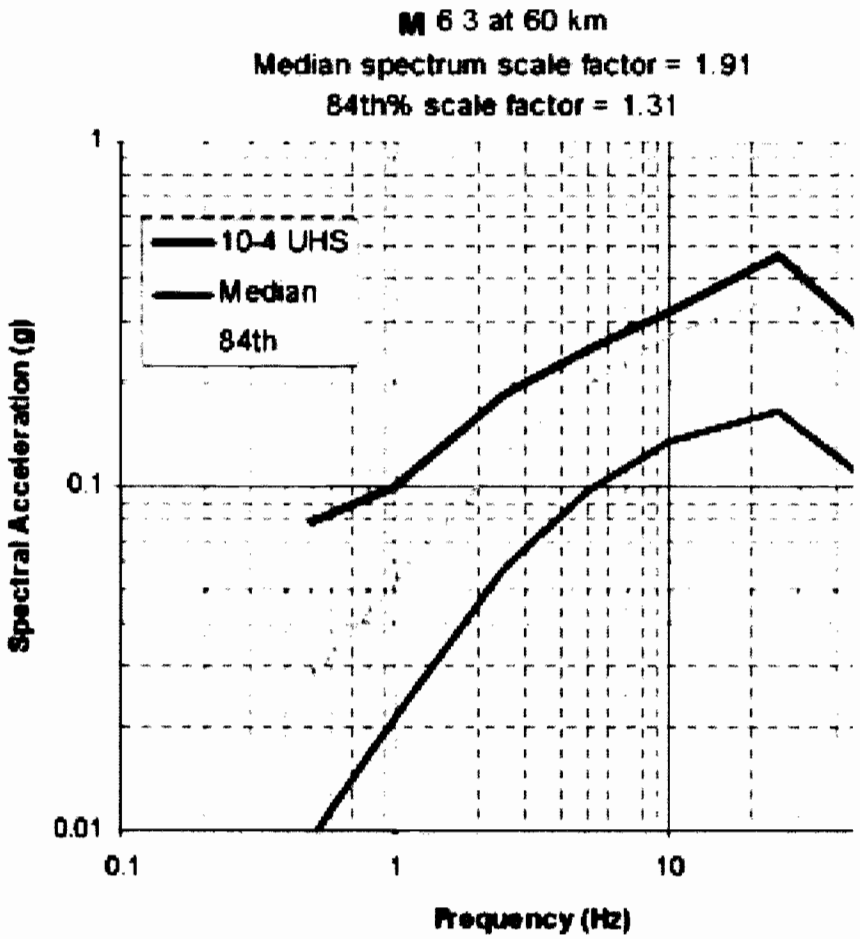
Note:

Conclusion 3 (Cont.)

- Exelon conducted Paleoliquefaction surveys on streams near ESP site
  - Found no evidence of repeated moderate to large earthquakes comparable to Springfield earthquake
- Exelon determined ground motion estimates from Springfield earthquake enveloped by $UHRS_{10\text{-}4}$ and PB SSE

Conclusion 3 (Cont.)





Summary

- All seismic open items resolved
- SSE is appropriate for the ESP site
- Questions or comments?

