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NUCLEAR REGULATORY COMMISSION

Title: Grand Gulf Early Site Permit Hearing

Docket Number: 52-009-ESP

Location: Rockville, Maryland

Date: Wednesday, November 29, 2006

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ATOMIC SAFETY AND LICENSING BOARD

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HEARING

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In the Matter of: :

SYSTEM ENERGY RESOURCES, INC.: Docket No. 52-009-ESP

(Early Site Permit for :

Grand Gulf ESP Site) :

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Third Floor Hearing Room

Two White Flint North

11555 Rockville Pike

Rockville, MD 20852-2738

Wednesday, November 29, 2006

The above-entitled matter came on for hearing, pursuant to notice at 9:00 a.m.

BEFORE:

THE HONORABLE LAWRENCE G. McDADE, Chairman

THE HONORABLE NICHOLAS G. TRIKOUROS

THE HONORABLE RICHARD E. WARDWELL

APPEARANCES:

On Behalf of the Applicant:

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On Behalf of the NRC:

JONATHAN RUND, ESQ.
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PATRICK MOULDING, ESQ.
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Office of the General Counsel
US Nuclear Regulatory Commission
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I-N-D-E-X

P-R-O-C-E-E-D-I-N-G-S

9:04 a.m.

JUDGE MCDADE: This hearing will come to order. First, for the NRC staff, is everybody here that's going to be here?

MR. RUND: We have a few people that are just walking in now. They have the electronic versions the Board requested, so if we could request just a couple of minutes to just make sure we've got everything in order. We'll be ready to go in two minutes.

JUDGE MCDADE: Okay. Let me just note one thing. I notice there are people standing in the back. I just would note for you that in the ACRS room which is on the second floor of this building, right down one floor on the elevator, this proceeding is being broadcast. So from your standpoint if you get tired of standing, if a seat doesn't open up you can go down to the second floor to the ACRS room which is available just off the elevator and view the proceedings from there.

While the staff is getting ready, from the applicant are you all set to go?

MS. SUTTON: We're ready, Your Honor.

MR. RUND: Staff is ready.

JUDGE MCDADE: Okay. Before we get started here, again let me remind everybody this is being recorded. It's necessary for the court reporter to take down what we're saying, so to the degree that you can, please remember to talk into the microphone, also to mention to your witnesses that they should be talking into the microphone as well so that we have a record of what it is that they say.

Now, before we get started I want to do a bit of introduction here, an introduction for basically two purposes. One, to explain who we are and what we're doing to any subsequent superior tribunal that may be reviewing what we're doing, and also to explain to the people who are here what it is that we are doing. This is an adjudicatory proceeding, but it's not an adversary proceeding and in that sense it's a little bit different than what probably most people think of by an adjudicative proceeding. In most proceedings you have a plaintiff and a defendant who are adversaries. The plaintiff comes in, they present their evidence, the defendant then raises any affirmative defenses they may have and the judges decide whether or not - or a jury decides whether or not they have met their burden of proof. They serve basically as a referee between the two parties and ultimately make a determination as to whether or not the plaintiff has met its burden of proof.

This is somewhat different in that it's not an adversarial proceeding. We have two parties. We have the NRC staff and we have the applicant, but they have the same interest. They have the interest in getting at this point the application approved. The NRC staff has reviewed the application and they have made a determination that the application, the Early Site Permit, should be approved. So now we have to do our job, and our job is to a very large degree to review the staff's work. We are not doing a de novo review of the application, but rather we are starting from the work that the staff has done in this particular case.

So what I want to do is just to take a few minutes and to explain to you the procedure and also to explain to you what it is we're going to be doing during the course of the proceeding. Now, System Energy Resources, Inc., has filed an application. The application is for an Early Site Permit. It is an Early Site Permit to allow the construction, or the first stages going towards the construction of a nuclear electric power facility in Grand Gulf, Mississippi, Clayborn County, Mississippi. It is an Early Site Permit. Under the Nuclear Regulatory Commission regulations, an Early Site Permit is as a matter of law a construction permit, and under the Atomic Energy Act in a construction permit for a nuclear facility there must be a hearing. Now, the hearings can take a number of forms. First of all, once the application is filed, once the staff takes certain preliminary actions, parties who believe that they have an interest can file a petition to intervene. They have to demonstrate that they have standing and they have to demonstrate that there is an issue that they have identified that they have prepared to litigate that is relevant to the decisions that the Commission is going to have to make. In this particular case there were various interveners who filed petitions, but the Board determined that those individuals had either not shown standing or had not submitted an admissible contention, in other words identified an issue that they were prepared to litigate. So we are now left with what is referred to as a mandatory hearing. It is a hearing before this particular Board without an adversary party.

Now, we have been instructed by the Nuclear Regulatory Commission, we have been delegated from the Nuclear Regulatory Commission the authority and the responsibility to conduct this particular hearing and we have been given specific direction on what it is we are supposed to do and what it is we are not supposed to do in conducting these hearings for the Commission. Now first of all, we're not to conduct a de novo review. We're not starting at square one. The staff has conducted a review and we are supposed to determine whether or not, having reviewed the staff's work, that they have adequately demonstrated, factually and logically, that their conclusions are justified. So effectively we are reviewing the staff's review of SERI's application, specifically with regard to the safety aspects of this particular application.

Now, the scope of the Board's review was set out first of all in regulations promulgated by the Nuclear Regulatory Commission at 10 C.F.R. § 2.104 and then subsequently in 1995 in response to a request of certified questions the Nuclear Regulatory Commission gave us more specific directions on what it is we're supposed to do. Specifically, we are to determine whether the staff performed an adequate review and made findings with reasonable support in fact and logic. Now, in doing this we have to answer various specific questions. First of all, we have to determine, based on the staff's review, whether or not we are satisfied that in granting the license it would be harmful to the common defense or security or to the health or the public safety. We have to make sure that the regulations promulgated by the Nuclear Regulatory Commission have been followed, taking into consideration site criteria contained in the Nuclear Regulatory Commission regulations at 10 C.F.R. Part 100, whether a reactor can be constructed and operated at the proposed site without undue risk to the public health and safety. That's what we're supposed to do with regard to the safety aspects.

We also have to make determinations with regard to the environmental impact and potential environmental impact of the proposed action, the granting of this Early Site Permit. Our responsibility for that first of all comes under the National Environmental Policy Act. You're going to hear it referred to by almost everybody during this hearing as NEPA. And we have to make determinations under NEPA. Again, it starts with the staff review.

They, based on the environmental reports submitted by the applicant, have prepared an Environmental Impact Statement, and much of what we have done is to review the Environmental Impact Statement submitted by the staff. We have to determine whether or not the staff has complied with NEPA, whether or not they have complied with the regulations under NEPA and also whether or not they have complied with the regulations issued by the Nuclear Regulatory Commission which further implement the provisions of the National Environmental Policy Act. In addition to that, we have to make a determination. After weighing the alternatives, we have to determine whether or not the Early Site Permit should be issued, whether it should be denied, or if in issuing it, it should be conditioned in certain ways in order to protect significant environmental issues. Anyway, that is basically what it is that we need to do and the purpose behind this particular hearing.

Now, this particular hearing, if you just came in, you're going to say we're starting in the middle. And let me explain a little bit about what has gone on before today. First of all, we issued orders, a number of orders, asking for information from the staff and from the applicant. Back in April we requested documents and briefing. September 13 we issued specific questions to the staff to which the applicant also had an opportunity to respond relative to the Safety Evaluation Report. We received answers from that. On October 3 we issued another order having to do with the Environmental Impact Statement, again asking very specific questions about the review that led to the creation of the Environmental Impact Statement. Based on the responses to those questions, we then issued another order identifying hearing issues. And what we are going to be doing over the next few days is going through those hearing issues. There were nine that we identified. And we asked them to provide first of all pre-filed testimony, which is their direct testimony with regard to the questions that we asked in our order of November 6. We have received the pre-filed testimony. We are now going to give them the opportunity to make additional presentations and also to allow us to ask specific questions based on the pre-filed testimony, based on the question responses that we received to our orders of September 13 and October 3. So there is a significant record that has already been developed at this point in time that this hearing is the culmination of the process rather than the beginning of the process. It began with the submission of the application by SERI. It was followed up by the creation of documents such as the Environmental Impact Statement and the Safety Evaluation Report of the staff. It was followed up by requests for information, documents and briefing by the Board, followed with the specific questions on the Environmental Impact Statement and the Safety Evaluation Report by the Board, the responses to those questions and then the identification of hearing issues and the submission of pre-filed direct testimony. So for the witnesses who come in here today and tomorrow and the next day until we're finished with this, they're not going to be starting at square one. They're not going to be sitting down explaining who they are and regurgitating everything that they've said in their pre-filed testimony. That's available, it's on the ADAMS for anybody who wishes to view it, but we are going to be jumping in kind of in the middle of their testimony. I think that's by way of preliminary, sort of explains who we are, what it is we view our responsibilities, what directions we have been given by the Nuclear

Regulatory Commission in conducting this hearing for them, what has happened up until this point in the proceeding and what we anticipate is going to be happening over the next couple of days.

Before we proceed further, Judge Trikouros wanted to ask some very specific questions, but before I turn the floor over to him let me ask of the staff, do you have any preliminary matters to be taken up before Judge Trikouros' question, and then we will be getting into Hearing Issue A.

MR. RUND: I guess we'd like to start off by introducing ourselves. My name's Jonathan Rund. With me to my right is Ann Hodgdon. Robert Weisman is immediately to my left, followed by Tison Campbell and Patrick Moulding. Yesterday the Board asked about supplemental testimony. Mr. Weisman will explain what the purpose of that was.

JUDGE MCDADE: Okay. Right before we begin with Hearing Issue A there will be a number of preliminary matters. First of all, you know, we have all of the pre-filed testimony that we want to formally accept into the record. We also have a number of pre-filed exhibits that we want to formally accept into the record and admit so that we won't have to be talking about them specifically each time, you know, one of them comes up. So we'll do that as a preliminary right before the beginning of Hearing Issue A. While I'm on the subject just let me mention to the degree practicable, and I realize it may be difficult, but when you get a chance to talk to your witnesses, when they refer to a document, if it is an exhibit, if they can refer to it by the exhibit number. I think all of us are going to be pretty familiar with it, but again, you know, any subsequent tribunal that reviews this may not be as familiar with the documents and it's going to be an awful lot easier if it's not only identified as Figure 2-135 of the SSAR, but it's also identified as SERI Exhibit 21 or Staff Exhibit 61 or whatever. So I realize that some of them may not be familiar with that. To the degree that you all can help them along when they refer to it you can interrupt them and say, "And by that you mean Exhibit," you know, and that way it'll be clear from the record to anybody who's reviewing it. But anyway, we'll take that up right before Hearing Issue A.

Before we proceed further, does the applicant have any preliminary matters?

MS. SUTTON: By way of introduction, Your Honor, I am Kathryn M. Sutton. I'm a partner in the law firm of Morgan, Lewis & Bockius. With me are two associates from the firm. On my left is Paul Bessette. On my right is Martin O'Neill. We represent the applicant System Energy Resource, Inc., in this proceeding. It's commonly referred to as SERI, S-E-R-I.

JUDGE MCDADE: Okay. And one of the things I would also ask and you know relatively early on, I went through what it is we think we're supposed to be doing. If either the staff or the applicant has an objection to that, you know, don't be shy about stating it so that we can get that resolved rather than our doing something that you think is wrong and then we wind up at the end of the hearing having to, you know. If by some odd chance we actually were wrong, which is almost inconceivable, to go back and retrace our steps.

MS. SUTTON: We have no objection at this time and will not be shy.

JUDGE MCDADE: Thank you. Judge Trikouros?

JUDGE TRIKOUROS: Thank you. Before we get started on Hearing Issue A, I wanted to kick this off with a question that has been plaguing me that I'd like to get an answer to. I think the answer would be very helpful to me and to the Board in terms of some of the hearing issues that we're going to be discussing today and tomorrow. And specifically, my question is regarding the components of an Early Site Permit. I do not have any clear understanding of what those are. For example, I'm assuming it will include plant parameter envelope and permit conditions. However, it's not clear to me what the statements will be made. For example, will the Early Site Permit specify a thermal megawatt power level that's been approved for the site? Will the Early Site Permit specify a megawatt electric limit for the site? Will it specify both? So what exactly would an Early Site Permit look like in terms of its components, its contents so that as we begin to ask questions down the road here, we can understand if something important will not be included in the permit or will be included in the permit which would make it then less onerous to us if it were, you know, not included in let's say the plant parameter envelope. So I address this question to the staff. However, the applicant is obviously free to chime in.

MR. WEISMAN: This is Bob Weisman for the NRC staff. And while I don't have a copy of the form of an Early Site Permit with me, I can tell you what it will contain at least to the best of my recollection. And that is it will list the thermal power level. The staff is planning on including that in the Early Site Permit.

JUDGE TRIKOUROS: Not the megawatt electric power level.

MR. WEISMAN: Not the megawatt electric. I think in part because the thermal efficiency of a particular plant could vary and with respect to siting, the only thing that is important is the thermal power level. It will have a list of site characteristics that's incorporated into the permit. That is in the SER and I believe it's in Appendix A. It will have, if necessary it may have some bounding site parameters necessary for the safety review. It could also - on the environmental side it will have a list of plant parameters, in this case a plant parameter envelope that was used for the environmental evaluation. It will also have, let's see, I'm sorry I left out on the safety side a set of COL action items. All of these will be incorporated into the Early Site Permit.

JUDGE TRIKOUROS: Now I'm assuming that when you say plant parameter envelope on the environmental side, you mean the plant parameter envelope period, which includes both the safety side and the environmental side.

MR. WEISMAN: No, I don't mean that. I do mean because the plant parameter envelope, they're used for different purposes on the safety side and on the environmental side, so the plant parameter envelope on the environmental side is necessary to define the staff's evaluation. If at the COL stage a plant did not fall within those parameters, that could be significant new information, it could require additional environmental evaluation. But if it - I'm seeing - can I clarify something for you?

JUDGE TRIKOUROS: Yes, go ahead.

MR. WEISMAN: I saw a look of puzzlement on your face and I wondered what your question was.

JUDGE TRIKOUROS: Well, I'm having a bit of a problem with what you said. The plant parameter envelope includes a number of important design - it is, in fact, the surrogate plant which has implications both in design and in environmental, in safety and in environmental. So what you're telling me is the plant parameter envelope that will be included in the Early Site Permit will separate out only those parameters associated with the environmental side and will not include anything associated with the safety side?

MR. WEISMAN: To be clear, there will be two separate tables in the ESP. There will be a table that - incorporated into the ESP that has certain plant parameters that are important for the safety review to the extent that they're necessary to consider to establish a site characteristic. Those things will be in a separate table, but at the COL stage all that is necessary on the safety side is to assure that the plant falls within the site characteristics, that the design of the actual facility accounts for all of the site characteristics.

The plant parameters on the safety side considered at the ESP stage are, if you will, for practicality. It's is this a reasonable design, a reasonable - could a plant be put at this site with its characteristics. So it's not necessary to put all of those plant parameters on the safety side into the permit. On the environmental side, however, the bounds of the analysis are where the plant parameters interact with the environment what effect will the plant have on the surrounding environment. Those plant parameters are in a different table and it is a complete set for the environmental review.

JUDGE TRIKOUROS: So when we're at the COL stage, the safety analyses that were done at the ESP stage, will they have to be redone at the COL stage or can the applicant just simply reference certain analyses from the ESP stage that utilized plant parameter envelope parameters.

MR. WEISMAN: At the ESP stage the safety analysis all has to do with siting, whether or not the site is acceptable. To the extent that a design is considered in deciding that, and to my - I would believe that the only area where that would occur would be in the accident dose calculation. That design could be set, the COL applicant could rely on that at the ESP stage. Now, to the extent that the site characteristics play into whether the design is acceptable, those are going to be set in the ESP and the applicant will be entitled to rely on them at the COL stage. But the rest of the design will have to meet all the independent requirements in Part 50 and its appendices, Part 20 and the other provisions of the Commission's regulations.

JUDGE TRIKOUROS: Well okay. I could debate this, and I will, but not right now. I think we're going to be picking up on this in more detail later in hearing issues and also in the miscellaneous items at the back end, but I wanted to get a good feel for the contents of the ESP and I think you've helped me quite a bit. But let me ask you one other question associated with that. Thermal power level, would it be the site power level or would it be the - would there be a site power level and an upper limit specified for a given plant size as well?

MR. WEISMAN: I believe that the way the ESP would be currently structured is that it would be a per-unit power level as well as a site overall power level for any new units.

JUDGE TRIKOUROS: Okay, so a single unit could not be greater than the specified value in the Early Site Permit, but if it were less than that one could produce - could build two units, for example, as long as the two units were individually less than the single unit value and that the sum of the two units was less than the site-approved value.

MR. WEISMAN: Yes. Yes. The ESP would allow for modular construction, for example.

JUDGE TRIKOUROS: And there would be no specification at all with respect to the number of plants?

MR. WEISMAN: No, Your Honor.

JUDGE WARDWELL: And in all cases would that - the site value that you're talking about would not include the existing plant, or would there be cases -

MR. WEISMAN: That is correct.

JUDGE WARDWELL: For instance, national blowdown rate and those types of things that will be part of what I believe would be the environmental side of the bounding values, would those flow rates be only the ESP site and not include the existing plant that's there?

MR. WEISMAN: The ESP will only include numbers, parameters, site characteristics for any new plants. It will not include the existing plants.

JUDGE WARDWELL: Thank you.

JUDGE MCDADE: Judge Trikouros, anything further?

JUDGE TRIKOUROS: Yes, I have quite a bit, but as I said I'm not -

JUDGE MCDADE: For now.

JUDGE TRIKOUROS: - going to address it at this point. So I'm done with that here and now, but I think this entire issue, we'll revisit a number of times.

MS. SUTTON: Judge Trikouros, the applicant will be addressing these questions in great detail with respect to Hearing Issue G in their presentation.

JUDGE TRIKOUROS: Thank you.

JUDGE MCDADE: Okay.

JUDGE WARDWELL: I have one other question and that relates to, if I can remember what it is now. I will remember it. If in fact we wanted to - felt it was desirable to recommend that additional tables of assumptions or commitments be referenced or included in this permit, is there an avenue and a mechanism to achieve that that would be something that would seem reasonable to the staff?

MR. WEISMAN: If I could confer with my colleagues for just a moment.

JUDGE WARDWELL: Sure.

MR. WEISMAN: Your Honor, I think the

Board clearly has the authority to impose permit conditions in its decision and that that would be an appropriate avenue for the Board to add any matters such as you identified that the Board thought was missing from what the staff proposed.

JUDGE WARDWELL: Thank you and one second question, that's going to be my second last question. That is you mentioned a form. Is there a standard form for ESP permits?

MR. WEISMAN: Well, we are - the staff is developing a form, but we haven't finally arrived at what it would look like.

JUDGE WARDWELL: Okay, thank you.

JUDGE TRIKOUROS: Would it be appropriate for us to - when do you think you're going to complete this form?

MR. WEISMAN: It's difficult to estimate, but I would think that it would be developed very shortly, within a few days.

JUDGE MCDADE: Certainly before this one is granted.

MR. WEISMAN: Yes, Your Honor.

JUDGE MCDADE: Okay. Could we ask, you know, would it be possible for you to at some point during the course of the proceeding to give us, stamp a draft, stamp a most recent draft, put the date of the draft on it and just give us the - what the current version looks like?

MR. WEISMAN: I think we could do that for you, Your Honor.

JUDGE MCDADE: Okay, thank you. Anything further from SERI before we proceed?

MS. SUTTON: No, Your Honor.

JUDGE MCDADE: Okay, thank you. At this point let me just note that in response to our request for pre-filed testimony we received from the staff pre-filed testimony with regard to various hearing issues. First, Hearing Issue A site characterization, Hearing Issue B monitorability of radiological releases, Hearing Issue C relating to seismic issues, Hearing Issue D with regard to the continuity between the ESP and the COL stage, Hearing Issue E which is the alternative analysis, Hearing Issue F cumulative site impacts, Hearing Issue G evaluation of the plant parameter envelope, Hearing Issue H continuity between the ESP stage, I radiological reviews. Do you wish that we receive those into the record?

MR. RUND: The staff wishes that those be admitted into the record as if read, please.

JUDGE MCDADE: Okay. I understand that you have also developed an errata sheet for some of the ones that were submitted back on the 20th of November, is that correct?

MR. RUND: That's correct.

JUDGE MCDADE: Okay. What I would ask is if you could give to the court reporter at this point the corrected copies of those documents that we've made a permanent part of the record and also hand up to us the errata sheet so that we can - just as we are asking questions based on the copies that we've been using as our working copies, we'll see what the errata are.

Does SERI have any objection to our receiving that testimony?

MS. SUTTON: No, Your Honor.

JUDGE MCDADE: Okay. And it will be part of the record as if it were given here in person by the witnesses. I'd note for the record that we have received affidavits from each of the individuals purporting to give testimony there, indicating that they have made the statements under penalty of perjury and that they attest that the content of those documents is true and correct. And they are received.

(Whereupon, the NRC staff's Pre-Filed Testimony on Hearing Issues and Errata were admitted into evidence.)

JUDGE MCDADE: I would also note that we also received supplemental pre-filed testimony with regard to geotechnical issues and concerning various hydrology issues. Do you also wish that we receive those into evidence at this time?

MR. RUND: Yes we do, Your Honor.

JUDGE MCDADE: Okay. Are there any errata with regard to those documents?

MR. RUND: No, there aren't.

JUDGE MCDADE: Okay, and there's no objection to our receiving the testimony?

MS. SUTTON: No.

JUDGE MCDADE: Okay. We will receive that testimony as well. We also note that it is made under oath subject to the penalties of perjury and it is accepted into the record.

(Whereupon, the NRC staff's Pre-Filed Testimony on

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	

CORRECTIONS TO THE NRC STAFF'S PREFILED TESTIMONY
ERRATA SHEET

Hearing Issue A

page 8: Replace "As a common engineering practice for determining the potential for a karst formation, the Applicant should search and investigate. . ." with "The Applicant should follow common engineering practice for determining the potential for a karst formation and should search and investigate. . ."

page 11: Replace: "grater" with "greater"

Hearing Issue B

page 3: Add the initials (GB) after "A.4"

Hearing Issue D

page 1: Replace the title: "CONTINUITY BETWEEN THE ESP STAGE AND COL STAGE" with "SLOPE AND FOUNDDATION STABILITY"

Hearing Issue F

page 2: Replace "response to Q.5 in the testimony on Hearing Issue I" with "response to Q.3 in the testimony on Hearing Issue I."

page 5: Replace "ML" with "dADAMS Accession Number: ML062650312"

Hearing Issue I

page 6: Replace "Exhibit [I.A.3]" with "Staff Exhibit 10"
page 7: Replace "Exhibit [I.A.4] with "Staff Exhibit 11"
page 7: Replace "Exhibit [I.A.4] with "Staff Exhibit 11"

November 20, 2006

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	

NRC STAFF PRE-FILED TESTIMONY CONCERNING HEARING ISSUE A:
SITE CHARACTERIZATION

Q.1. Please state your name, occupation, by whom you are employed and your professional qualifications.

A.1. (GB) Goutam Bagchi. I am employed as a Senior Advisor in the Office of Nuclear Reactor Regulation by the U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached.

A.1. (LV) Lance W. Vail. I am employed as a Senior Research Engineer II with the Hydrology Group at the Department of Energy's Pacific Northwest National Laboratory, operated by Battelle. I am providing testimony under a technical assistance contract with the staff of the U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached.

A.1. (TC) Thomas M. Cheng. I am employed as a Senior Structural/Geotechnical Engineer in the geosciences and Civil Engineering Branch A (EGCA), Division of Engineering (DE), Office of Reactor Regulation (NRR), NRC. A statement of my professional qualifications is attached.

Q.2. Please describe your professional responsibilities with regard to the review of the application by System Energy Resources, Inc. ("SERI" or "Applicant") for an early site permit

("ESP") for a new nuclear power plant or plants to be located on the existing Grand Gulf Nuclear Station ("GGNS") site near Port Gibson, Mississippi.

A.2. (GB) As part of the NRC Staff's health and safety review of the SERI ESP application, documented in NUREG-1840, the "Safety Evaluation Report for an Early Site Permit (ESP) at the Grand Gulf Site," April 2006 ("SER"), I reviewed the hydrology aspects of the Applicant's Site Safety Analysis Report. This review included evaluating the adequacy of hydrology-related site characterization data related to surface and subsurface hydrologic processes and the reliability of the safety-related conclusions that SERI made based on this characterization data.

A.2. (LV) As part of the NRC Staff's environmental review of SERI's ESP application, documented in the FSER, I assisted the NRC Staff in its analysis of the aspects of the Applicant's SSAR that concerned hydrology.

A.2. (TC) As part of the NRC Staff's health and safety review of the SERI ESP application, documented in NUREG-1840, the "Safety Evaluation Report for an Early Site Permit (ESP) at the Grand Gulf Site" ("SER"), I reviewed the aspects of the Applicant's Site Safety Analysis Report that concerned geotechnical engineering related issues.

TESTIMONY ON EXISTING SITE CHARACTERIZATION DATA

I. Hydrogeologic Characterization

Q.3. In its November 6, 2006, Order, the Atomic Safety and Licensing Board ("Board") identified certain issues to be addressed in connection with the mandatory hearing. With regard to the site characterization, the Board asked that the NRC Staff summarize and discuss the existing site characterization data, and any additional data that will be needed at the COL stage relating to the hydrogeologic characterization of the shallow aquifers in the loess and alluvium and the deeper aquifers of the Catahoula/old alluvium that was used to estimate aquifer yield, water quality, and drawdown conditions for the purpose of (a) demonstrating that an adequately designed ground water well system capable of withdrawing 3,570 gpm could be provided for the proposed plant(s) without impacting the water quality of the aquifer; and (b) defining construction dewatering requirements, and drawdown effects on existing structural support and lateral loads against finished foundation walls. Please address these issues.

A.3. (LV, GB) The Staff does not specify the specific methodologies or the specific data that an applicant utilizes in preparing an SSAR or an ER. However, the Staff does review the appropriateness of the methodologies and the completeness of the data used by the applicant. Limitations on available site characterization data and lack of specific plant design information may require the Staff to propose Permit Conditions or COL Action Items in the safety review and to not resolve specific issues in the environmental review.

In the Staff's safety review of SERI's ESP application for the Grand Gulf site, one Permit Condition (#2) and nine COL Action Items (2.4-1 through 2.4-9) related to hydrology were proposed by the Staff. In the Staff's environmental review the issue of impacts to the Catahoula aquifer was "unresolved."

The Staff was unable to determine that either the specific isotopes chosen by SERI or the distribution coefficients (Kd) of the chosen isotopes were appropriate. Information on both the chemistry of the radwaste system and the aquifer itself did not preclude the possibility that the radionuclides' mobility might be significantly increased through chemical chelation. Permit Condition #2, which precludes the release from the radwaste system, eliminated the necessity for further characterization information.

If SERI continues to propose to withdraw water from the Catahoula Formation for construction and operation of the ESP facility, the Staff will require further characterization of the Catahoula aquifer. The Staff will review the applicant's proposed aquifer characterization program based on: the location and depth of the proposed wells; the location and depth of existing and proposed subgrade plant structures; and the location and properties of existing and proposed fill material. Since the construction of subgrade facilities would alter the subsurface environment and, thereby, could alter the geohydrologic characteristics of the Catahoula Formation, the determination of an appropriate aquifer characterization plan requires subgrade design information not available at the ESP stage. At the COL stage, a combination of pump tests, numerical modeling, boreholes, geophysical logging, and chemical characterization of groundwater may be used to develop an adequate understanding of the impacts of pumping on the Catahoula Formation. Since the Catahoula aquifer is designated as a sole-source aquifer by the EPA, the Staff will coordinate the aquifer characterization requirements with the EPA.

Listed below are the existing data supporting subsurface characterization of the ESP site:

1. geologic maps of site area (SSAR Figure 2.5-27)
2. description of regional geologic formations (SSAR Table 2.4-20)
3. hydrogeologic cross sections located in Mississippi River floodplain (SSAR Figure 2.4-33/UFSAR Figure 2.4-27, SSAR Figure 2.4-36/UFSAR Figure 2.4-28, and SSAR Figure 2.4-37/UFSAR Figure 2.4-28)
4. chemical analyses results of surface and ground water samples (SSAR Table 2.4-23/UFSAR Table 2.4-21)
5. water quality sampling data from three ground water wells in the Catahoula formation that are used to supply water for general site purposes of the existing plant (SSAR Table 2.4-25); sampled water quality parameters include pH, alkalinity, aluminum, chloride, sulphate, fluoride, free carbon dioxide, iron, magnesium, manganese, calcium, sodium, potassium, zinc, total dissolved residue, and hardness
6. ground water levels measured in piezometers (SSAR Table 2.4-30/UFSAR Table 2.4-24; two piezometers in alluvium, five in terrace deposits, and eight in the Catahoula formation), in observation wells (SSAR Table 2.4-31/UFSAR Table 2.4-25), in

monitoring wells (SSAR Table 2.4-32/UFSAR Table 2.4-29), and in on-site wells (SSAR Table 2.4-33); hydrographs of piezometers and wells (SSAR Figure 2.4-39/UFSAR Table 2.4-32), construction observation wells (SSAR Figure 2.4-44/UFSAR Figure 2.4-36), and replacement observation wells (SSAR Figure 2.4-45/UFSAR

7. location of perched water zones (SSAR Figure 2.4-33/UFSAR Figure 2.4-27)
8. hydrogeologic properties of subsurface material (SSAR Table 2.4-34/UFSAR Table 2.4-26; hydraulic conductivity measured using pumping tests in seven wells in the terrace deposits, using variable head permeability tests in three wells in the terrace deposits and one in the Catahoula formation, and using laboratory consolidation tests at five locations in the Catahoula formation and two in the alluvium); hydraulic conductivity and transmissivity of the terrace deposits (SSAR Table 2.4-35/UFSAR Table 2.4-26a; 22 wells)
9. projected ground water level contours under 8000 gpm of continuous pumping from all six radial collector wells (SSAR Figure 2.4-55/UFSAR Figure 2.4-44) -- only four of the radial collector wells were constructed for GGNS
10. USGS water quality data for the Mississippi River at Vicksburg 1961 to 1999 (URL: http://nwis.waterdata.usgs.gov/nwis/qwdata?site_no=07289000)

Only limited site characterization data was obtained recently by the Applicant (items 1, 2, 5, and part of 6 (ground water levels in on-site wells), listed above). All other items listed above, except for item 10, were reported in the GGNS UFSAR.

GGNS UFSAR Figure 2.4-27 shows the locations of radial collector wells. The Applicant reported results from pumping tests conducted in collector wells # 3 and # 5. These were long term pumping tests lasting 134 days from August through December, 1979. The average pumping rates for these two collector wells were 8000 gpm and 7600 gpm, respectively. The collector wells were installed to draw water indirectly from the Mississippi River through the alluvium.

Three wells that draw water from the Catahoula formation are used to provide water for general site purposes of the existing plant. These wells are rated at 513, 535, and 577 gpm, respectively.

The Staff reviewed the existing data to determine the groundwater characteristics near the ESP site. The radial collector wells can sustain pumping rates in excess of 7600 gpm for a sustained duration; the wells finished in the Catahoula formation can sustain pumping rates in excess of 500 gpm. Based on the available groundwater characterization data, the Staff determined that it is not unreasonable to expect that a suitable system of groundwater wells can be designed to extract water at a maximum rate of 3570 gpm from the Catahoula formation. The design of the groundwater well system will depend on the specific plant design chosen by the COL applicant and the layout of the plant infrastructure. The Staff will review the adequacy of the groundwater well system design at the COL stage, using appropriate NRC regulations and regulatory guidance.

The Applicant stated that dewatering will be required during construction of the ESP facility. The effects of any dewatering during construction of the ESP facility on existing structures will be reviewed at the COL stage under the requirements of 10 CFR Part 50 and 10 CFR Part 52. There are many engineered solutions to resolve specific conditions that can arise during the construction process; the Applicant has proposed a tried method of dewatering during construction. However, limited use of sheet piling, injection grouting, etc. can resolve construction circumstances in the future. Nevertheless, the maximum withdrawal rate is short-term and the safety-related SSCs of the existing plant are distant from the ESP site boundary. Therefore, it is expected that the potential for affecting the structural integrity of the safety-related SSCs of the existing plant from ground subsidence due to any dewatering activity at the

ESP site would be temporary and minimal. The Applicant stated that inspection and monitoring procedures will be developed for the construction phase of the ESP facility. Observation wells would be installed and monitored periodically throughout the construction of the ESP facility to measure ground water levels and to verify that ground water drawdown and the radius of influence evolve as predicted. The Staff concluded that it is feasible to conduct construction activities in a completely safe manner at the proposed ESP site and the site does not have any intrinsic characteristics that preclude its choice as a suitable site for locating future reactor or reactors, should a permit be granted. A dewatering system can be designed such that its effects on existing structures and systems are minimized, and existing regulatory criteria and review guidance will ensure a completely adequate review at the COL stage.

II. Fill Material Characterization

Q.4. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the site characterization, the Board asked that the NRC Staff summarize and discuss the existing site characterization data, and any additional data that will be needed at the COL stage relating to the characterization of the existing fill material for foundation design and to define construction conditions. Please address these issues.

A.4. (TC) The existing fill materials are located at an elevation approximately 130 ft (at planned plant grade) and were placed over time in an uncontrolled condition.[1] Therefore, there is no significant information on the strength and stiffness properties of the material, grain size distribution, and expected behavior under design load conditions. However, since the plant grade will be located at a depth of about 132.5 ft MSL, this fill material will have a negligible impact on the design of the facility. According to the Applicant's response to RAI 2.5.4-11, this

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[1] An uncontrolled condition exists where the engineering properties do not need to be reasonably estimated.

fill material will be removed during plant construction and, where needed, new fill material will be placed under controlled conditions. Some minor impacts on construction may occur, although the Staff believes that any such impacts will be negligible.

III. Characterization Relating to Potential Karst Formation

Q.5. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the site characterization, the Board asked that the NRC Staff summarize and discuss the existing site characterization data, and any additional data that will be needed at the COL stage relating to deep explorations in the power block footprint to evaluate the potential for a karst formation. Please address these issues.

A.5. (TC) The issue of the potential for development of sinkholes, dissolution cavities or soft zones in calcareous clays and limestone below any nuclear sites, including the Grand Gulf site, needs to be evaluated. If such soft zones or voids exist in the soil/rock profile below the site, the potential for the collapse of these zones during and following a seismic event can lead to differential settlements of power block foundations and at the ground surface. Such effects are of serious concern at other sites housing critical facilities.

The geotechnical report, ER-02, indicates that materials below the plant are calcareous and therefore potentially susceptible to the effects of dissolutioning. The Staff believes that it is, however, most likely inappropriate to use deep borings or other such penetrations to investigate this potential at the Grand Gulf site. First, the fact that such penetrations do not encounter such a soft zone does not imply that such zones do not exist. Second, the number and spacing of such penetrations will depend on the estimated size of these features. The Applicant should follow common engineering practice for determining the potential for a karst formation and should search and investigate the available database of information for the known site materials, and determine the opinions of recognized geologic experts versed in the area. This data would then be provided to the Staff. The Staff would also perform a chemical evaluation of available soil samples to support any of the conclusions drawn from the Applicant's study of the database. These evaluations should be performed prior to planning any deep boring program. During the COL stage, the Applicant will perform additional borings and laboratory testing as committed in the response to RAI 2.5.4-3. SER at 2-233. The Applicant's field exploration information and test results will be available to the Staff during its review of the COL Application.