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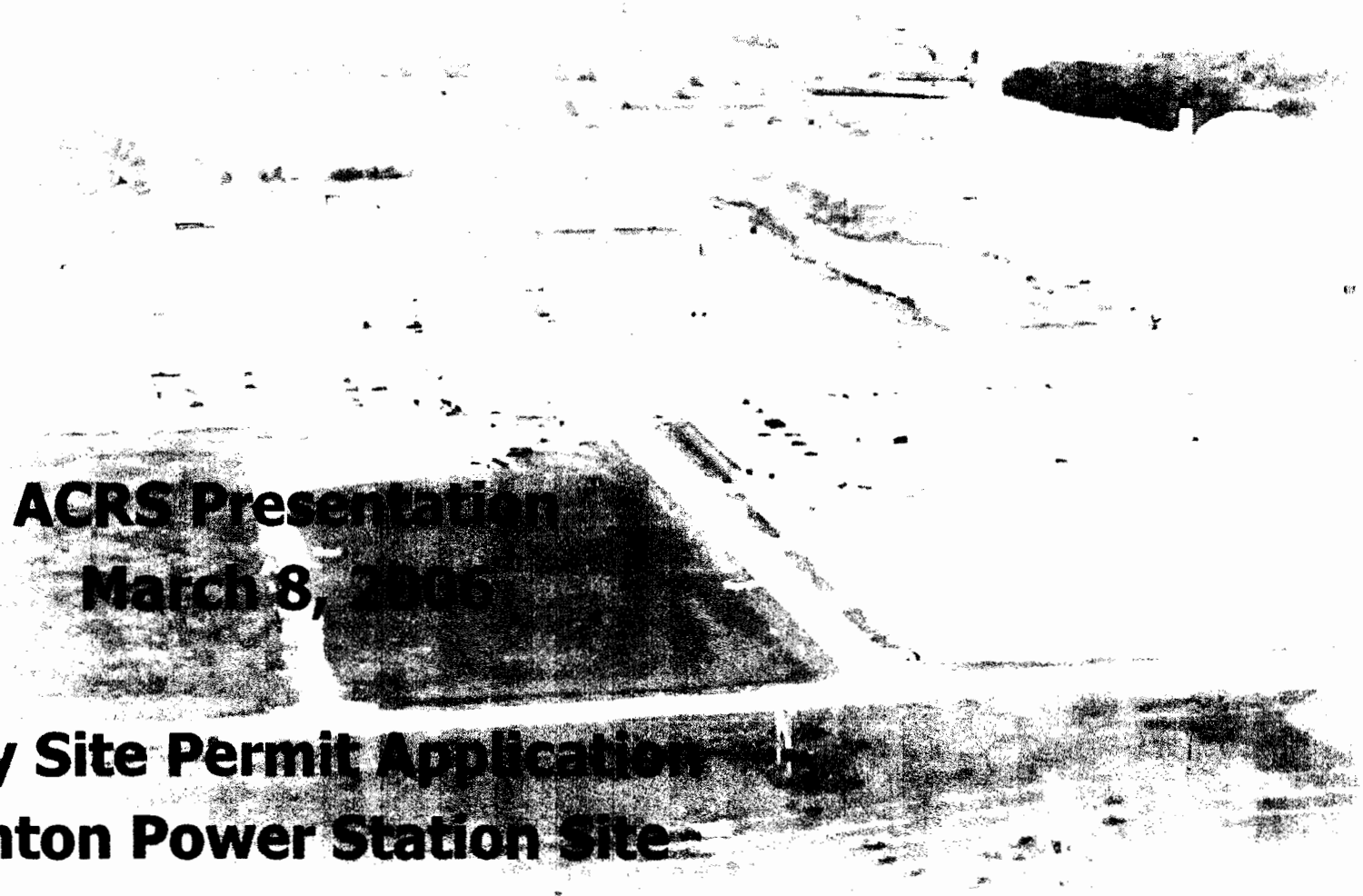

ACRS Presentation
March 8, 2006

Early Site Permit Application
Clinton Power Station Site
Final Safety Evaluation Report

Agenda

- Introductions
- Significant Changes Since Draft Safety Evaluation Report (DSER)
- Geotechnical Approach
- Seismic Evaluation
- Supplemental DSER Issue Closure
- Summary

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Introductions - ESP Project Team

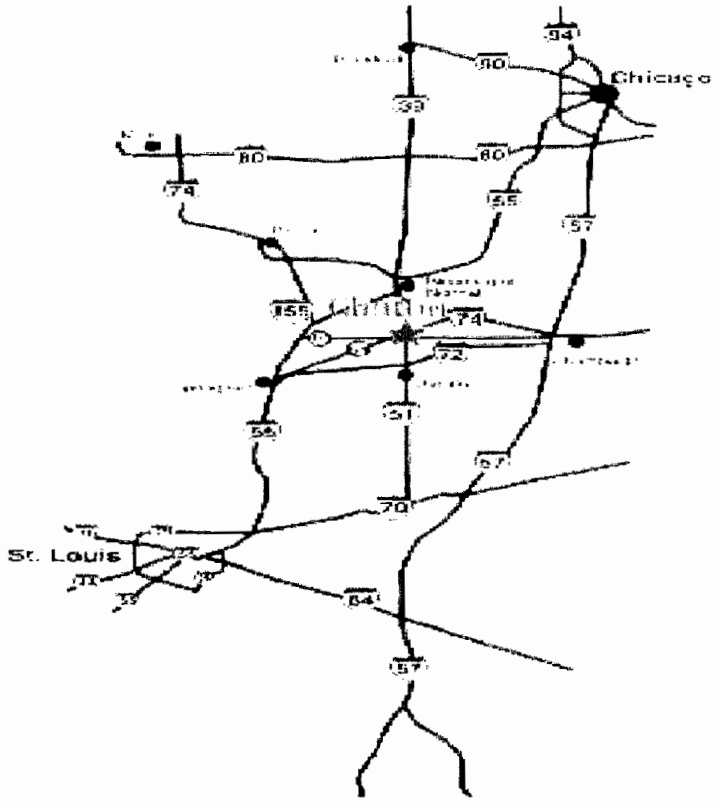
- Marilyn Kray – Project Executive Sponsor
- Christopher Kerr – Sr. Project Manager
- Eddie Grant – Safety / EP Lead
- William Maher – Environmental Lead