IV. Characterization Relating to Effect of River Flooding on Bluff

Q.6. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the site characterization, the Board asked that the NRC Staff summarize and discuss the existing site characterization data, and any additional data that will be needed at the COL stage relating to the effect of river flooding on future erosion of the bluff and any retrogressive sloughs of the bluff. Please address these issues.

A.6. (TC, GB) The Staff notes that the levee systems and the revetments built on the banks of the Mississippi river by the Corps of Engineers focus on flooding on the west bank; on the east bank, protection is provided by revetments, which limit any erosion of the bank. The proposed ESP site is located on the east bank of the Mississippi River at an elevation of approximately 132.5 ft MSL. The ESP site is not subject to any significant flooding from the Mississippi River. The levees on the west bank of the river near the ESP site have a crest elevation between 101 and 103 ft MSL. If a future river flood overtops the levees on the west bank, the ESP site will still be above the river flood water elevation. During floods, the Mississippi River overtops the revetments on the east bank and flows through the floodplain located to the west of the bluffs. The Staff, in consultation with the U.S. Army Corps of Engineers, determined during its review of the design basis flood in the Mississippi River that the static flood water surface elevation would not be substantially greater than 103 ft MSL near the GGNS site because of the large discharge capacity of the Mississippi River floodplain west of the levees. The bluff on the east bank, adjacent to the ESP site, is not protected from erosion from river flooding by engineered revetments. The bluff on the west of the ESP site area steeply falls from an approximate elevation of 160 ft MSL to 90 ft MSL. The bluff west of the foot of this steep portion then gradually slopes towards Gin and Hamilton Lakes. During the design basis flood, the static flood water surface elevation of 103 ft MSL will result in the inundation of the gradually sloping portion of the bluff and a smaller extent of the steeply sloping portion of the bluff.

(TC) The response to this question dealing with retrogressive sloughing is provided in the response to Hearing Issue D Question 7.

V. Mississippi River Sediment Characterization

Q.7. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the site characterization, the Board asked that the NRC Staff summarize and discuss the existing site characterization data, and any additional data that will be needed at the COL stage relating to Mississippi River sediment characterization for construction of the intake and discharge structures and operation of the water intake and treatment plant. Please address these issues.

A.7. (GB, TC) The Mississippi River intake and the discharge for the proposed ESP site are related to the normal operation of the plant, so they are not safety-related. The applicant has proposed the construction of a cooling tower with a water storage underneath, should there be a need for a water cooled ultimate heat sink. The Staff determined that it is not necessary to characterize the sediment deposition rate or associated data for the COL application. The Staff also determined that the Mississippi River is deep and has a very high continuous flow rate to allow the applicant to design a well engineered and satisfactory intake and discharge system for the normal cooling of a future plant.

VI. Characterization of the Loess

Q.8. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the site characterization, the Board asked that the NRC Staff summarize and discuss the existing site characterization data, and any additional data that will be needed at the COL stage relating to shear strength and creep characteristics of the loess for retrogressive slope deformations of the bluff that might impact the integrity of the proposed plant(s). Please address these issues.

A.8. (TC) The loess formation is an extensive formation that exists over large areas in this region of the country. The generic properties of the loess formation have been developed and studied for many years and a large database of information has been compiled. According to its response to RAI 2.5.4-11, the Applicant committed to locate the power block foundation on stiff and compact materials that are located well below the loess materials. SER at 2-243. The Applicant also noted that it modified the ESP site plan to restrict the location of the proposed power block area (PPBA) to a distance greater than 100 ft from the bluff area on the west side of the site. The Staff believes that the Applicant's commitment will eliminate the significant impacts of the loess material on the design of the plant structures.

VII. Surface and Ground Water Characterization

Q.9. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the site characterization, the Board asked that the NRC Staff summarize and discuss the existing site characterization data, and any additional data that will be needed at the COL stage relating to baseline surface and ground water quality to quantify potential impacts for the existing plant to assure sufficient data is available to discriminate between the existing plant and the proposed plant(s). Please address these issues.

A.9. (GB) Data available for characterization of the subsurface at and near the ESP site is discussed in response to Board's Hearing Issue A, Question 3. Data that would be needed in the future depend upon the monitoring system that will be put in place. The system selected would depend upon many different factors such as: the reactor, the design of its radwaste facility, radioisotope inventory, etc. The Staff believes that it would be speculative to make a list of any additional data that will be needed at the COL stage.

With regard to radiation levels in surface and ground water at and near the ESP site that may impact the existing plant, the Staff concluded that there will be no impact on the existing GGNS plant from accidental releases from the ESP facility. The Staff's proposed Permit Condition 2 requires that the ESP facility be designed such that any and all accidental releases of radionuclides into any potential liquid pathway are precluded. An overwhelming majority of evolutionary and advanced reactor designs employ the concept of a nuclear island or a power block that is buried into the ground at a depth of approximately 40 ft to 60 ft. In some advanced designs the radwaste facility is located on the nuclear island, which is protected from leakage by a stainless steel liner and leakage collection drains. The radwaste tank is also protected by high surrounding walls to contain any inadvertent spillage during radwaste handling or any unanticipated component failure. The Staff concluded that it is technically feasible to design engineered barriers and other hydraulic conditions to meet the requirements of Permit Condition 2.

With respect to normal releases, the Staff reviewed the Grand Gulf radiological environmental monitoring program (REMP). The requirements for the REMP are in 10 CFR 50.34a(a); 10 CFR 50.36a(a); SEC IV, B.2 of Appendix I in 10 CFR Part 50 and the REMP for the operating unit has been reviewed and approved by NRC Staff. Environmental monitoring has been performed around the Grand Gulf site since 1978. The REMP includes monitoring of the airborne exposure pathway, direct exposure pathway, water exposure pathway, aquatic exposure pathway with control and indicator locations within a 29 km (18 mi) radius of the site. The pre-operational program included collection and analysis of samples of air particulates, precipitation, milk, crops, soil, well water, surface water, fish, and silt as well as measurement of ambient gamma radiation.

Related to surface and groundwater sampling, three surface water samples are taken, one upstream, one downstream and one downstream during a Liquid Radwaste Discharge. The surface water samples are taken at 92 day intervals and a gamma isotropic and tritium analysis are performed. The groundwater sample is taken at two wells once a year and a gamma isotropic and tritium analysis are also performed. Review of data from 2002 and 2003 showed no results above the lower limit of detection (LLD).

VIII. Aquifer Characterization

Q.10. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the site characterization, the Board asked that the NRC Staff summarize and discuss the existing site characterization data, and any additional data that will be needed at the COL stage relating to subsurface hydrological and chemical properties of the aquifer and definition of composition of the radwaste effluent. Please address these issues.

A.10. (GB) There is only limited data available regarding hydrological and chemical properties of the subsurface at and near the ESP site. At the ESP stage, the reactor type for the proposed facility has not been finalized and therefore the composition of the liquid radwaste effluent is not known.

The Staff's proposed Permit Condition 2 requires the ESP facility to be designed in such a way that any and all accidental releases of radionuclides are precluded. The Staff's proposed COL Action Item 2.4-9 addresses the need to obtain detailed groundwater characterization for dewatering system design.

The Staff requested that the Applicant provide more detailed data so the Staff could understand all the ground water pathways from points of release to the accessible environment. The Staff also requested that the applicant provide the chemical properties of the subsurface environment, since the mobility of radionuclides in the subsurface depends on the chemical properties of the subsurface media. Based on the Applicant's response, the Staff determined that, at the ESP stage, due to the incomplete characterization of subsurface hydrological and chemical properties in addition to the unknown composition of the liquid radwaste effluent of the proposed ESP facility, a comprehensive radionuclide migration analysis cannot be performed. The Staff determined that the proposed ESP site does not have any unique characteristics that could make a suitable system for monitoring or arresting radionuclide transmission through liquid pathway technically infeasible. The Staff imposed Permit Condition 2 to ensure that effective measures can be put in place during the COL stage. The Staff concluded, therefore, that further characterization of the composition of the liquid radwaste effluent and that of the subsurface hydrological and chemical properties was not needed, provided that Permit Condition 2 is not violated. As discussed in the Staff's response to the Board's Hearing Issue A, Question 9, the Staff concluded that it is technically feasible to design engineered barriers and other hydraulic conditions to meet the requirements of Permit Condition 2.

TESTIMONY ON LONG TERM STABILITY OF THE BLUFF

Q.11. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the site characterization, the Board asked that the NRC Staff summarize and explain the factual record concerning the long term stability of the bluff and its potential impact on the integrity of the proposed plant(s). Please address these issues.

A.11. (TC) The long term stability of the bluff can impact the evaluation of the plant design from several points of view. From a static perspective, the erosion of the bluff will reduce confining pressures on soils underneath the toe of the foundation mat at the edge adjacent to the bluff. This reduction in confinement can reduce strength and stiffness of the toe soils needed to provide gross seismic overturning and sliding capacity for the plant. In response to RAI 2.4.5-11, the Applicant made a commitment to locate the foundation of seismic Category I structures at a depth where the minimum shear wave velocity is 1000 fps. SER at 2-236, A-17. Adherence to the minimum shear wave velocity would ensure that the foundation will be at a depth of between 120 and 140 ft below grade. Consequently, concerns related to seismic overturning and sliding will be resolved by such a deeply embedded foundation.

The impacts of erosion of the bluff on calculated seismic responses of the plant are more difficult to evaluate, since there is little to no experience with seismic response calculations for unbalanced site configurations. (All the current techniques used for seismic analyses are based on the assumption of uniform or balanced site conditions on all sides of the plant facility.) This behavior can potentially impact the computation of both seismic-induced element stresses (and therefore estimates of resulting demand/capacity ratios of structural plant elements) and the computation of in-structure floor response spectra.

TESTIMONY ON SUBSURFACE HYDROLOGICAL AND CHEMICAL PROPERTIES OF THE AQUIFER

Q.12. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the site characterization, the Board asked that the NRC Staff summarize and explain the factual record concerning the sufficient knowledge of the subsurface hydrological and chemical properties of the aquifer and composition of the radwaste effluent to meet 10 C.F.R. § 100.20(c)(3) requirements for site suitability determination factors relating to accidental releases to the liquid pathway. Please address these issues.

A.12. (GB) Data available for characterization of the subsurface at and near the ESP site is discussed in response to Board's Hearing Issue A, Question 3.

There is only limited data available regarding hydrological and chemical properties of the subsurface at and near the ESP site. At the ESP stage, the reactor type for the proposed facility has not been finalized and therefore the composition of the liquid radwaste effluent is not known.

The Staff's proposed Permit Condition 2 requires the ESP facility to be designed in such a way that any and all accidental releases of radionuclides are precluded. The Staff's proposed COL Action Item 2.4-9 addresses the need to obtain detailed groundwater characterization for dewatering system design.

10 CFR Part 100.20(c)(3) requires that factors important to hydrological radionuclide transport be obtained from on-site measurements. These factors include subsurface soil characteristics, hydrological conditions, and pathways.

The Staff requested that the Applicant provide more detailed data so the Staff could understand all the ground water pathways from points of release to the accessible environment. However, the subsurface at the ESP site will be substantially disturbed during construction of the ESP facility. A COL recipient referencing a Grand Gulf ESP may be required to use an engineered fill to finish the grade at the ESP site. Underground portions of structures constructed as part of the ESP facility will act as barriers to regional groundwater flow and thus will modify flow pathways. The Staff concluded that a more useful and comprehensive analysis of subsurface pathways can only be carried out at the COL stage when the plant design including location and layout of ESP facility structures are known.

The Staff also requested that the Applicant provide chemical properties of the subsurface environment since the mobility of radionuclides in the subsurface depend on the chemical properties of the subsurface media. Based on the Applicant's response, the Staff determined that, at the ESP stage, due to the incomplete characterization of subsurface hydrological and chemical properties and the unknown composition of the liquid radwaste effluent of the proposed ESP facility, a comprehensive radionuclide migration analysis cannot be undertaken. The Staff determined that the proposed ESP site does not have any unique characteristic that could make a suitable system for monitoring or arresting radionuclide transmission through liquid pathways technically infeasible. The Staff imposed Permit Condition 2 to ensure that effective measures can be put in place during the COL phase. The Staff concluded, therefore, that further characterization of the composition of the liquid radwaste effluent and that of the subsurface hydrological and chemical properties was not needed provided that Permit Condition 2 is not violated. As discussed in the Staff's response to the Board's Hearing Issue A, Question 9, the Staff concluded that it is technically feasible to design engineered barriers and other hydraulic conditions to meet the requirements of Permit Condition 2.

November 20, 2006

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	

NRC STAFF PRE-FILED TESTIMONY CONCERNING HEARING ISSUE B:
MONITORABILITY OF INADVERTENT RADIOLOGICAL RELEASES

Q.1. Please state your name, occupation, by whom you are employed and your professional qualifications.

A.1. (GB) Goutam Bagchi. I am employed as a Senior Advisor in the Division of Engineering, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission. A statement of my professional qualifications is attached.

A.1. (SK) Stephen Klementowicz. I am employed as a Senior Health Physicist in the Division of License Renewal, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission. A statement of my professional qualifications is attached.

Q.2. Please describe your professional responsibilities with regard to the review of the application by System Energy Resources, Inc. ("SERI" or "Applicant") for an early site permit ("ESP") for a new nuclear power plant or plants to be located on the existing Grand Gulf Nuclear Station ("GGNS") site near Port Gibson, Mississippi.

A.2. (GB) As part of the NRC staff's health and safety review of the SERI ESP application, documented in NUREG-1840, the "Safety Evaluation Report for an Early Site Permit (ESP) at the Grand Gulf Site" ("SER"), I reviewed the aspects of the Applicant's Site Safety Analysis Report that concerned hydrology.

A.2. (SK) As part of the NRC Staff's health and safety review of the SERI ESP application, documented in the Grand Gulf Site SER, I reviewed the aspects of the Applicant's Site Safety Analysis Report that concerned the radioactive waste treatment system and the radiological impacts from routine operation to plant workers and members of the public. I was also part of the NRC Staff's environmental review of the SERI ESP application, documented in NUREG-1817, "Environmental Impact Statement for an Early Site Permit (ESP) at the Grand Gulf ESP Site: Final Report," April 2006 ("FEIS"). I reviewed the aspects of the Applicant's Environmental Report that concerned the radioactive waste treatment system and the radiological impacts from routine operation to plant workers, members of the public, and to the environment.

Q.3. In its November 6, 2006, Order, the Atomic Safety and Licensing Board ("Board") identified certain issues to be addressed in connection with the mandatory hearing. With regard to the monitorability of inadvertent radiological releases, the Board stated its opinion that the suitability of the Grand Gulf site for the eventual construction of an additional plant(s) hinges, in part, on SERI's ability (1) to detect discharges from plant systems, structures, and components that have a potential for the inadvertent release of radioactivity into the site soils or into the surface and ground water, and (2) to determine whether future detections of radiation are the result of historic impacts from the existing facility, or are the result of new contamination from the proposed plant(s). Please address this statement.

A.3. (GB) A number of NRC regulations and guidance documents address monitoring of radioactive material in effluents from nuclear power reactors.[1]

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[1] 10 CFR Part 20, Standards for Protection Against Radiation; 10 CFR 50.34a, Design objectives for equipment to control releases of radioactive material in effluents - nuclear power reactors; 10 CFR 50.36a, Technical specifications on effluents from nuclear power reactors; 10 CFR 50.72, Immediate notification requirements for operating nuclear power reactors; 10 CFR 50.73, Licensee event report system; 10 CFR Part 50, Appendix A, Design Criterion 60, Control of Releases of Radioactive Materials to the Environment; 10 CFR Part 50, Appendix A, Design Criterion 64, Monitoring Radioactivity

(continued...)

As stated in responses to the Board's Hearing Issue A, Questions 9 and 10, accidental releases of radionuclides from the ESP facility are precluded by Permit Condition 2. The Staff concluded that it is technically feasible to design engineered barriers and other hydraulic conditions to meet the requirements of Permit Condition 2. Accordingly, monitoring of inadvertent radiological releases is not required or warranted.

Q.4. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the monitorability of inadvertent radiological releases, the Board asked that the Staff address site monitorability relating to surface water, ground water, and shallow soil impacts and sediments by presenting the existing knowledge base with detailed descriptions of the exploration program, aquifer testing, hydraulic modeling, and transport estimates used to characterize the site aquifer(s), and surface water courses. Please address these issues.

A.4. (GB) At the ESP stage, when the details of the reactor design, construction, and operating processes are not known, it is speculative and generally unproductive to investigate monitorability of the proposed ESP site. NRC's regulatory criteria and guidelines are in place to

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[1](...continued)
Releases; 10 CFR Part 50, Appendix I, Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low As Is Reasonably Achievable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents; 40 FR 19439 (May 5, 1975; an immediately effective rule, using the terminology "as low as practicable"); Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I (Rev. 1, 10/75); Regulatory Guide 1.21, Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants (Rev. 1, 6/74); Regulatory Guide 1.143, Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants (Rev. 2, 11/01); Regulatory Guide 4.1, Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants (1/73); Regulatory Guide 4.2, Preparation of Environmental Reports for Nuclear Power Stations (Rev. 2, 7/76); Regulatory Guide 4.8, Environmental Technical Specifications for Nuclear Power Plants (12/75) and Branch Technical Position (Rev. 1, 11/79, specific to environmental monitoring program); Regulatory Guide 4.15, Quality Assurance for Radiological Monitoring Program (Normal Operation) - Effluent Streams and the Environment; NUREG-0472, Radiological Effluent Technical Specifications for PWRs (2/80); NUREG-0473, Radiological Effluent Technical Specifications for BWRs (7/79).

ensure that a future COL review will require a full description of radioactive effluent monitoring systems and associated technical specification limits.

With regard to radioactive releases in ground water, it should be noted that the ESP site has a deep soil deposit. Consequently, the monitoring wells may need to be deep. On the other hand, predominantly clay soil at the site provides an advantage of relative impermeability.

Q.5. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the monitorability of inadvertent radiological releases, the Board asked that the Staff address site monitorability relating to surface water, ground water, and shallow soil impacts and sediments by describing and illustrating the extent of the existing radiological concentrations in the soil, sediment, surface water and ground water at the site, and the monitoring program used to quantify existing impacts. Please address these issues.

A.5. (SK) In addressing surface and groundwater radiologic impacts, the Staff relied on information from the radiological environmental monitoring program (REMP) currently in place at the Grand Gulf Nuclear Station. The REMP monitors the offsite environment outside the plant site. The NRC's requirements contained in Appendix A to 10 CFR Part 50, Criterion 64 - "Monitoring radioactivity releases," and its regulatory guidance in Branch Technical Position, Revision 1 (ML010710060), focus on the offsite environmental monitoring of soil, sediment, surface water, and ground water. However, the REMP does not focus on environmental monitoring within the plant site. The NRC requires that the REMP monitor the general offsite environment for the presence of radioactive material from the operating nuclear reactor. NRC's guidance describes the specified environmental monitoring program, which provides measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential radiation exposure of individuals resulting from the station operation. Thus, there is no NRC requirement to have data for radiological ground water or soil conditions at the site. The Staff did not receive any data in the SERI application on radiological conditions at the site.

Q.6. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the monitorability of inadvertent radiological releases, the Board asked that the Staff address site monitorability relating to surface water, ground water, and shallow soil impacts and sediments by summarizing meteorological, geologic, and hydrogeologic data that can be used to estimate migration pathways for future impacts from plant(s) at the site. Please address these issues.

A.6. (GB) The Staff has summarized the hydrologic characteristics of the ESP site in its response to the Board's Hearing Issue A, Question 3. As noted in the Staff's answer to Question 4 above, data available at the ESP stage do not allow a reliable estimate of migration pathways for future impacts from plant(s) at the site, since the reactor type, liquid radwaste inventory, location of radwaste facility, extent of site modification due to construction activities, and the extent of the use of engineered backfill are unknown. Permit Condition 2 precludes the inadvertent radiological releases to which this Board question refers and is sufficient to ensure that necessary and appropriate review will be undertaken at the time of the COL review.

Q.7. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the monitorability of inadvertent radiological releases, the Board asked that the Staff address site monitorability relating to surface water, ground water, and shallow soil impacts and sediments by explaining how the impact from a hypothetical release from the new plant could be separated from the historic impacts, and, as a corollary, if a future radiological release was detected, how it would be possible to determine which plant was the source of the impact. Please address these issues.

A.7. (SK) Hypothetical inadvertent radiological releases from the proposed new plant could be separated from historic impacts through a program of radiological surveys and specialized monitoring. The surveys and monitoring would have to trace the pathway of the residual radioactivity back to the source of the discharge in order to establish which plant was the source of the impact. As a practical matter, the NRC has experience with licensees who have performed such detailed, extensive surveys and monitoring of inadvertent liquid discharges at operating nuclear power reactor sites. However, as discussed in the Staff's response to Question 5, there are no NRC requirements to have such a detailed onsite monitoring program in order to detect inadvertent discharges. This is in contrast to routine radiological effluent discharges into the unrestricted area (public area). There is a requirement in Appendix A to 10 CFR Part 50, Criterion 64 - "Monitoring radioactivity releases," to monitor effluent discharge paths, and there is detailed regulatory guidance on the appropriate location, type, and sensitivity of monitoring equipment to be used. In addition, there is a requirement in 10 CFR 50.36a to submit an annual report that specifies the quantity of each of the principal radionuclides released to unrestricted areas in liquid and gaseous effluents. However, the regulation does not require the data to be reactor specific. As a matter of practice, licensees do a best effort to apportion the radioactive effluents to each reactor unit.

The NRC would not eliminate this site from future consideration because of the lack of a proposed radiological survey and monitoring program to monitor the onsite environment from potential inadvertent releases of radioactive material, because existing NRC requirements and guidance do not require such a program.

Q.8. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the monitorability of inadvertent radiological releases, the Board asked that the Staff address site monitorability relating to surface water, ground water, and shallow soil impacts and sediments by describing the reasons why the potential un-monitorability of the site would or would not possibly eliminate this site from future consideration for a new plant.

A.8. (GB) The Staff imposed Permit Condition 2 to ensure that effective measures for precluding releases will be put in place during the COL phase. The Staff concluded, therefore, that further characterization of the composition of the radwaste effluent and that of the subsurface hydrological and chemical properties was not needed. As discussed in the Staff's response to the Board's Hearing Issue A, Question 9, the Staff concluded that it is technically feasible to design engineered barriers and other hydraulic conditions to meet the requirements of Permit Condition 2.

November 20, 2006

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	

NRC STAFF PRE-FILED TESTIMONY CONCERNING HEARING ISSUE C:
SEISMIC IMPACTS

Q.1. Please state your name, occupation, by whom you are employed and your professional qualifications.

A.1. Yong Li (YL). I am employed as a Senior Geophysicist in the Division of Engineering, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached.

Q.2. Please describe your professional responsibilities with regard to the review of the application by System Energy Resources, Inc. ("SERI" or "Applicant") for an early site permit ("ESP") for a new nuclear power plant or plants to be located on the existing Grand Gulf Nuclear Station ("GGNS") site near Port Gibson, Mississippi.

A.2. (YL) As part of the NRC staff's health and safety review of the SERI ESP application, documented in NUREG-1840, "Safety Evaluation Report for an Early Site Permit (ESP) at the Grand Gulf Site" ("SER"), I reviewed the aspects of the Applicant's Site Safety Analysis Report ("SSAR") that concerned geology and seismology.

Q.3. In its November 6, 2006, Order, the Atomic Safety and Licensing Board ("Board") identified certain issues to be addressed in connection with the mandatory hearing. With regard to seismic impacts, the Board asked for a summary and discussion of the process that was utilized by the NRC staff to evaluate seismicity at the Grand Gulf site, including the specific steps used to evaluate the relevance, precision, and accuracy of analytical and digital models. Please address these issues.

A.3. (YL)

Regional and Site Geology

The Applicant described the regional geology, including the physiography, geological provinces, geologic history, stratigraphy, tectonic settings, and seismicity of the site region. SER at 2-144. The Applicant described these items in detail, including the geologic periods (era) in which they formed. SER at 2-144 through 2-159. The Applicant discussed each of the following seismic source zones and associated seismic activities surrounding the ESP site:

- Appalachian Mountains
- Ouachita Orogenic Belt
- Arkoma and Black Warrior Basins
- Reelfoot Rift
- New Madrid Seismic Zone (NMSZ)
- Gulf Coast Basin
- Pickens-Gilberttown and Southern Arkansas Fault Zones
- Saline River Source Zone (SRSZ)
- nontectonic structural features

The applicant fully considered the NMSZ in its investigation process because the NMSZ can contribute to the seismic hazard at the site, even though it is outside the 320 kilometer (200 mile) radius recommended by RG 1.165. SER at 2-151 through 2-159.

The Staff evaluated the geological and seismological information submitted by the Applicant in SSAR Section 2.5.1. as follows: The technical information presented in Section 2.5.1 of the application (SSAR) resulted from the Applicant's surface and subsurface geological and seismological investigations performed in progressively greater detail as these investigations approached the site. SER at 2-162. Through its review, the Staff determined whether the Applicant complied with the applicable regulations and conducted its investigations with an appropriate level of thoroughness, as required by 10 C.F.R. § 100.23. SER at 2-162. SSAR Section 2.5.1 contains the geologic and seismic information gathered by the Applicant in support of the vibratory ground motion analysis; site SSE spectrum is provided in SSAR Section 2.5.2. SER at 2-163.

According to RG 1.165, applicants may develop the vibratory design ground motion for a new nuclear power plant using either the Electric Power Research Institute ("EPRI") or Lawrence Livermore National Laboratory ("LLNL") seismic source models for the Central and Eastern United States ("CEUS"). SER at 2-163. However, RG 1.165 recommends that applicants update the geological, seismological, and geophysical database and evaluate any new data to determine whether revisions to the EPRI or LLNL seismic source models are necessary. SER at 2-163. As a result, the Staff focused its review on geologic and seismic data published since the late 1980s that could indicate a need for changes to the EPRI or LLNL seismic source models. SER at 2-163. To thoroughly evaluate the geological and seismological information presented by the Applicant, the Staff obtained the assistance of the USGS.[1] SER at 2-163. In addition, the Staff and its USGS advisors visited the ESP site and surrounding area to evaluate and confirm the interpretations, assumptions, and conclusions presented by the Applicant concerning potential geologic and seismic hazards. SER at 2-163.

The Staff's review focused on the Applicant's characterization of the regional and local geologic structure and seismic potential. SER at 2-163. The Staff considered the Applicant's descriptions of physiographic provinces within the site region, the Mississippi embayment and

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[1] One of the staff members from USGS was the key person to study and compile a database for Quaternary faults, liquefaction features and possible tectonic features in the CEUS, east of the Rock Mountain Front.

Gulf Coast Basin, tectonic evolution for major geologic features, and the stratigraphy of the site region. SER at 2-163. The Staff determined that these descriptions reflect well-documented geologic information, and concluded that they provide a relevant, accurate and thorough description of the regional site geology. SER at 2-163. Similarly, the Staff reviewed the Applicant's characterization of the tectonic features in the EPRI seismic source model from the late 1980's, focusing on two seismic zones: SRSZ and NMSZ. SER at 2-163. With the addition of these sources to the site seismic hazards estimate, which only enhanced the conservative estimate of ground motions for the ESP site, the Staff found that the Applicant accurately characterized the tectonic features and their correlations with the regional seismicity. SER at 2-164. Finally, the Staff considered a seismic catalog, which the Applicant revised in response to a Staff question, and determined that the Applicant had provided an accurate and thorough description of the regional seismicity. SER at 2-164.

With respect to site geology, the Applicant described the geologic information of both the site area (within an 8 kilometer radius [5 miles]) and the site location (within a 1 kilometer radius [~0.6 miles]) in terms of the (1) site physiography and geomorphology, (2) site geologic history, (3) site geologic conditions, (4) site structure, and (5) geotechnical properties of subsurface materials. SER at 2-159. The Applicant described these matters in detail. SER at 2-159 through 2-162. The Applicant did not identify any faults within the 8-kilometer radius of the site area. SER at 2-161.

The Staff found that the Applicant provided a thorough and accurate description of the surface features and characteristics for the ESP site. SER at 2-164. The Staff also found that the Applicant provided an accurate and thorough description of the site area stratigraphy, with emphasis on the younger layers of rock and soils. SER at 2-165. The Staff therefore found that the Applicant's description of the geological structures was complete and accurate. SER at 2-165. Nonetheless, the Staff stated that, based on RG 1.132, any excavation made during construction will provide an opportunity to obtain additional geologic and geotechnical data. SER at 2-165. Therefore, the Staff found that the Applicant must perform geologic mapping of future excavation for safety-related structures, evaluate any unforeseen geologic features that are encountered, and notify the NRC no later than 30 days before any excavations for safety-related structures are opened. This is Permit Condition 3. SER at 2-165. In addition, the Staff also proposed COL Action Items 2.5-3 and 2.5-4 (Appendix A, A5). COL Action Item 2.5-3 requires the applicant to perform additional borings to confirm the current base case material properties and their variabilities throughout the site. COL Action Item 2.5-4 requires the applicant to provide information to correlate plot plans and profiles of each category I structure with subsurface profiles and materials properties to ascertain the sufficiency of selected borings to represent soil variations under each structure. Finally, the Staff found that the effects of human activity (e.g., ground water withdrawal or mining activity) have no potential to compromise the safety of the site. SER at 2-165.

Based on the facts and reasoning set forth above, the Staff concluded that the Applicant properly characterized the site lithology, stratigraphy, geological history, structural geology, and the characteristics of subsurface soils and rocks. SER at 2-165. Accordingly, the Staff concluded that the Applicant identified and appropriately characterized all the significant seismic sources for determining the safe-shutdown earthquake ("SSE") for the ESP site, in accordance with RG 1.165 and Section 2.5.1 of NUREG-0800, and therefore satisfied the associated requirements of 10 C.F.R. § 100.23(c) and GDC 2. Therefore, the Staff concluded that the proposed ESP site is acceptable from a geological and seismological standpoint and meets the requirements of 10 C.F.R. § 100.23. SER at 2-165.

Vibratory Ground Motion

The Applicant described the regional and local geology and structural background and outlined the major seismotectonic sources and materials in the site region. SER at 2-165. The Applicant described: (1) its determination of the ground motions at the ESP site resulting from possible earthquakes inside or outside the site region; (2) the characteristics of seismic sources used in the ESP site seismic hazard calculation; (3) the procedure for the probabilistic seismic hazard analysis ("PSHA") and its results; (4) site characteristics in seismic wave transmission; and (5) site responses at the ESP site. SER at 2-166. The Applicant then summarized the development of the SSE and operating-basis earthquake (OBE) ground motion for the ESP site. SER at 2-166.

With respect to seismic source characterization, the Applicant described the characteristics of all seismic sources in the ESP site region. SER at 2-166. The Applicant reviewed the original 1986 EPRI earthquake source model related to the ESP site and found that the model adequately captures the regional earthquake source characteristics and the uncertainty associated with the source model at the time the model was developed. SER at 2-166. The Applicant also addressed the SRSZ and updated NMSZ and their associated parameters resulting from the recent studies. SER at 2-166. The Applicant summarized the EPRI seismic source model, and the seismic source information for the seismic sources in the site region. SER at 2-166. This source information includes the maximum magnitude, closest distance to the ESP site, probability of activity, and an indication as to whether new information regarding the seismic source has been identified since the original EPRI seismic hazard analysis. SER at 2-166, 2-167. The Applicant presented detailed characterizations of the NMSZ and the SRSZ. SER at 2-167, 2-168. Finally, the Applicant described the effect of updating the earthquake catalog on the EPRI-Seismicity Owners Group ("SOG") seismicity parameters. SER at 2-169, 2-170.

In its review, the Staff considered the regulatory requirements of 10 C.F.R. § 52.17(a)(1)(vi) and 10 C.F.R. § 100.23(c) and (d), which require that an applicant for an ESP describe the seismic and geologic characteristics of the proposed site. SER at 2-180. In particular, 10 C.F.R. § 100.23(c) requires that an ESP applicant investigate the geological, seismological, and engineering characteristics of the proposed site and its environs with sufficient scope and detail to support estimates of the SSE and to permit adequate engineering solutions to actual or potential geologic and seismic effects at the proposed site. SER at 2-180. Section 100.23(d) states that the SSE for a site is characterized by both horizontal and vertical free-field ground motion response spectra at the free ground surface. Section 2.5.2 of NUREG-0800 provides guidance concerning the evaluation of the proposed SSE, and RG 1.165 provides guidance regarding the use of PSHA to address the uncertainties inherent in estimating ground motion at the ESP site.

First, the Staff found that the Applicant adequately characterized the overall seismic sources at the ESP site. SER at 2-183. The Staff also concluded that the Applicant's descriptions of the NMSZ and the SRSZ are accurate and sufficient to address the need for updated EPRI sources and to calculate the SSE for the ESP site. SER at 2-183. In addition, the Staff concurred with the Applicant's decision to use the original EPRI seismicity parameters based on its comparison of the updated seismic catalog to the original EPRI catalog. SER at 2-183.

Second, the Staff concluded that the Applicant's description of the PSHA parameters and procedures for the ESP site, as clarified through several RAI responses, is reasonably accurate and adequate. SER at 2-188. The Staff concurred with the Applicant on its conservative approaches in overlapping the new characteristic NMSZ onto the original EPRI source model, and in using only attenuation relationships for the mid-continent to estimate ground motion, although the ESP site is located in the extended Mississippi embayment. SER at 2-188. In addition, the applicant also used point of closest approach, which assumes earthquakes along the three segments of the NMSZ as point sources at the southernmost end of each fault with the closest distance to the ESP site.

Third, the Staff concluded that the Applicant generally used an acceptable approach to characterize the site shear wave properties to the appropriate depth required by the reference rock used in the EPRI ground motion attenuation relationships in order to obtain the site-specific seismic wave responses. SER at 2-188.

Fourth, the Staff found that because of the narrow range in the magnitudes of the controlling earthquakes, it was appropriate to use the Applicant's chosen approach, the 2A approach described in NUREG/CR 6728, "Technical Basis for Revision of Regulatory Guidance on Design Ground Motions: Hazard- and Risk-consistent Ground Motion Spectra Guidelines". The Staff therefore concluded that SERI's description of the site responses and its approach in deriving the site soil response are reasonably accurate and adequate. SER at 2-188.

Finally, the Staff considered the SSE developed for the ESP site to be consistent with Appendix S to 10 C.F.R. Part 50, which defines the SSE as the "vibratory ground motion for which certain structures, systems and components must be designed to remain functional." The Staff concluded that the Applicant's approach to calculating the SSE for the ESP site is also consistent with the requirements of 10 C.F.R. §§ 100.23(c) and (d) and RG 1.165, and that the Applicant's description of the SSE and the subsequent operating-basis earthquake ("OBE") is accurate and adequate. SER at 2-189.

Based on the facts and reasoning set forth above with respect to vibratory ground motion, the Staff found that: (1) the Applicant provided a thorough characterization of the seismic sources surrounding the site, as required by 10 C.F.R. § 100.23; (2) the Applicant adequately addressed the uncertainties inherent in the characterization of these seismic sources through a PSHA, which follows the guidance provided in RG 1.165; (3) the controlling earthquakes and associated ground motion derived from the Applicant's PSHA are generally consistent with the seismogenic region surrounding the ESP site; and (4) the Applicant's SSE was determined in accordance with RG 1.165 and Section 2.5.2 of NUREG-0800. SER at 2-189. Accordingly, the Staff concluded that the proposed ESP site is acceptable from a geological and seismological standpoint and meets the requirements of 10 C.F.R. § 100.23. SER at 2-189.