Introductions – Support Team

- CH2M Hill (Prime Contractor)
  - Environmental / Redress
  - Geotechnical
  - EP
- CH2M Hill Subcontractors
  - WorleyParsons
    - Safety
  - Geomatrix
    - Seismic
  - Seismic Board of Review
    - Expert, independent review
  - Others
- RPK Structural Mechanics Consulting
  - Seismic
- Sargent and Lundy
  - Draft Application Review
- Morgan Lewis
  - Legal counsel

Introductions – Site Location

- ESP Site Location
  - Central Illinois
  - Clinton Power Station Property
  - AmerGen Owned (EGC Subsidiary)
- Applicant
  - Exelon Generation Company, LLC (EGC)
    - o Wholly owned subsidiary of Exelon Corporation



Significant Changes Since DSER

- Closure of all Open Items
- Completion of all Confirmatory Items
- Acceptance of SSE ground motion spectra
  - Minor revisions in response to open items
- Documented Criteria for:
  - Permit Conditions
  - Combined License Action Items

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Geotechnical Approach

- Builds on existing CPS information
  - Regional geology
  - Site geology
  - Exploration
  - Laboratory testing
- EGC ESP work
  - Confirm conditions
  - Updated information

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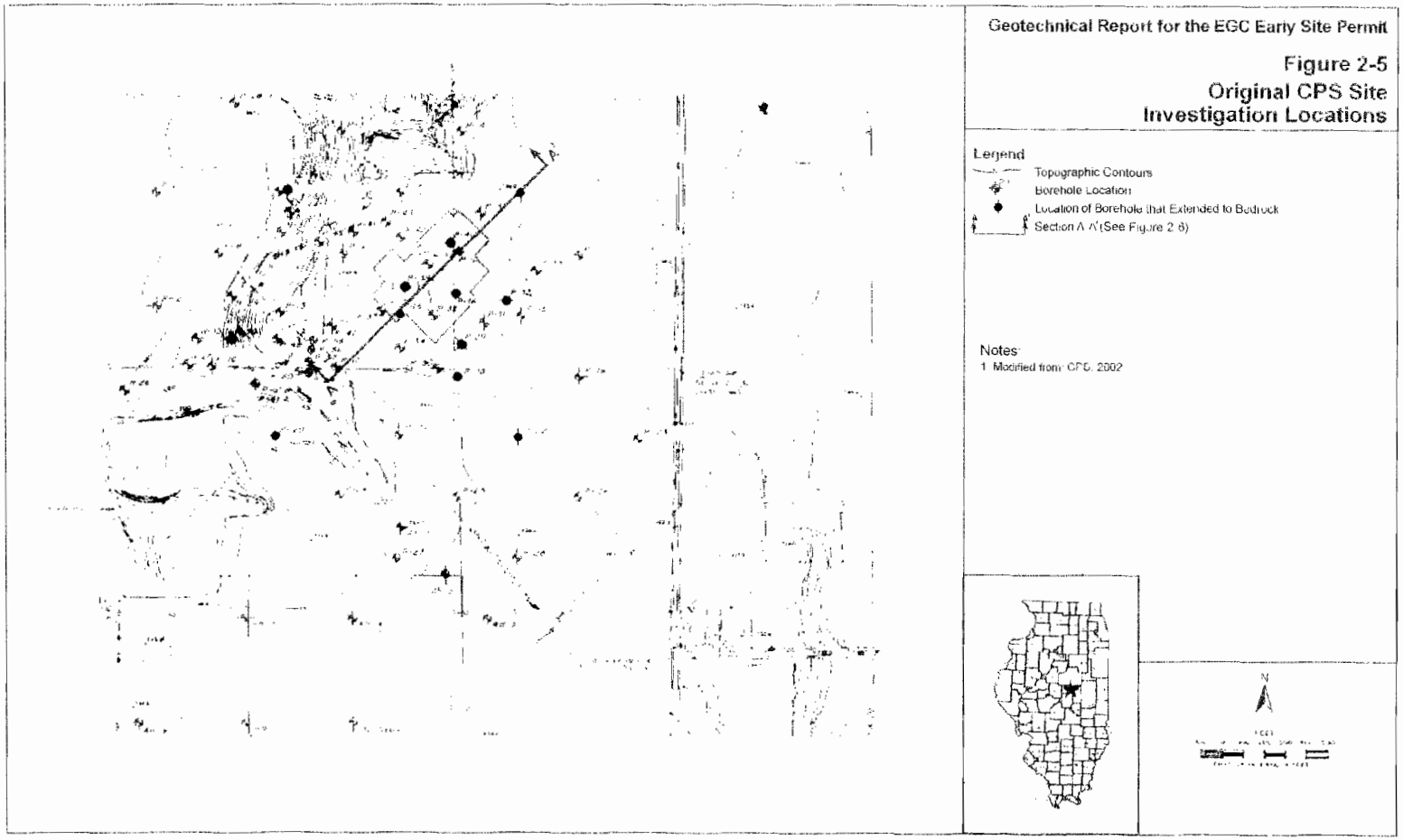
Geotechnical Approach (cont'd)