Surface Faulting

The Applicant described the potential for tectonic fault rupture at the ESP site. SER at 2-189. The Applicant performed the following investigations to assess the potential for surface faulting at and within an 8 kilometer (5-mile) radius of the ESP site:

- compilation and review of existing data
- interpretation of aerial photography
- discussions with current researchers in the area
- review of seismicity
- field reconnaissance

SER at 2-190. The Applicant stated that a wealth of information is available for the site regarding the surface faulting studies. The information comes from three primary sources: (1) previous research for the existing GGNS; (2) published and unpublished geologic maps from USGS, the State of Mississippi, and the University of Memphis; and (3) seismicity data compiled from published journal articles and evaluated as part of the Applicant's study. SER at 2-190. The Applicant performed field reconnaissance and interpreted aerial photography, which it used to produce an updated map of surficial deposits and geomorphology for the site location. SER at 2-190. The Applicant used the new map, in combination with other preexisting maps, to verify the absence of subsurface faulting or other forms of tectonic and nontectonic deformation by showing the surface of buried stratigraphic layers. SER at 2-190.

The Staff and its USGS advisors visited the ESP site and met with the Applicant to assist in confirming its interpretations, assumptions, and conclusions concerning potential surface deformation. SER at 2-192. Specific areas of the Staff's review included the geological, seismological, and geophysical investigations, previous investigations, geological evidence or absence of evidence of surface deformation, correlation of an earthquake with capable tectonic sources, characterization of capable tectonic sources, zones of Quaternary deformation requiring detailed fault investigation, and the potential for surface tectonic deformation at the site. SER at 2-193.

The Staff focused its review on the adequacy of the Applicant's investigations to ascertain the potential for surface deformation that could affect the site. SER at 2-193. The Staff reviewed the Applicant's summary of previous site investigations recorded in the updated final safety analysis report ("UFSAR") along with the Applicant's recent investigations, and concluded that the Applicant adequately investigated the potential for surface deformation in the site area. SER at 2-193. The Staff and its USGS consultants also visited the site area and did not observe any evidence for Quaternary tectonic activity near the site. SER at 2-193. The Staff concluded that the Applicant adequately investigated the potential for surface deformation, as required by 10 C.F.R. § 100.23, and concurred with the Applicant's conclusion that no evidence of Quaternary folding or faulting can be associated with these local faults. SER at 2-193.

In its review of the geological and seismological aspects of the ESP site, the Staff considered the pertinent information gathered by the Applicant during the regional and site-specific geological, seismological, and geophysical investigations. SER at 2-193. The Staff concluded that the Applicant performed its investigations in accordance with 10 C.F.R. § 100.23 and RG 1.165 and provided an adequate basis to establish that no capable tectonic sources exist in the site vicinity that would cause surface deformation in the site area. SER at 2-193. The Staff concluded that the site is suitable from the perspective of tectonic surface deformation and meets the requirements of 10 C.F.R. § 100.23. In addition, the Staff found that the

Applicant appropriately considered the most severe surface deformation historically reported for the site and surrounding area, with sufficient margin for uncertainties, and that the application satisfies GDC 2 in that respect. SER at 2-193.

November 20, 2006

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	

NRC STAFF PRE-FILED TESTIMONY CONCERNING HEARING ISSUE D: SLOPE AND FOUNDATION STABILITY

Q.1. Please state your name, occupation, by whom you are employed and your professional qualifications.

A.1. (TC) Thomas M. Cheng. I am employed as a Senior Structural/Geotechnical Engineer in the geosciences and Civil Engineering Branch A (EGCA), Division of Engineering (DE), Office of Reactor Regulation (NRR), NRC. A statement of my professional qualifications is attached.

Q.2. Please describe your professional responsibilities with regard to the review of the application by System Energy Resources, Inc. ("SERI" or "Applicant") for an early site permit ("ESP") for a new nuclear power plant or plants to be located on the existing Grand Gulf Nuclear Station ("GGNS") site near Port Gibson, Mississippi.

A.2. (TC) As part of the NRC Staff's health and safety review of the SERI ESP application, documented in NUREG-1840, the "Safety Evaluation Report for an Early Site Permit (ESP) at the Grand Gulf Site" ("SER"), I reviewed the aspects of the Applicant's Site Safety Analysis Report that concerned geotechnical engineering related issues.

Q.3. In its November 6, 2006, Order, the Atomic Safety and Licensing Board ("Board") identified certain issues to be addressed in connection with the mandatory hearing. With regard to slope and foundation stability, the Board stated that it believed that the geotechnical stability of the bearing strata and exterior earthen slopes (*i.e.*, bluff) is a fundamental site characteristic that could be quantified and addressed in this ESP application. Please address this comment.

A.3. (TC) The issues associated with both slope and foundation stability are not fundamental site characteristics since the importance of each of these site characteristics on plant behavior is directly a function of both soil properties and plant characteristics. The evaluation of foundation stability (or bearing capacity) is computed as the ratio of maximum demand (peak induced seismic toe pressure, for example) to available soil shear strength. The demand is directly related to characteristics of the plant, while the soil strength is directly related to the depth at which the plant foundation is to be located.

The evaluation of the effect of slope stability of the loess soils comprising the bluff is related not only to the strength parameters of the bluff material, but to the horizontal bluff standoff distance and depth of the foundation. Preliminary estimates made by SERI with the use of simplified slope stability evaluations and summarized in Section 2.5.5 of the SSAR indicated that, with stand-off distances of the order of 100 ft, potential failure surfaces through the bluff material would not intersect the plant cross-section.

The Staff believes that both of these issues can best be addressed at the COL stage, when specific plant geometries and locations are provided which can then be evaluated.

Q.4. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to slope and foundation stability, the Board requested that the Staff provide a comprehensive geologic description (*e.g.*, cross-sections, profiles, isopach maps, etc.) of site strata from beneath the ESP power block and extending to the Mississippi River, showing the location of the various strata at the site and using the most recent nomenclature that will be carried over to the COL stage. Please provide such a description and, in doing so, resolve any discrepancies between SSAR Figures 2.5-36, 2.5-37, and 2.5-75 to 2.5-77. Additionally, in this description, show (or eliminate as an archaic term) the following: loess, upland complex, upland alluvium, new alluvium, young alluvium, old alluvium, clay-silt alluvium, sand-gravel alluvium, fill, Catahoula Formation.

A.4. (TC) A description of site soils is provided in SSAR section 2.5.4 and Entergy Grand Gulf ESP Engineering report ENTO002-ER-02 (ER-02). The figures in these documents show cross-sections of the site strata beneath and adjacent to the planned ESP power block location. The deposits were classified into four distinct layers based upon evaluation of sample texture, grain-size, estimated relative density (based on Standard Penetration Test [SPT] and Cone Penetrometer Test [CPT] measurements) and color. Stratigraphic profiles estimated from these identifications were developed and are shown in Figures ER-02-5 through 7. These are based on the few sample evaluations from the three ESP borings along with the borings available from the GGNS investigations. The primary soil layers are:

1. Loess - a medium stiff, slightly to moderately plastic, silt or clayey silt; average SPT blow counts between 5 and 13; shear wave velocities of 800 to 900 fps;
2. Upland Complex Alluvium - generally stiff interbedded sand, clayey sand, gravelly sand and sandy gravel with little fines content and little or no plasticity; SPT blow counts of 20 to 85; shear wave velocity of 800 to 1,800 fps;
3. Upland Complex Old Alluvium - interbedded clayey sands, silty sands and gravelly sands typically exhibiting poorer sorting than alluvium materials above; SPT blow counts of 33 to 85 bpf; shear wave velocity of 1,000 to 2,600 fps;
4. Catahoula Formation - a very stiff, hard clay to claystone material; one SPT sample with blow count of 82 bpf; shear wave velocity estimated from 1,600 to 2,800 fps;

Localized fill was placed at or near plant grade level to fill local swales that crossed the site. This fill was placed in a generally uncontrolled manner and consists of excavated loess materials. Since this material will be excavated during construction of any new facilities, its engineering significance is relatively minor except for the possible impact on surface facilities and/or embedded components. The Staff will conduct an evaluation when the excavation information is available during the COL stage. The specific terminology used to characterize the alluvium does not impact the engineering properties of the site soils that control the assessments of suitability of the site for new plant construction. In some cases, the Staff may perform confirmatory analysis to support its conclusions.

SSAR Figures 2.5-75 through 2.5-77 present site cross-sections, which incorporate the material descriptions generated from the samples taken from the few available borings drilled for the ESP evaluation together with older borings taken for the construction of the currently operating GGNS. The layer interfaces are sketched thereon using the data available from the borings. Revision 1 of SSAR Figure 2.5-76 shows the cross-section of site strata beneath the planned ESP power block and the geotechnical information extended to the Mississippi River. In this cross-section, the boring log for Boring 3 is presented in Revision 1 of SSAR Figure 2.5-37. In Figure 2.5-77, the boring log for Boring-2A, the deepest available boring for this cross-section, is presented in Figure 2.5-36. The information presented on these logs includes the descriptors from the Unified Soil Classification System, which are descriptors based essentially on grain size distributions, measured in the laboratory or visually estimated from the sample inspections. These descriptors are used to estimate, along with sample SPT blow counts, potential engineering properties of the site soils.

The comparison of Revision 1 of SSAR Figures 2.5-36 and 2.5-37 with Revision 1 of SSAR Figures 2.5-75 through 2.5-77 indicates that a zone of filled material is noted at the top of Soil Boring WLA-3B (between Elevation 134 ft and Elevation 110 ft) in SSAR Figure 2.5-76. This zone of filled material is not shown in SSAR Figure 2.5-37. Based on the Applicant's commitment in its response to RAI 2.5.4-11, which states that soils at the plant foundation depth have a minimum shear wave velocity of 1000 fps (SER at 2-236), the soil material including the fill above Elevation minus 5 ft will potentially be removed for the construction of the plant foundation mat as shown in Revision 1 of SSAR Figures 2.5-75 through 2.5-77 and Figure 2.5.5-1 (RAI Figure 2.5.5.1-1). SER at 2-244. Based on the above discussion, this discrepancy will not affect the construction of the plant foundation.

Q.5. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to slope and foundation stability, the Board requested that the Staff provide existing geotechnical information with specific emphasis on the shear strength, creep, and consolidation characteristics of the loess, alluvium, and Catahoula Formation. Please provide this information.

A.5. (TC) Existing geotechnical information for the significant layers of the site profile is presented in SSAR Section 2.5.4.1.1 and ER-02. SER at 2-194. The Catahoula formation, the deepest soil layer encountered in the ESP site investigation, is described as a rock-like formation with high shear strengths as indicated by the high SPT blow count shown for Boring 3 (Figure 2.5-36). The shear wave velocity measured is on average about 2,000 fps, generally considered acceptably stiff for nuclear facilities. The alluvium layers encountered higher up in the profile have blow counts of the order of 30 to 40 bpf with shear wave velocity of on average 1,000 to 1,500 fps. According SSAR Section 2.5.4.1, this material is to be the foundation soil on which the plant basemat will be located (SSAR Figures 2.5-76, -77). The SSAR Section 2.5.4.1 indicates that this material is at a depth of about 120 to 140 ft below the ground surface. The softer materials encountered in the borings, primarily the fill and loess soils, have lower recorded SPT blow counts and shear wave velocities that fall below 1,000 fps. Assuming that the foundation depth of the basemat is maintained at from 120 ft to 140 ft below grade, these loess soils will only impact the plant facility along the walls, but will not affect the foundation response. The stiffer soils providing support to the plant tend to be stiff and are generally not susceptible to liquefaction and creep. The upper loess soils, encountered at depths of about 70 ft, tend to be fine-grained, relatively soft and potentially susceptible to sloughing along the bluff; these soils are not acceptable to provide primary support to the plant. The impact of potential slope erosion needs to be carefully evaluated during the COL stage since slope erosion, even though not influencing the primary support capacity of the stiffer soil layers, can have an impact on seismic stresses due to the unbalanced profile on both sides of the plant. However, since in the SSAR the Applicant restricts the location of the power block foundation to distances of greater than 100 ft from the bluff area on the west side of the plant site, the effect of slope erosion is insignificant. (SER at 2-243).

Q.6. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to slope and foundation stability, the Board requested that the Staff provide a discussion of the potential for slope deformations of the bluff due to creep and/or retrogressive movements. Please discuss the potential for slope deformations of the bluff due to creep and/or retrogressive movements.

A.6. (TC) As shown in SSAR Figure 2.5-76 (Revision 1), the fine-grained soils (colluvium and/or old landslide deposits derived from loess) along the bluff are known to be susceptible to sloughing and local slope failure over time. This behavior may also be influenced by flooding effects from the Mississippi due to undercutting of the slope face. These slope effects could result in unbalanced static and dynamic loads on the plant structures, which may not have been incorporated into the standard plant design. Such unbalanced forces can influence anticipated site settlements, calculated seismic induced stresses, and the design of plant structures. These responses are all related to both the horizontal standoff distance from the bluff and the foundation depth of the power block structures. In addition, all the current techniques used for seismic analyses are based on the assumption of uniform site conditions on all sides of the plant facility. If these unbalanced configurations occur at the site, the potential impact of the site condition on induced seismic stresses needs to be evaluated. Although the Staff believes that, based on its past review experience, these effects on seismic design forces and plant floor response spectra will be small, the basis for this judgment needs to be verified at the COL stage, as described in COL Action Item 2.5-10. SER at 2-243.

Q.7. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to slope and foundation stability, the Board requested that the Staff provide a description of the impacts of flooding on erosion of the bluff and slough material on the bluff as it might affect the integrity of the plant. Please describe the impacts of flooding on erosion of the bluff and slough material on the bluff as it might affect the integrity of the plant.

A.7. (TC, GB) During its review of the design basis flood in the Mississippi River, the Staff, in consultation with the U.S. Army Corps of Engineers, determined that the static flood water surface elevation would not be substantially greater than 103 ft mean sea level (MSL), because of the large discharge capacity of the Mississippi River flood-plain west of the levees, once the levees are overtopped. The bluff on the east bank, adjacent to the ESP site, is not protected by engineered revetments from erosion due to river flooding. As a result of a design basis flood, the static flood water surface elevation of 103 ft MSL would result in the inundation of the gradually sloping portion of the bluff and, to a smaller extent, the steeply sloping portion of the bluff. In RAI 2.5.5-1, the Staff requested that the Applicant perform an evaluation to demonstrate the expected behavior of the loess escarpment (bluff) or the extent to which such movements will not occur. In its response, the Applicant noted that it modified the ESP site plan to restrict the location of the proposed power block area (PPBA) to a distance of over 100 ft from the bluff area on the west side of the site, and the foundation level will potentially be up to 130 ft below grade, which is in the zone of the old alluvium. SER at 2-243. The Applicant also stated that, based on a qualitative assessment of stability, the hazard to the ESP site from potential future movements of the loess soils is very low to none. The Staff concurs with this assessment.

Therefore, the impacts of flooding on erosion of the bluff and slough material on the bluff are not expected to affect the integrity of the plant.

Q.8. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to slope and foundation stability, the Board requested that the Staff provide technical analyses that support the opinions expressed in FSER §§ 2.5.4 and 2.5.5 including, but not limited to (i) stability analyses of existing bluff under varying conditions (including high water table conditions, plant setbacks, etc.) to indicate degree of safety; (ii) ground water flow estimates into excavation or measured values from previous construction for existing plant; (iii) bounding values of typical plant loads to verify no fatal flaw. Please provide these requested analyses.

A.8. (TC) The following evaluations were made to address the three items mentioned in this question.

(i) To evaluate the potential effect of a slope failure through the loess material of the bluff on a proposed plant, a simple linear (plane) failure surface assumption was made. Using the estimated shear strength parameter indicated by the Applicant for the loess material, the potential horizontal extent of the failure surface (or break out point at plant grade) can be estimated. This calculation directly led to the conclusion that from a static point of view, a bluff stand-off distance of the order of 100 ft would minimize the potential effect of a slope failure on the plant.

(ii) Ground water flow estimates into the excavation were not made for this evaluation since such inflows can be directly controlled during excavation and construction by means of dewatering schemes typically used during such heavy construction. Previous experience with similar construction of the GGNS indicates that no unusual ground water conditions would be encountered during this new construction.

(iii) Presuming that the depth of the plant foundation will be located in the stiff old alluvium materials at a depth of up to 130 ft below grade (SSAR Figure 2.5-76), the loss of any passive pressure capacity on the west side of the plant by a slope failure through the loess material will not be a major loss since bottom friction as well as lateral capacity through the alluvium should provide enough total capacity required to overcome the lateral seismic demands on the plant. Since bounding calculations for these effects depend upon the specific plant footprint dimensions and depth, this analysis needs to be confirmed during the COL stage evaluations when the specific plant configuration is known.

November 20, 2006

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	

NRC STAFF PRE-FILED TESTIMONY CONCERNING HEARING ISSUE E: THE ALTERNATIVE ANALYSES FOR THE GRAND GULF ESP PROCEEDING

Q.1. Please state your name, occupation, by whom you are employed and your professional qualifications.

A.1. (JW) James H. Wilson. I am employed as a Senior Project Manager in the New Reactor Environmental Projects Branch, Division of New Reactor Licensing, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached.

A.1. (PH) Paul L. Hendrickson. I am employed as a Staff Scientist with the Engineered Systems Group at the Department of Energy's Pacific Northwest National Laboratory, operated by Battelle. I am providing testimony under a technical assistance contract with the staff of the U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached.

A.1. (LV) Lance W. Vail. I am employed as a Senior Research Engineer II with the Hydrology Group at the Department of Energy's Pacific Northwest National Laboratory, operated by Battelle. I am providing testimony under a technical assistance contract with the staff of the U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached.

Q.2. Please describe your professional responsibilities with regard to the review of the application by System Energy Resources, Inc. ("SERI" or "Applicant"), pursuant to 10 C.F.R. Part 52, Subpart A, for an early site permit ("ESP") for a site within the existing site of the Grand Gulf Nuclear Station property.

A.2. (JW) I am the NRC Senior Project Manager for the environmental review of SERI's Grand Gulf ESP application. I was responsible for overseeing the preparation of NUREG-1817, the "Environmental Impact Statement for an Early Site Permit (ESP) at the Grand Gulf ESP Site: Final Report," April 2006 ("FEIS").

A.2. (PH) As part of the NRC staff's environmental review of SERI's ESP application, documented in the FEIS, I assisted the NRC staff in its analysis of the aspects of the Applicant's Environmental Report that concerned alternative power generation and alternative sites.

A.2. (LV) As part of the NRC staff's environmental review of SERI's ESP application, documented in the FEIS, I assisted the NRC staff in its analysis of the aspects of the Applicant's Environmental Report that concerned plant design alternatives.

Q.3. In its Order of November 6, 2006, the Atomic Safety and Licensing Board ("Board") identified certain issues to be addressed in connection with the mandatory hearing. With regard to the NRC staff's alternative analyses, the Board asked the NRC staff to "discuss why the alternative analyses included in the FEIS do or do not evaluate potential site impacts from the construction and operation of the proposed plant(s) and how future construction may affect the environmental factors that might conflict with the issuance of an ESP." Does the FEIS evaluate potential site impacts from the construction and operation of the proposed plant(s) and how future construction may affect the environmental factors that might conflict with the issuance of an ESP, and if so, why?

A.3. (JW) Yes. The alternative analyses included in the FEIS evaluated potential site impacts from the construction and operation of the proposed plant(s); in addition, Chapter 10 of the FEIS discusses how future construction may affect the environmental factors that might conflict with the issuance of an ESP, one of the factors being consideration of alternatives to the proposed action. The alternative analyses include potential site impacts from the construction and operation of the proposed plant(s) based on the requirements of the National Environmental Policy Act (NEPA). NEPA requires that the NRC prepare a detailed statement on alternatives to the proposed action for every major Federal action significantly affecting the quality of the human environment. 42 USC § 4332(2)(C).

As the Board observed, if considered in isolation, the Grand Gulf ESP decision will not authorize any construction, and as a result, will not directly result in an environmental impact. However, in determining the "significance" of a Federal action, Council on Environmental Quality (CEQ) regulations state that an agency should consider "[w]hether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts." 40 C.F.R. § 1508.27(b)(7). The fact that the licensing action concerning the Grand Gulf ESP is separate from any potential licensing action concerning the construction and operation of proposed plant(s) does not excuse the NRC from evaluating the potential site impacts from the construction and operation of proposed plant(s) and how future construction may affect the environmental factors that might conflict with the issuance of an ESP when the NRC performs its alternative analyses. It is for this reason that the NRC considered alternative power generating sources and plant design alternatives in addition to alternative sites.

I. Alternative Power Generating Sources

Q.4. In its Order of November 6, 2006, the Atomic Safety and Licensing Board ("Board") identified certain issues to be addressed in connection with the mandatory hearing. With regard to the NRC staff's alternative analyses, the Board asked for a discussion of the review of alternative power generation analysis. Would you address this issue?

A.4. (PH) Yes. The Staff addressed alternative power generating sources, including alternatives not requiring new generating capacity and alternatives that would require new generating capacity. In assessing these alternatives, the Staff used a target value of 2000 MW(e) for the electrical output of a new nuclear generating facility at the ESP site, which was also the value SERI used in its application. FEIS at 8-3.

The Staff considered four alternatives that would not involve new generating capacity. These consisted of purchase of the needed electric power from other suppliers, reactivation of retired power plants, extension of the operating life of existing power plants, and implementation of conservation or demand-side management programs. The Staff concluded that conservation or demand-side management was not a reasonable alternative to an ESP directed at base load electricity generation, and did not further consider this alternative. FEIS at 8-3.

Because of uncertainty concerning factors such as the timing for the construction of a new nuclear generating facility at the Grand Gulf ESP site and whether the plant would be a merchant or a regulated facility – factors which significantly impact the viability of options not involving new generating capacity – the Staff did not evaluate the remaining non-new-generating-capacity alternatives in great detail. With respect to the purchased power alternative, the Staff noted that the environmental impacts of power production would still occur, but would be located elsewhere within the region, nation, or in another country. FEIS at 8-4. The impacts would depend on the generation technology and location of the generation site and, therefore, are unknown. FEIS at 8-4. Finally, depending on whether new transmission lines and rights-of-way are necessary to receive the purchased power, the Staff concluded that the local environmental impacts could range from SMALL to LARGE.[1] With respect to extension of the life of existing nuclear power plants, the Staff found that although the environmental impacts are significantly less than new construction, continued operation does not provide additional generation capacity. FEIS at 8-5. With respect to refurbishment, the Staff noted that most fossil plants available for refurbishment are older and would require extensive and expensive work to meet current environmental standards. FEIS at 8-5. The Staff concluded that these three alternatives are not reasonable alternatives to providing new base load power generation capacity, and noted that it would be unreasonable for an applicant to proceed with development of a nuclear power plant if the electrical power sought could be reasonably purchased, or could be obtained through reactivation or life extension of existing plants. FEIS at 8-5.

The Staff next considered alternatives involving new generating capacity. These consisted only of sources the Staff considered to be technically reasonable and commercially viable for base load power generation, which were limited to coal-fired and natural gas-fired generation. FEIS at 8-5.

The Applicant evaluated the construction of four 509 MW(e) coal-fired units at the Grand Gulf ESP site in its environmental report. In its evaluation, the Staff also used this assumption.

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[1] To guide its assessment of environmental impacts of a proposed action or alternative actions, the NRC established a standard for quantifying environmental impacts using the Council on Environmental Quality guidance (40 C.F.R. § 1508.27). FEIS at 1-5, 1-6. Using this approach, the NRC established three significance levels -- SMALL, MODERATE, or LARGE – that the Staff applied to its findings throughout the FEIS. The NRC Staff's definitions of these significance levels are as follows:

SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

FEIS at 8-7. The Applicant estimated that the coal-fired plant would consume approximately 6 million MT/yr (6.6 million tons/yr) of pulverized bituminous coal with an ash content of approximately 11.9 percent, and that approximately 223,000 MT (246,000 tons) of lime would be used annually for flue gas desulfurization. FEIS at 8-7.

In terms of air quality, the Applicant estimated the coal-fired plant's annual emissions, including those for sulfur oxides (SOx) (12,100 MT (13,340 tons)), nitrogen oxides (NOx) (11,600 MT (12,800 tons)), carbon monoxide (CO) (1500 MT (1650 tons)), and particulate matter (PM) (350 MT (390 tons)). FEIS at 8-7. A coal-fired plant would also have unregulated carbon dioxide emissions that could contribute to global warming. FEIS at 8-7. The plant would also be subject to emissions caps and the owner/operator would have to obtain pollution credits, certain permits pursuant to the Clean Air Act, and comply with other source performance and visibility standards. FEIS at 8-7, 8-8. The Staff concluded that air quality impacts from coal-fired generation would be MODERATE, noting the analysis in the GEIS on License Renewal (NUREG-1437) that implied substantial air quality impacts and global warming risks from coal-fired plants, as well as the human health effects associated with coal combustion. FEIS at 8-8.

In terms of waste management, the Applicant estimated that a 2000 MW(e) coal-fired plant would generate approximately 711,000 MT (784,000 tons) of ash and spent catalyst and an additional 660,000 MT (728,000 tons) of scrubber sludge annually. FEIS at 8-9. The Staff concluded that the impacts from waste generated at a coal-fired plant would be MODERATE, noting discussion in the GEIS of coal combustion waste products, recent EPA endorsement of regulations to address such products because of health concerns, and the potential land use and groundwater quality impacts of waste disposal. FEIS at 8-9.

With respect to human health impacts, the Staff noted that coal-fired power generation introduces risks from mining, transportation, waste, emissions, and in some circumstances radiological doses. FEIS at 8-9. However, the Staff concluded that because of regulatory oversight exercised by the EPA and by State agencies, the human health impacts from radiological doses and inhaled toxins and particulates generated from coal-fired generation would be SMALL. FEIS at 8-9, 8-10.

In terms of other environmental impacts, the Applicant stated that a coal-fired plant would require approximately 1085 ha (2680 ac), including approximately 610 ha (1500 ac) to be converted to industrial use for the power block, infrastructure and support facilities, coal and limestone storage and handling, and landfill disposal of ash and scrubber sludge. FEIS at 8-10. Land use changes would also occur offsite in an undetermined coal-mining area to supply coal for the plant. The Staff concluded that the land-use impacts would be MODERATE. FEIS at 8-10. As a result of construction and operations, including coal and limestone mining, construction of a rail spur, and fly ash disposal, the Staff concluded that the ecological impacts could be MODERATE to LARGE. FEIS at 8-10. The Staff found that impacts on water use and quality would be SMALL and comparable to the impacts associated with a new nuclear facility, including the use of cooling water, cooling towers, blowdown, and waste discharge. FEIS at 8-10.

The Staff found that socioeconomic impacts from the coal-fired plant would be SMALL to MODERATE, based on the proximity to the surrounding population area and the relatively small number of workers (about 300) needed to operate the plant. FEIS at 8-11. The Staff also concluded that tax revenues would have a LARGE beneficial impact for Claiborne County. FEIS at 8-11. The Staff also concluded that the visual and aesthetic impacts of a coal-fired generation plant would be MODERATE, based on the presence of power block units and exhaust stacks visible offsite, cooling towers and associated plumes, and mechanical noise audible offsite (particularly rail delivery of fuel), though some of these impacts are intermittent or could be visually mitigated. FEIS at 8-11, 8-12. The Staff found that the historic and cultural resource impacts would be SMALL (in light of the impacts from construction and operation of the existing GGNS), that environmental justice impacts would be LARGE and beneficial (given high property tax revenues), and that other construction and operation impacts would be SMALL. FEIS at 8-12.

The Applicant also evaluated natural gas-fired generation in its environmental report using combined-cycle combustion turbines and employing four units with a net capacity of 508 MW(e) per unit. In its evaluation, the Staff also used these assumptions. FEIS at 8-14.

In terms of air quality, the Staff found that compared with a coal-fired plant, a natural gas-fired plant would release similar types of emissions but in lower quantities. FEIS at 8-14. The Applicant estimated that a natural gas-fired plant equipped with appropriate pollution control technology would annually emit approximately 109 MT (120 tons) of SOx, 417 MT (460 tons) of NOx, 553 MT (610 tons) of CO, and 63 MT (70 tons) of PM10 (particulate matter having an aerodynamic diameter less than or equal to 10 μm). FEIS at 8-15. The owner/operator would also have to obtain certain permits pursuant to the Clean Air Act, and comply with other stationary source and visibility standards. FEIS at 8-14. The Staff concluded that air quality impacts from new natural gas-fired power generation at the ESP site would be SMALL to MODERATE. FEIS at 8-15.

With respect to waste management, the Staff noted the finding in the GEIS that waste generation from natural gas is minimal; the Staff thus concluded that waste impacts from natural gas-fired power generation would be SMALL. FEIS at 8-15. With respect to human health risks, while the Staff noted its finding in the GEIS analysis that cancer and emphysema are potential health risks from natural gas-fired plants, it noted Mississippi Department of Environmental Quality (MDEQ) regulation of the ESP site and concluded that the impacts would be SMALL. FEIS at 8-15, 8-16.

In terms of other environmental impacts, the Applicant estimated that a natural gas plant would need approximately 91 ha (225 ac), including the power block and support facilities, cooling towers and support systems, and a natural gas pipeline. FEIS at 8-16. For any new natural gas-fired power plant, additional land would be necessary for natural gas wells and collection stations. FEIS at 8-16. In light of this relatively small land disturbance, the Staff concluded that land-use impacts from new natural gas-fired power generation would be SMALL, and ecological impacts would be SMALL to MODERATE. FEIS at 8-16. Based on the analysis in the GEIS, the Staff concluded that impacts on water use and quality would be SMALL. FEIS at 8-16.

With respect to socioeconomic impacts, the Staff concluded that based on the proximity to the surrounding population area and the relatively small number of workers (approximately 150) needed to construct and operate the plant in comparison to nuclear and coal-fired generation, the impacts would be SMALL. FEIS at 8-16, 8-17. The Staff concluded that the tax revenues would have a MODERATE beneficial impact on Claiborne County. FEIS at 8-17.

Although the turbine buildings, exhaust stacks (and emissions), cooling towers and associated plumes, and gas pipeline compressors would be visible offsite, and some noise would be audible offsite, the Staff concluded that the visual and aesthetic impacts of a natural gas-fired generation plant would be SMALL. FEIS at 8-17. Some of these impacts would be mitigated by the industrial and rural location and relatively smaller land use. FEIS at 8-17. The Staff found that the historic and cultural resource impacts would be SMALL (in light of the existing GGNS), that environmental justice impacts would be MODERATE and beneficial (given moderate property tax revenues), and that other construction and operation impacts would be SMALL. FEIS at 8-17.

SERI's application also identified other energy alternatives. However, as new nuclear units at the ESP site would constitute a base load generation plant, and the Applicant determined that these alternatives either could not generate base load power or could not do so economically, it concluded that these alternatives were not reasonable. FEIS at 8-19. These alternatives included oil-fired generation, wind, solar, hydroelectric, geothermal, wood waste, municipal solid waste, biomass-derived fuels, and fuel cells. FEIS at 8-19 to 8-22. Based on its independent review (including, for some issues, reliance on the analysis in the GEIS), the Staff determined that SERI's conclusion – that these alternatives are not reasonable – is acceptable. FEIS at 8-19.

The Staff concluded that oil-fired generation has become more expensive than nuclear or coal-fired generation options and is likely to become even less economical in the future, particularly as a fuel source for a base load plant. FEIS at 8-19. The Staff found that Mississippi does not have sufficient wind resources to use large-scale wind turbines and that wind turbines typically do not operate at a capacity factor comparable to a base load plant, making them an uneconomical alternative. FEIS at 8-19, 8-20. With respect to solar power, the Staff found that it would be uneconomical because of solar power's higher capital cost per kilowatt of capacity, high energy storage requirements (limiting its use as a base load supply), and high land requirements. FEIS at 8-20.

Similarly, because of the relatively low amount of undeveloped hydropower resources in Mississippi and the large land and related environmental and ecological resource impacts (flooding, destruction of natural habitat, and alteration of natural river courses) associated with siting hydroelectric facilities large enough to produce 2000 MW(e), the Staff concluded that local hydropower was not a feasible alternative. FEIS at 8-20, 8-21. Although geothermal energy has an average capacity factor of 90 percent and can be used for base load power where available, the Staff found that no feasible eastern location for geothermal capacity can serve as an alternative to a base load nuclear power plant, making it an unreasonable alternative to the proposed ESP site. FEIS at 8-21.

Because of uncertainties associated with obtaining sufficient wood and wood waste to fuel a base load power plant (larger wood-waste power plants are typically only 40 to 50 MW(e) in size), the ecological impacts of large-scale timber cutting (for example, soil erosion and loss of wildlife habitat), and high inefficiency, the Staff concluded that wood waste is not a feasible alternative. FEIS at 8-21. Similarly, with respect to use of municipal solid waste, only about 89 waste-to-energy plants are operating in the United States, with an average output of approximately 28 MW(e) per plant; the Staff concluded that this would not constitute a feasible base load alternative to the proposed ESP site. FEIS at 8-22.

With respect to other biomass-derived fuels, including burning crops, converting crops to a liquid fuel such as ethanol, and gasifying crops (including wood waste), the Staff concluded, based on the analysis in the GEIS, that none of these technologies has progressed to the point of being competitive on a large scale or of being reliable enough to replace a large base load plant, and thus they do not represent reasonable alternatives. FEIS at 8-22. Finally, with respect to fuel cells, although significant efforts have been made to develop more practical and affordable fuel cell designs for stationary power applications, the Staff concluded that fuel cells currently are not economically or technologically competitive with other alternatives for base load electricity generation, and their future competitiveness compared to other fuels is speculative. FEIS at 8-22, 8-23. The Staff therefore concluded that fuel cells are not a reasonable alternative to nuclear generation at the proposed ESP site. FEIS at 8-23.

The Staff also considered the possibility that some combination of alternatives might be more economical than the construction of a new base load plant at the proposed ESP site. Of the many possible combinations, the Staff evaluated the environmental impacts of an assumed combination of three 508 MW(e) natural gas combined-cycle generating units at the Grand Gulf ESP site using closed-cycle cooling with cooling towers, 30 MW of wind energy, 30 MW of hydropower, 90 MW from biomass sources including municipal solid waste, and 326 MW from conservation and demand-side management programs. FEIS at 8-23, 8-24. However, after comparing the environmental impacts with those assessed for the proposed plant at the ESP site, the Staff concluded that, from an environmental perspective, none of the viable energy alternatives were clearly preferable to construction of a new base load nuclear power generation plant. FEIS at 8-24 to 8-26.

II. Plant Design Alternatives

Q.5. In its Order of November 6, 2006, the Atomic Safety and Licensing Board ("Board") identified certain issues to be addressed in connection with the mandatory hearing. With regard to the NRC staff's alternative analyses, the Board asked for a summary of the plant design alternatives analysis. Would you address this issue?