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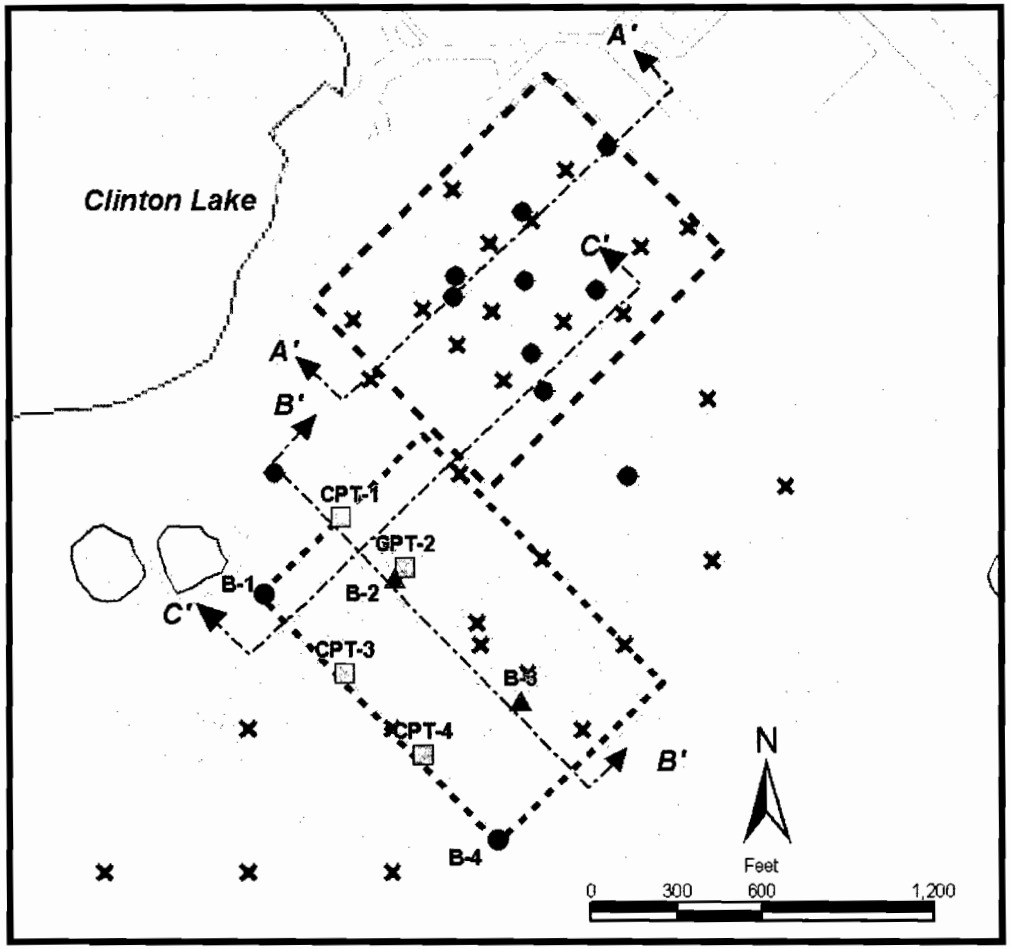
Geotechnical Approach (cont'd)