A.5. (LV) Yes. In its environmental report, SERI described the process behind its decision to propose natural or mechanical draft cooling towers or both with a makeup water intake in the Mississippi River and a blowdown discharge outfall downstream of the intake. FEIS at 8-24. SERI considered seven heat-dissipation alternatives in its environmental report, including once-through cooling, wet mechanical draft cooling towers, wet natural draft cooling towers, wet-dry cooling towers, dry cooling towers, a cooling pond, and spray canals. FEIS at 8-26, 8-27. After ruling out other options for various reasons, SERI only included wet natural draft and wet mechanical draft cooling towers in its PPE. FEIS at 8-27. Based on its independent review - including a determination that the Mississippi River is not suited for once-through cooling, that land limitations make the site unsuitable for cooling pond or spray canal heat-dissipation designs, and that dry cooling technology has some detrimental effects on electricity production by reducing the energy efficiency of steam turbines - the Staff agreed that the other options were not suitable and concluded that wet mechanical draft cooling towers and wet natural draft cooling towers are suitable for the site. FEIS at 8-27, 8-28. However, system design alternatives would be discussed at the CP or COL stage, because a specific cooling system design for the Grand Gulf ESP site has not been selected. FEIS at 8-28, 8-29.

For its intake system, SERI proposed to withdraw makeup water for the heat-dissipation system and the circulating water system directly from the Mississippi River through a shoreline embayment and intake constructed on the bank of the river. FEIS at 8-29. SERI considered two alternative types of water intake - either a direct intake from the river with a structure located on the riverbed and a pipeline connecting it to the bank, or a channel directing water to the intake structure on the shoreline - and the Staff found no basis to suggest that these alternatives would be environmentally preferable to SERI's proposed intake system. FEIS at 8-29.

For its discharge system, SERI stated that the thermal effluent from a new facility would also be released to the river through a new outfall structure that would be located downstream of the existing outfall. FEIS at 8-30. The Staff evaluated a shoreline diffuser outfall and a submerged single-point discharge, but it found no basis to suggest that the two discharge alternatives would be environmentally preferable to SERI's proposed discharge system. FEIS at 8-30.

In terms of water supply, the Staff did not identify any other water supply environmentally preferable to the Mississippi River and wells in the alluvial aquifer. FEIS at 8-30. Finally, with respect to water treatment, the Staff noted that although the water treatment requirements and water system effluents are not known, all chemical and thermal discharges would be regulated by the MDEQ through the National Pollutant Discharge Elimination System (NPDES) process. FEIS at 8-30.

III. Alternative Sites

Q.6. In its Order of November 6, 2006, the Atomic Safety and Licensing Board ("Board") identified certain issues to be addressed in connection with the mandatory hearing.

With regard to the NRC staff's alternative analyses, the Board asked for a summary of the alternative sites analysis, including (i) site screening procedures; (ii) impact assessment for ESP's unresolved issues; and (iii) summary of alternative site comparison. Please address these issues.

A. Alternative Site Screening Selection Process

A.6. (PH) Regarding the site screening procedures, the Staff examined Entergy's region of interest ("ROI") for possible siting of a new nuclear power plant, as well as its alternative site selection process. (Entergy Nuclear, a division of Entergy Corporation, conducted the alternative site selection process for the Grand Gulf ESP application). FEIS at 8-31. Entergy Nuclear selected its ROI for examining potential ESP sites as the locations of seven existing Entergy sites with operating nuclear power plants licensed by the NRC at the time of its application for an ESP: Arkansas Nuclear One, Grand Gulf Nuclear Station, James A. FitzPatrick Nuclear Power Plant, Indian Point Energy Center, Pilgrim Nuclear Station, River Bend Station, and Waterford-3. FEIS at 8-31. The application explained that these sites were identified for several reasons. For example, NRC has approved the sites for nuclear plant construction and operation, site characterization data have been collected and are available, the operational impact of the existing nuclear plants is documented, and the sites and related facilities are controlled by Entergy. FEIS at 8-32. The Staff concluded that the criteria used to identify the ROI were reasonable for consideration and analysis of potential ESP sites. FEIS at 8-32.

The application next explained how Entergy Nuclear further screened its site list. It first removed Indian Point due to greater population density in the site vicinity. FEIS at 8-33. It then ranked the remaining sites with respect to 11 weighted screening criteria, including pricing, seismic evaluation, water availability, exclusion area, and spent fuel storage. FEIS at 8-33, 8-34. In the interest of regional and market diversity and to gain ESP experience in different environments, Entergy removed Waterford and Arkansas-One (its 4th and 5th ranked sites), but retained Pilgrim for further evaluation, along with Grand Gulf, River Bend, and FitzPatrick, its top three sites. FEIS at 8-33. The Staff concluded this was a reasonable basis for narrowing the sites for examination. FEIS at 8-34.

To narrow its site selection to a final site, Entergy Nuclear ranked the sites using a final set of 34 weighted screening criteria, including flooding, accident effects, radionuclide pathways, socioeconomics, highway and rail access, and labor rates. FEIS at 8-35 to 8-37. This resulted in an ordered ranking of Grand Gulf, FitzPatrick, River Bend, and Pilgrim. The Staff concluded that the overall site selection process for alternative sites was reasonable and that the identification of the Grand Gulf ESP site was consistent with that approach. FEIS at 8-37.

B. Comparison of Impacts (Including Impacts for Unresolved Issues) for the Proposed and Alternative Sites

In its environmental report, the Applicant examined the River Bend, Pilgrim, and FitzPatrick alternative sites in detail. The Staff conducted its own independent examination, including visiting each of the three alternative sites to collect additional reconnaissance-level information. The Staff also visited the Grand Gulf ESP site. FEIS at 8-37, 8-38. The Staff found that SERI reasonably identified alternative sites, adequately evaluated the environmental impacts of construction and operation, and used a logical means of comparing sites. FEIS at 9-2. To compare the proposed action with the alternatives, the Staff weighed the impact significance levels (SMALL, MODERATE, or LARGE) it had determined with respect to the Grand Gulf ESP site for each major impact area with the corresponding levels for each of the three identified alternative sites. FEIS at 9-2. Where the Staff had been unable to reach a single determination level for the Grand Gulf ESP site due to insufficient information, the Staff indicated a likely impact level for unresolved issues – so that a comparison could be made – based on professional judgment, experience, and consideration of controls likely to be imposed under required Federal, State, or local permits that would not be acquired until an application for a construction permit or combined license is underway. FEIS at 9-2. The Staff believes that the impact levels that were assigned in these areas are sufficiently defined for the purposes of comparison between the proposed and the alternative sites. The final impact assessment of construction and operation of new nuclear units at the Grand Gulf ESP site would be performed at the CP or COL stage for issues that were not resolved during the review of the ESP application. The alternative sites do not have unresolved impacts because impacts at alternative sites were evaluated using reconnaissance-level information.

The Staff determined that the impact level from construction would be SMALL for most of the environmental issues at each of the sites. See FEIS at Table 9-1. The Staff's issue-by-issue construction impact determinations are explained more fully in Chapter 4 of the FEIS for the Grand Gulf ESP site and in Chapter 8 for the alternative sites. The Staff found that construction of transmission corridors at the Pilgrim and FitzPatrick sites would have SMALL to MODERATE land use impacts. FEIS at 9-5. For terrestrial ecosystems, the Staff determined that impacts would likely be MODERATE at Grand Gulf and River Bend and as much as LARGE at FitzPatrick because of probable impacts to forests and wetlands and associated habitats. FEIS at 9-5. For threatened and endangered species, the Staff determined that impacts would likely be SMALL to MODERATE at River Bend and MODERATE TO LARGE at Pilgrim because of potential impacts to protected species. FEIS at 9-5. The Staff found socioeconomic and environmental justice impacts ranging from SMALL to MODERATE adverse impacts in some aspects, and up to LARGE beneficial impacts in other aspects, such as social and economic benefits because of tax revenue. FEIS at 9-5.

Similarly, the Staff determined that the impact level from operations would be SMALL for most of the environmental issues at each site. *See* FEIS Table 9-2. Once again, the Staff's issue-by-issue operational impact determinations are explained more fully in Chapter 5 of the FEIS for the Grand Gulf ESP site and in Chapter 8 for the alternative sites. Exceptions to the Staff's findings of SMALL impacts from operations included aquatic and terrestrial ecosystems and threatened and endangered species at the Pilgrim site, arising from potential impacts to the winter flounder larvae and on the redbelly turtle. FEIS at 9-5. Additionally, the Staff's findings concerning social and economic impacts in socioeconomics at the alternative sites included LARGE to SMALL beneficial impacts, principally due to added tax revenue and beneficial impacts on the local economy. FEIS at 9-5. The Staff determined that social and economic impacts at the Grand Gulf ESP site would be LARGE and beneficial, while impacts on infrastructure and community services would be MODERATE adverse at the Grand Gulf ESP site and SMALL to MODERATE adverse at the alternative sites. FEIS at 9-5. Finally, the Staff found that environmental justice impacts would be SMALL at the alternative sites, but up to LARGE and beneficial at the Grand Gulf ESP site. FEIS at 9-5, 9-6.

C. <u>Summary of Alternative Site Comparison</u>

The Staff then analyzed whether any of the alternative sites are environmentally preferable to the Grand Gulf site. First, with respect to construction impacts, while the Staff concluded that impacts were generally SMALL for all four analyzed sites, the Staff identified several differences between the environmental impacts of construction at the proposed and alternative ESP sites. FEIS at 9-6. However, while the Grand Gulf site had some higher adverse impacts with respect to demographics, terrestrial ecosystems and infrastructure and community services (as well as one area, social and economic benefits from tax revenues, of significantly higher beneficial impacts), the Staff found that each alternative site had higher adverse impacts for the same issues or in other respects. FEIS at 9-6. The Staff concluded that none of the differences were sufficient to determine that any of the alternative sites is environmentally preferable to the Grand Gulf ESP site. FEIS at 9-6.

Second, with respect to operational impacts, the Staff again noted that impacts were generally SMALL for all four analyzed sites, and identified several differences between the environmental impacts at the proposed and alternative ESP sites. FEIS at 9-7. However, while the Grand Gulf site again had some higher adverse impacts with respect to demographics and infrastructure and community services (and also had significantly higher potential social and economic benefits), the Staff found that the alternative sites had, on the whole, either closely comparable impacts or slightly less beneficial impacts than the Grand Gulf site. FEIS at 9-7. The Staff again concluded that none of the differences were sufficient to determine that any of the alternative sites is environmentally preferable to the Grand Gulf ESP site. FEIS at 9-7.

Because the Staff determined that none of the alternative sites was environmentally preferable to the Grand Gulf ESP site, it concluded by extension that none of the alternative sites is obviously superior to the Grand Gulf ESP site. FEIS at 9-7.

Finally, the Staff compared the proposed action with the no-action alternative. The Staff noted that denial of the ESP application would prevent early resolution of safety and environmental issues for the site, and it further found that although SERI could follow any of several paths to satisfy its electric power needs, each of the paths would have associated environmental impacts. FEIS at 9-7, 9-8. The Staff additionally concluded that no significant environmental impacts would be avoided by the no-action alternative because no such impacts are caused by a site-suitability determination. FEIS at 9-8.

November 20, 2006

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	

NRC STAFF PRE-FILED TESTIMONY CONCERNING HEARING ISSUE F:
CUMULATIVE SITE IMPACTS FOR THE GRAND GULF ESP PROCEEDING

Q.1. Please state your name, occupation, by whom you are employed and your professional qualifications.

A.1. (SK) Stephen Klementowicz. I am employed as a Senior Health Physicist in the Division of License Renewal, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission ("NRC").

A.1. (CB) Charles A. Brandt. I am employed as the Resource and Ecosystems Management Product Line Manager at the Pacific Northwest National Laboratory. I am providing testimony under a technical assistance contract with the staff of the NRC. A statement of my professional qualifications is attached.

Q.2. Please describe your professional responsibilities with regard to the review of the application by System Energy Resources, Inc. ("SERI" or "Applicant"), pursuant to 10 C.F.R. Part 52, Subpart A, for an early site permit ("ESP") for a site within the existing site of the Grand Gulf Nuclear Station ("GGNS") property.

A.2. (SK) As part of the NRC Staff's health and safety review of the SERI ESP application, documented in NUREG-1840, "Safety Evaluation Report for an Early Site Permit (ESP) at the Grand Gulf Site" ("SER"), I reviewed the aspects of the Applicant's Site Safety

Analysis Report that concerned the radioactive waste treatment system and the radiological impacts from routine operation to plant workers, members of the public, and to the environment. I was also part of the NRC Staff's environmental review of the SERI ESP application, documented in NUREG-1817, "Environmental Impact Statement for an Early Site Permit (ESP) at the Grand Gulf ESP Site: Final Report," April 2006 ("FEIS"). I reviewed the aspects of the Applicant's Environmental Report that concerned the radioactive waste treatment system and the radiological impacts from routine operation to plant workers, members of the public, and to the environment.

A.2. (CB) I was the Pacific Northwest National Laboratory Task Manager responsible for the Laboratory's environmental review of SERI's ESP application and preparation of NUREG-1817, the "Environmental Impact Statement for an Early Site Permit (ESP) at the Grand Gulf ESP Site: Final Report," April 2006 ("FEIS"). As part of this function, I assisted the NRC Staff in its analysis of the aspects of the Applicant's Environmental Report that concerned cumulative site impacts.

Q.3. In its November 6, 2006, Order, the Atomic Safety and Licensing Board ("Board") identified certain issues to be addressed in connection with the mandatory hearing. With regard to the NRC Staff's cumulative site impacts analysis, the Board stated its opinion that some issues will have an impact on the site which may be cumulative with respect to the number of plants, including any existing plants on the site. Would you please explain which parameters were, or should have been, evaluated in this regard?

A.3. (SK) The Staff presented information on its evaluation of the projected cumulative impacts of routine radiological discharges from a potential new reactor(s) and existing station to workers, members of the public, and to the environment in response to Q.3 in the testimony on Hearing Issue I.

A.3. (CB) In conducting the cumulative impacts evaluation for the environmental review of SERI's ESP application, the Staff considered the combined effects of the existing GGNS Unit 1 and the proposed GG ESP facility for all environmental issues that had been evaluated for construction, operation, fuel cycle, transportation, and decommissioning. This evaluation focused on issues where potential cumulative impacts could reasonably be expected to occur, including impacts of the existing GGNS Unit 1. Based on this analysis, the Staff identified the following impact issues and associated parameters as relevant to the cumulative impacts analysis:

- <u>Land Use</u> – land conversion to accommodate new workers and services for construction and operation; offsite land use changes resulting from transmission system improvements;
- <u>Air Quality</u> – pollutant emissions resulting from construction; pollutant emissions resulting from operation; heat, water vapor, and drift plumes from cooling tower operation;
- <u>Water Use and Quality</u> – surface water use (on site and from the Mississippi River); groundwater use; surface water quality (on site and in the Mississippi River); groundwater quality;
- <u>Terrestrial Ecosystems</u> – loss of important species and habitats due to construction; loss of important species and habitats from operation;
- <u>Aquatic Ecosystems</u> – loss of important species and habitats due to construction; loss of important species and habitats from operation;
- <u>Socioeconomics</u> – physical impacts; demography, social and economic impacts, infrastructure, and community services;
- <u>Historic and Cultural Resources</u> – cumulative impacts to historic and cultural resources;

- Environmental Justice – unusual resource dependencies or practices or environmental pathways; tax revenues; infrastructure and community services;
- Nonradiological Health – microbial organisms; occupational health; noise and dust emissions; chronic effects of electromagnetic fields;
- Radiological Impacts from Normal Operations – public and occupational radiological doses; radiological emissions;
- Fuel Cycle – fuel use for light-water reactor designs; fuel use for gas cooled designs;
- Transportation – radiological dose to public from unirradiated fuel, spent fuel, and radiological wastes from light-water reactor designs; radiological dose to public from unirradiated fuel, spent fuel, and radiological wastes from gas cooled reactor designs; and
- Decommissioning – radiological dose to workers and public; waste management; water quality; air quality; ecological resources; socioeconomics.

Q.4. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. The Board noted that in response to FSER Inquiry No. 2, the Staff indicated that in the FEIS it evaluated the impact of the combined radiological effluent discharges from the existing operating unit and the proposed plant(s). For both the FSER and the FEIS, please identify and discuss all of the issues that have or will contribute to cumulative effects.

A.4. (CB) In conducting the environmental review of SERI's ESP application, the Staff determined a cumulative impact level for each issue and associated parameter(s) (identified previously in response A.3) based upon an appropriate temporal and spatial context. The results of that analysis, including the relevant context for the analysis, are summarized in a table entitled "Summary of Issues for Which Cumulative Effects Were Analyzed," which accompanies this testimony.

Q.5. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the NRC Staff's cumulative site impacts analysis the Board requested a discussion on whether the impacts of radiological effects should or should not be the only cumulative impact that needs to be considered in order to properly qualify the site. Please address this issue.

A.5. (SK) The only potential cumulative impact that was not required to be evaluated (as discussed in response to Q.5 in the testimony on Hearing Issue B) is the potential impact from inadvertent releases of radioactive liquid on the plant site. The Health Physics Branch of the Division of Inspection and Program Support within NRR is currently developing a plan and schedule to address the recommendations contained in the Lessons Learned Task Force Report (Adams Accession Number: ML062650312) on inadvertent radioactive liquid releases onto a plant site. The report contained several recommendations concerning the need to explore enhanced onsite environmental monitoring to detect the presence of radioactive material that originated from an inadvertent release. At this time, the Staff does not have any regulations and guidance to guide it in an evaluation of potential impacts from inadvertent releases of radioactive liquid on the plant site.

A.5. (CB) As just described in A.3 and A.4, and in the FEIS, radiological effects should not be (and were not) the only component of the cumulative impact analysis used to evaluate the Grand Gulf site. Consideration of only one potential impact (be it radiological effects or any other) would undermine the rigor and reliability of the qualification, because impacts not considered could potentially bias the Staff's analysis in favor of the site. Thus, the Staff considered in a cumulative sense all impacts that had the potential to affect the environment for the duration of the proposed action (construction period plus 40 years of operation). The impacts considered included all of those addressed in the analyses of construction, operation, fuel cycle, transportation, and decommissioning. As noted in the Staff response to Board EIS Inquiry No. 5, the only impact issue that did not receive discussion in the cumulative impacts section of the FEIS was design basis accidents. This issue was not addressed cumulatively because (1) the purpose of the design basis accident analysis is to compare predicted dose consequences with regulatory limits and guidance pertaining to individual reactors (not collections of reactors), and (2) the likelihood of simultaneous design basis accidents is small.