Modified from ESP SSAR, Appendix A, Figure 3-1

Geotechnical Approach (cont'd)

Site is:

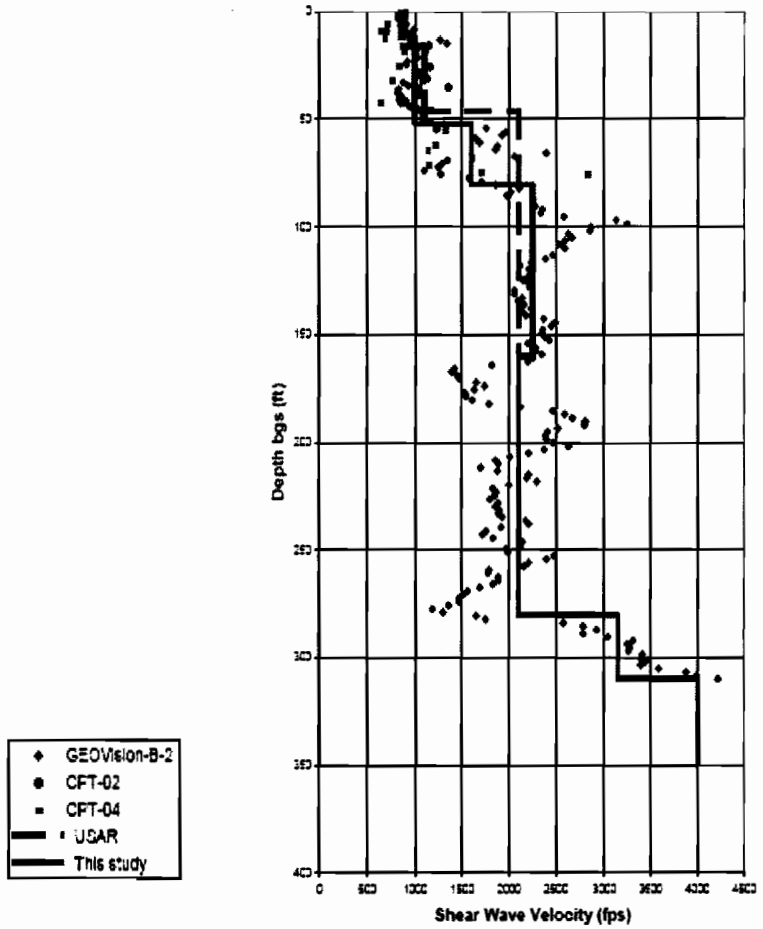
- Relatively uniform
- Stiff soils

Field data shows:

- Shear wave velocities consistent with CPS characterizations

Lab data shows:

- Good match to EPRI soil modulus and damping curves



Seismic Evaluation

SSE Ground Motion Determination

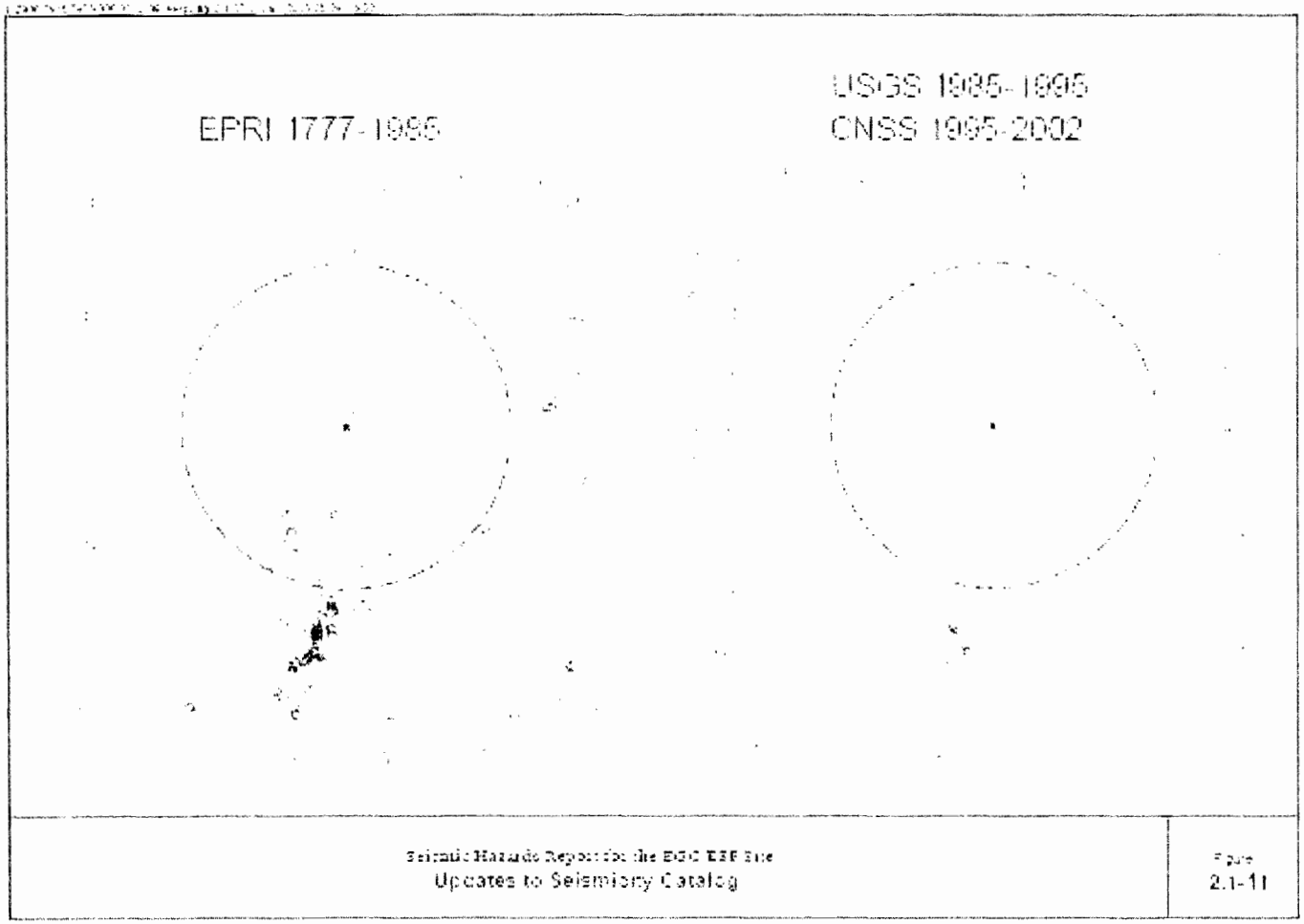
RG 1.165 Methodology	*EGC ESP Application*
➢ Investigations	➢ Same
➢ Seismic sources update	➢ Same
➢ SSHAC assessment	➢ Same
➢ PSHA	➢ Same
➢ Determine SSE ground motion spectra	➢ Determine SSE ground motion spectra
• **Relative based -- Reference Hazard Probability Criterion**	• **Performance-based – Risk-informed Criterion**

Seismic Evaluation (cont'd)

SSE Ground Motion Determination (cont'd)

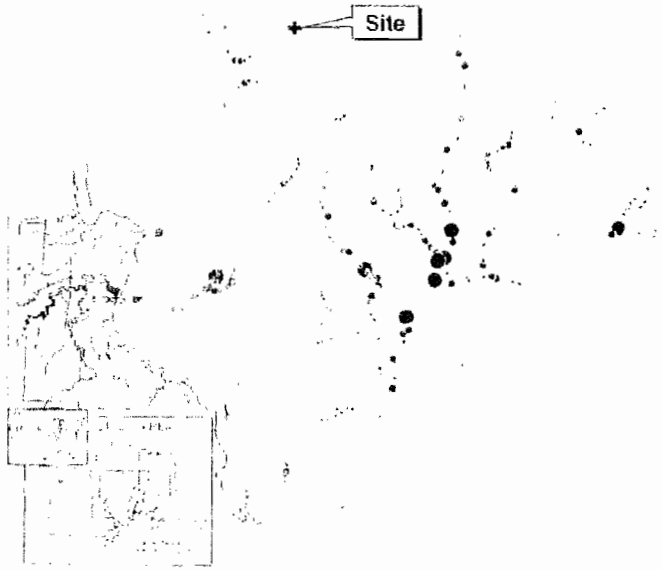
RG 1.165 Methodology	*EGC ESP Application*
➢ De-aggregate to identify controlling earthquakes	➢ Same
➢ Account for site effects	➢ Same [NUREG/CR-6728]

Seismic Evaluation (cont'd)



Seismic Evaluation (cont'd)

- Major new information
  - Repeated large events in New Madrid seismic zone in past 2,000 years
  - Large events in Wabash Valley/ Southern Illinois in past 12,000 years
  - One moderate event with energy center ~30 miles SW of site at Springfield ~6,000 years ago



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Seismic Evaluation (cont'd)

Reference Hazard RG 1.165, App. B

- Reference Probability
  - The annual probability level such that 50% of the set of most modern design currently operating plants have an annual median probability of exceeding the SSE that is below this level (1E-5) determined at an average of the 5 and 10 Hz SSE spectra with 5% damping.

Performance-Based ASCE 43-05

- Performance-Based
  - SSCs will have a target mean annual frequency of 1E-5 for seismic induced onset of significant inelastic deformation.
  - Significant margin against SSC failures that might lead to core damage.
  - Leads to seismically induced CDF significantly less than for existing plants

Seismic Evaluation (cont'd)

Performance-Based Approach History

- LLNL UCRL-15910, Design and Evaluation Guidelines for U.S. Department of Energy Facilities Subjected to Natural Phenomena Hazards, 1990
- DOE-Std-1020, Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities, 1994 & 2002
- USNRC NUREG/CR-6728, Technical Basis for Revision of Regulatory Guidance on Design Ground Motions: Hazard- and Risk-Consistent Ground Motion Spectra Guidelines, 2001
- ASCE/SEI 43-05, Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities, 2005

Seismic Evaluation (cont'd)

Performance-Based Approach Basis

- Establish Target Seismic Risk Goal, P_{FT}, Against OSID
- Establish Design Criteria Conservatism
  - ASCE Most Stringent Seismic Design Category, SDC-5D
  - Similar to Seismic Design Criteria, NUREG-0800
- Establish UHRS
  - Reference Seismic Hazard Exceedance Frequency, H
- Increase UHRS by "Design (Scale) Factor," DF
  (Based on Minimum Seismic Margin Factors for OSID)
  - 1% Probability of Unacceptable Performance for SSE
  - Also 10% Probability of Unacceptable Performance for 1.5xSSE

Seismic Evaluation (cont'd)

Performance-Based Approach Application

- Target Seismic OSID Risk Goal, $P_{FT} \leq$ mean 10^{-5}/yr
  - Based on Reported Seismic CDF of 25 licensed plants
- Design Criteria, NUREG-0800 ~ ASCE SDC-5D
- UHRS established at mean 10^{-4}/yr
- "Design (Scale) Factor," DF = 1.04 to 1.30 for EGC ESP
- Perform Probabilistic Analysis
  - Seismic CDF $\leq$ mean 2×10^{-6}/yr for EGC ESP

[[Detailed Derivation (ADAMS ML050250137)]]

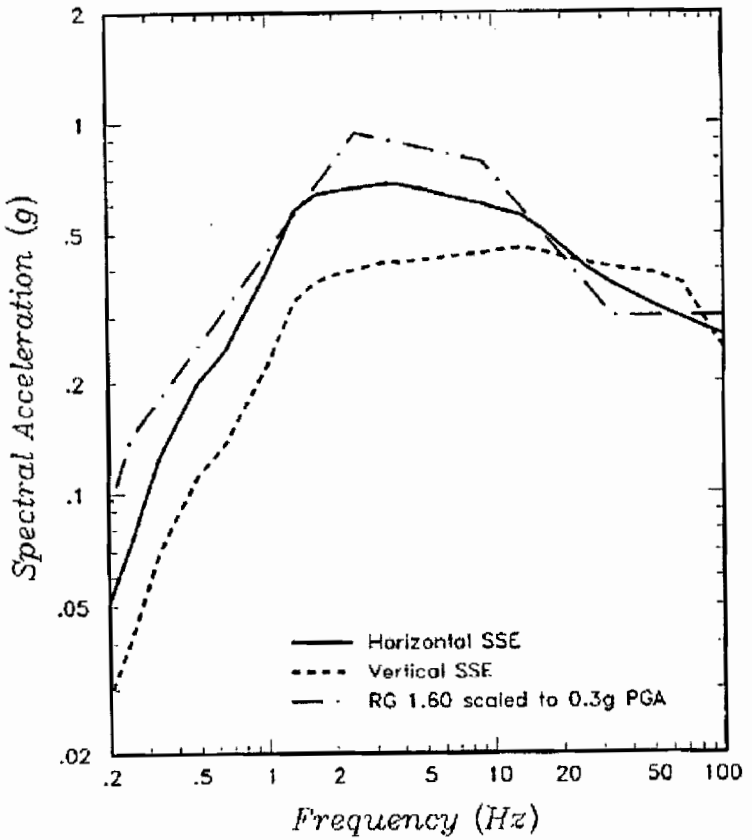
Seismic Evaluation (cont'd)

Seismic CDF for EGC ESP Hazard Curves

β	ASCE Method - SCDF $F_{1\%} = 1.67$ $*1x10^{-5}/yr$				
	1 Hz	2.5 Hz	5 Hz	10 Hz	Average 5 & 10 Hz
0.3	0.39	0.26	0.22	0.16	0.19
0.4	0.27	0.17	0.14	0.11	0.12
0.5	0.20	0.12	0.11	0.086	0.096
0.6	0.15	0.10	0.087	0.078	0.082

Seismic Evaluation (cont'd)

- Performance-Based EGC ESP SSE Ground Motion Spectra
  - Horizontal DRS
  - Vertical DRS
  - RG 1.60 0.3g PGA (for reference only)
  - Acceptable to NRC Staff
  - Compared to Design Spectra at COL stage



Supp. DSER Issue Closure

- Open Items (7) - resolved
  - 2.5.1-1, New Madrid magnitude estimates
  - 2.5.2-1, Distance-conversion in EPRI '03 Ground Motion Model
  - 2.5.2-2, Site velocity model for response analysis
  - 2.5.2-3, Site dynamic response analysis
  - 2.5.2-4, SSE ground motion adequately represents local prehistoric earthquakes
  - 2.5.2-5, Performance-based method clarification
  - 2.5.4-1, Additional borings

Supp. DSER Issue Closure

- New Madrid magnitude estimates
  - 2.5.1-1, NRC Issue – Incorporate hazard due to recent new estimates of magnitudes of the New Madrid earthquakes

Applicant actions:

- Hazard revised to include the small impact
  - o Site response spectra revision < 10%

Supp. DSER Issue Closure (Cont'd)

- Distance-conversion in EPRI 03 Ground Motion Model
  - 2.5.2-1, NRC Issue – Provide further clarification of EPRI 03 Ground Motion Model distance-conversion methodology

Applicant actions:

- Provided detailed description of the EPRI '03 distance-conversion implementation process

Supp. DSER Issue Closure (Cont'd)

- Site velocity model for response analysis
  - 2.5.2-2, NRC Issue – Further justify using a single velocity model for variability in strength and stiffness of site soils

Applicant actions:

- Variability of concern is in top 60 ft of soil profile
  - o This soil will be removed/replaced to address the potential settlement and liquefaction issues
  - o Identified by NRC as proposed Permit Requirement

Supp. DSER Issue Closure (Cont'd)

- Site dynamic response analysis
  - 2.5.2-3, NRC Issue – Demonstrate appropriateness of site dynamic properties model and implement 15% damping cutoff on free-field site response

Applicant actions:

- Provided additional information on soil plasticity and revised analysis using 15% damping cutoff
  - o Site response spectra revision < 2%

Supp. DSER Issue Closure (Cont'd)

- SSE ground motion adequacy
  - 2.5.2-4, NRC Issue – Justify SSE adequacy as bounding local prehistoric earthquakes

Applicant actions:

- Clarifying information provided addressing:
  - Use of prehistoric earthquake data in PSHA
  - Determination of controlling earthquake per RG 1.165
  - Relation of SSE ground motion to controlling earthquake
  - Comparison of SSE ground motion to estimated local prehistoric earthquake

Supp. DSER Issue Closure (Cont'd)

- Performance-Based Method Clarifications
  - 2.5.2-5, NRC Issue – Provide additional information regarding assumptions for implementation of the performance-based methodology

Applicant actions:

- Clarifying information provided addressing:
  - Appropriate mean annual hazard for implementing method
  - Determination of design factors and assumption of HCPLF margin and SSC capacity
  - Onset of significant inelastic deformation
  - Target performance goal value, its stability, and applicability for advanced reactor designs
  - Similarity of design criteria in SRP and ASCE

Supp. DSER Issue Closure (Cont'd)

- Additional borings
  - 2.5.4-1, NRC Issue – Additional borings will be needed at COL stage

Applicant actions:

- COL applicant will address additional borings per RG 1.132 guidance

Summary

- All Open Items Closed
- All Confirmatory Items Completed
- SSE Ground Motion Spectra Accepted