November 20, 2006

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	

NRC STAFF PRE-FILED TESTIMONY CONCERNING HEARING ISSUE G:
EVALUATION OF PLANT PARAMETER ENVELOPE

Q.1. Please state your name, occupation, by whom you are employed and your professional qualifications.

A.1. (GW) George F. Wunder. I am employed as a Project Manager in the ESBWR/ABWR Projects Branch 1, Division of Licensing Project Management, Office of New Reactors, U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached.

A.1. (JW) James H. Wilson. I am employed as a Senior Project Manager in the New Reactor Environmental Projects Branch, Division of New Reactor Licensing, Office of Nuclear Reactor Regulation, NRC. A statement of my professional qualifications is attached.

A.1. (BH) R. Brad Harvey. I am a Physical Scientist in the Nuclear Regulatory Commission's (NRC's) Office of Nuclear Reactor Regulation (NRR), Division of Risk Assessment (DRA). A statement of my professional qualifications is attached.

A.1. (SK) Stephen Klementowicz. I am a Senior Health Physicist in the Nuclear Regulatory Commission's (NRC's), Office of Nuclear Reactor Regulation (NRR), Division of License Renewal (DLR). A statement of my professional qualifications is attached.

A.1. (GB) Goutam Bagchi. I am a Senior Advisor in the Nuclear Regulatory Commission's (NRC's), Office of Nuclear Reactor Regulation (NRR), Division of Engineering (DE). A statement of my professional qualifications is attached.

A.1. (JR) James V. Ramsdell, Jr. I am employed as a Staff Scientist with the Atmospheric Chemistry & Meteorology Technical Group at the U. S. Department of Energy's Pacific Northwest National Laboratory operated by Battelle. I am providing testimony under a technical assistance contract with the staff of the U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached.

Q.2. Please describe your professional responsibilities with regard to the review of the application by System Energy Resources, Inc. ("SERI" or "Applicant") for an early site permit ("ESP") for a new nuclear power plant or plants to be located on the existing Grand Gulf Nuclear Station ("GGNS") site near Port Gibson, Mississippi.

A.2. (GW) I took over Project Management responsibilities in May 2006, following issuance of NUREG-1840, the "Safety Evaluation Report for an Early Site Permit (ESP) at the Grand Gulf Site" ("SER"). I have been responsible for project management activities with respect to the SER since that time.

A.2. (JW) I am the NRC Senior Project Manager for the environmental review of SERI's Grand Gulf ESP application. I was responsible for overseeing the preparation of NUREG-1817, the "Environmental Impact Statement for an Early Site Permit (ESP) at the Grand Gulf ESP Site: Final Report," April 2006 ("FEIS").

A.2. (BH) As part of the NRC staff's health and safety review of the SERI ESP application, documented in the Grand Gulf Site SER, I reviewed the aspects of the Applicant's Site Safety Analysis Report that concerned meteorology.

A.2. (SK) As part of the NRC staff's health and safety review of the SERI ESP application, documented in the Grand Gulf Site SER, I reviewed the aspects of the Applicant's Site Safety Analysis Report that concerned the radioactive waste treatment system and the radiological impacts of routine operation to plant workers and members of the public.

A.2. (GB) As part of the NRC staff's health and safety review of the SERI ESP application, documented in the Grand Gulf Site SER, I reviewed the aspects of the Applicant's Site Safety Analysis Report that concerned hydrology.

A.2. (JR) As part of the NRC staff's environmental review of the SERI ESP application, documented in the Grand Gulf FEIS, I assisted the NRC staff in its analysis of the aspects of the Applicant's Environmental Report that concerned Meteorology and Air Quality, and evaluation of Design Basis and Severe Accidents.

Q.3. In its November 6, 2006, Order, the Atomic Safety and Licensing Board ("Board") identified certain issues to be addressed in connection with the mandatory hearing. With regard to the NRC staff's evaluation of the plant parameter envelope ("PPE"), the Board stated that the list of PPE parameters provided in SERI's ESP application appears to be incomplete with respect to those identified in the Nuclear Energy Institute ("NEI") guidance. Please indicate any PPE parameters that are on the NEI list, but are not included in the PPE table for the Grand Gulf ESP.

A.3. (GW, JW) In response to the Board's question, the Applicant prepared a table identifying the NEI parameters and indicating whether each is included in the PPE table for the Grand Gulf ESP. That table is attached to this testimony as Table G-1. The Staff agrees with the Applicant's identification of which parameters from the NEI document were or were not used for the Grand Gulf application. The Staff takes no position concerning the Applicant's additional comments (column 3 of Table G-1) concerning the inclusion/exclusion of particular parameters.

Q.4. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the NRC staff's evaluation of the PPE, the Board stated that the relationship between the PPE parameters provided in SERI's ESP application and the maximum MWt and MWe in the ESP analyses performed by the NRC staff was unclear to the Board. Please discuss how the staff's analyses that use the PPE parameters support the maximum site reactor power requested by the Applicant. Provide separate discussions for the FSER and the FEIS analyses.

A.4. (GW) With respect to the Staff's health and safety review and the analyses documented in the FSER, the Staff believes that the PPE parameters in the Grand Gulf ESP PPE that are directly related to the site power level are not inconsistent with the maximum site reactor power requested by the Applicant.

(GB) For example, the bounding parameter for maximum makeup water flow (78,000 gpm) is not inconsistent with the proposed maximum site reactor power.

(BH) Regarding the parameters related to Normal Plant Heat Sink Condenser and Normal Heat Sink (NHS) Cooling Towers in PPE Sections 2.3.2, 2.4.8, and 2.5.8, as well as the parameters related to the Unit Vent/Airborne Effluent Release Point in PPE Sections 9.4.2 Elevation (Normal), 9.4.3 Elevation (Post Accident), and 9.4.4 Minimal Distance to Site Boundary, these PPE parameters are not inconsistent with the Applicant's proposed maximum site reactor power.

(SK) Likewise, for the evaluation of the radiological impacts to plant workers, members of the public, and the environment, the Staff used SERI's bounding radiological routine effluent release source term. The source term was stated by SERI to be the maximum value for any of the plant design / number of unit combinations being considered for the site. This value is not inconsistent with the Applicant's proposed maximum site reactor power.

(GW) In summary, with respect to the Staff's health and safety review and the analyses documented in the FSER, the Staff believes that the PPE parameter values in the Grand Gulf ESP PPE that are directly related to the site power level are not inconsistent with the maximum site reactor power requested by the Applicant.

A.4. (JR) With respect to the Staff's environmental review and the analyses documented in the FEIS, the Staff believes that the PPE parameters in the Grand Gulf ESP PPE that are directly related to the site power level are not inconsistent with the maximum site reactor power requested by the Applicant.

The Staff's analyses in the FEIS are based on either 1) specific reactor designs (e.g., the ABWR and the AP1000), or 2) composite characteristics that are derived from consideration of the individual characteristics of each of the 7 reactor designs listed in the Application. The site goal is generation of about 2000 MWe. None of the reactors discussed in the Application is capable of generation of 2000 MWe. Therefore, at least two reactors would be necessary to meet that goal.

Of the reactors discussed, the ABWR is the largest, with a postulated rating of about 1500 MWe based on a design power level of 4300 MWt. Thus, the PPE (ER Table 3.0-1) lists 4300 MWt as a unit specific parameter. The corresponding site value (not included explicitly in the PPE) is 8600 MWt. The PPE contains several parameters that are directly related to the site power level. These parameters include normal heat sink blowdown flow rate, evaporation rate, and makeup water flow rate. The ABWR was considered in establishing these parameters. Consequently, the Staff assumes that the values given in the PPE encompass the heat rejection needs of two 4300 MWt ABWRs.

Normal heat sink blowdown flow rate, evaporation rate, and makeup water flow rate were considered in the evaluation of the impacts of plant operation on water use and quality. A similar set of parameters is associated with the ultimate heat sink. The ultimate heat sink would have lesser impacts on the environment. Makeup water and blowdown flows were considered along with blowdown temperature (which is not likely to be related to power) in evaluation of the impacts of the postulated facility on aquatic ecology. Intake and outfall design characteristics not related to power level may have impacts on aquatic ecology that are as large as those related to power level.

Land use and terrestrial ecology impacts related to site power level are not likely to be particularly sensitive to the ultimate site power level, except to the extent that they will be impacted if the ESP site power level exceeds the capacity of the existing transmission system. If transmission capacity is exceeded and additional capacity installed, further increases in the size of the plant are not likely to have proportionately large increases in impacts.

Although radiological releases are affected somewhat by design power level, use of the PPE as implemented by SERI negated any effect that design power level might have. The radiological releases from plants are determined by plant systems and release paths as much as by the design power level.

SERI included tables of gaseous (Table 3.0-7) and liquid (Table 3.0-8) radiological releases expected during normal operations in its PPE. These tables are based on radionuclide-by-radionuclide comparison of projected releases from each of the 7 reactor designs being considered. For each radionuclide, the largest release from among the 7 designs was entered into the tables. Therefore, the PPE normal-operations source terms in these tables bound the source terms for all 7 reactor designs, including the ABWR. The source term for any other reactor design should be compared against the source terms in the tables on an isotopic basis to determine if the source terms are bounded by the FEIS analysis. Reactor power rating is not an appropriate basis for making this determination.

Comparisons of isotopic release rates and doses are more appropriate means of establishing whether a reactor design is within the bounds of the Staff's analysis than is reactor design power. Design basis accidents and severe accidents were evaluated for both the ABWR and AP1000 reactor designs. The ABWR has a higher thermal power than the AP1000. However, the consequences of ABWR design basis accidents are not necessarily greater than those of AP1000 design basis accidents.

In summary, with respect to the Staff's environmental review and the analyses documented in the FEIS, the Staff believes that the PPE parameter values in the Grand Gulf ESP PPE that are directly related to the site power level are not inconsistent with the maximum site reactor power requested by the Applicant.

Q.5. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the NRC staff's evaluation of the PPE, the Board requested that the staff identify and discuss any differences or inconsistencies in the treatment of the PPE between the FSER and the FEIS.

A.5. (GW, JW) The Staff does not believe that there are "inconsistencies" in the FSER and FEIS treatment of the PPE. However, in general terms, there are some fundamental differences between the approaches used for the FSER and the FEIS; these differences influence, among other things, why the Staff analyzes the PPE values for a particular component of its review. The sources of these differences are the statutory and regulatory requirements for each review. The Staff's safety review is performed under the Atomic Energy Act and in accordance with the regulations in 10 C.F.R. Part 52. The environmental review is performed under NEPA as implemented in NRC regulations at 10 C.F.R. Part 51. Whereas the safety review is focused primarily on protecting the health and safety of the public, the environmental review considers a much broader range of impacts to the environment as a whole. This broader range of impacts is reflected in the longer set of PPE values relevant to the environmental review.

Appendix I of the FEIS presents the PPE submitted by the Applicant in its ER. The listing is not a complete listing of plant parameters, but is a listing of the plant parameters that the Applicant considered relevant to the environmental review (ER page 3.1-1). Similarly, the PPE listing in the SSAR includes only those plant parameters relevant to the site-suitability evaluation (SSAR page 1.3-5). The PPE tables in the SER and EIS agree for those parameters that are found in both.

In its safety review, the Staff reviewed the Applicant's PPE parameters to evaluate site-related aspects of plant design, in order to determine whether the site characteristics would be consistent with a design that might be described in an eventual COL application. Consequently, the Staff's safety analysis focused on how the site would meet the functional or operational needs of a potential future unit (or units), as well as the capability of the facility to withstand any site environmental hazards (natural and man-made). In contrast, the Staff's environmental review focused on evaluating the environmental impacts of construction and operation of a nuclear unit or units at the proposed site if the characteristics of those units were within the parameter values defined in the PPE. The intent of the Staff's environmental review is to provide a bounding estimate of the environmental impacts that might occur at the Grand Gulf ESP site.

In other words, an important reason for the differences in approach between the FEIS and the FSER is the matter of perspective. For example, both the FEIS and the FSER consider impacts related to hydrology. But in these two documents, the Staff is looking at hydrology for very different reasons. In the FEIS, the Staff is evaluating the impacts on the hydrology of the surrounding area of constructing and operating a nuclear plant (or plants). In the FSER, in contrast, the Staff is evaluating the potential impacts of local hydrology on the plant. Thus, in one case the Staff is looking from the inside out, and in the other case it is looking from the outside in. This difference in perspective leads to very different evaluations in relation to the same resource. Specifically, the analyses in the FSER address, for example, concerns related to the probable maximum flood, an issue unrelated to the environmental review. On the other hand, the analyses in the FEIS address concerns related to issues such as reduced streamflow downstream of the plant.

More generally, for an environmental review under NEPA and Part 51 the Staff evaluates the reasonably foreseeable impacts. In addition, the Staff has the latitude, if numerical data are not available, to qualitatively evaluate the impacts.[1] In contrast, the safety review generally focuses on the results of conservative analyses. As an example, in considering χ/Q values the Staff used "typical" meteorological conditions in the FEIS (see FEIS at 5-63). "Typical" is defined as those conditions that give atmospheric dispersion factors that are exceeded [i.e., dispersion is less and dose is higher] 50 percent of the time. In contrast, for the Chapter 15 analyses in the FSER, the Staff used values for χ/Q associated with "adverse" meteorological conditions (defined as those conditions that give atmospheric dispersion factors that are exceeded no more than 5 percent of the time).

In summary, because of the differences in the basic goals of the analyses in the FEIS and the FSER, there are differences not only in the data used and the approaches applied by the Staff in the analyses, but also in the significance of particular PPE values to those analyses. Based upon the reasoning described above, these differences are to be expected between the FEIS and FSER reviews, including in the Staff's analyses of the particular PPE parameter values and their relevance to the respective safety and environmental conclusions.

Q.6. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the NRC staff's evaluation

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[1] As stated in 10 C.F.R. § 51.71(d), "The analysis for all draft environmental impact statements will, to the fullest extent practicable, quantify the various factors considered. To the extent that there are important qualitative considerations or factors that cannot be quantified, these considerations or factors will be discussed in qualitative terms."

of the PPE, the Board requested that the staff discuss the completeness of the PPE parameters for the Grand Gulf ESP and why it is acceptable for the Grand Gulf PPE to provide only a subset of the parameters identified in NEI 01-02.

A.6. (GW) The Staff determined that all of the parameters necessary for the health and safety evaluation of the Grand Gulf ESP PPE were included in the Application and, based on its experience and judgment, including extensive experience with the characteristics of operating reactors, the Staff determined that the values selected for those parameters were not unreasonable.

(JW) The Staff determined that all of the PPE parameters necessary for the Staff's independent evaluation of the Environmental Report for the Grand Gulf ESP were included in the Application or were obtained from reconnaissance-level information gathered in the course of the Staff's environmental review. Based on its experience and judgment, including extensive experience with the characteristics of operating reactors, the Staff determined that the values selected for those parameters were not unreasonable.

(GW, JW) The Staff notes that it has not formally endorsed NEI-01-02, and thus the set of parameters identified in that document is not binding on the Staff in its review of PPEs, including the PPE for the Grand Gulf ESP. In any event, the NEI-01-02 PPE is not intended to represent any specific site or design. Individual PPEs are based on the unique analysis of data needed to support a particular ESP. Although NEI-01-02 identifies other parameters that could be used in generating a PPE, the Staff does not agree that an ESP applicant's PPE must address all the NEI-01-02 parameters to be complete. Indeed, NEI, in correspondence with the NRC concerning the refinement of a PPE worksheet based on the guidance of NEI-01-02, agreed that an applicant should evaluate which parameter values would be necessary for its particular application; that correspondence also noted that the completeness of the industry parameter list would continue to be assessed to identify new or unnecessary parameters. *See*

Letter from Ronald Simard (NEI) to James Lyons, dated February 7, 2003, ADAMS Accession No. ML030420321.

With respect to the Grand Gulf ESP, the Applicant explained (SSAR Page 1.3-3) that its PPE was derived from a PPE worksheet that was, in turn, based on the guidance of NEI-01-02. The Applicant also explained that the PPE worksheet was refined through work with the NEI ESP Task Force. Because the PPE in the Grand Gulf application is site-specific, it is expected that it would differ from the NEI sample PPE as well as from PPEs developed for other specific sites. For example, some parameters on the NEI list (such as those concerning once-through cooling or cooling ponds) were not relevant to the Grand Gulf ESP application because of the plant design features that the Applicant chose to consider.

In summary, for the Grand Gulf ESP Application, the Staff reviewed the PPE selected by the Applicant and found that the included parameters and parameter values were complete. The Staff agreed that the Applicant's PPE was not unreasonable and was, therefore, acceptable.

November 20, 2006

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	

NRC STAFF PRE-FILED TESTIMONY CONCERNING HEARING ISSUE H:
CONTINUITY BETWEEN THE ESP STAGE AND COL STAGE

Q.1. Please state your name, occupation, by whom you are employed and your professional qualifications.

A.1. (GW) George F. Wunder. I am employed as a Project Manager in the ESBWR/ABWR Projects Branch 1, Division of Licensing Project Management, Office of New Reactors, U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached.

A.1. (JW) James H. Wilson. I am employed as a Senior Project Manager in the New Reactor Environmental Projects Branch, Division of New Reactor Licensing, Office of Nuclear Reactor Regulation, NRC. A statement of my professional qualifications is attached.

A.1. (TC) Thomas Cheng. I am employed as a Geotechnical Engineer in the Division of Engineering, Office of Nuclear Reactor Regulation, NRC. A statement of my professional qualifications is attached.

A.1. (GB) Goutam Bagchi. I am employed as a Senior Advisor in the Division of Engineering, Office of Nuclear Reactor Regulation, NRC. A statement of my professional qualifications is attached.

Q.2. Please describe your professional responsibilities with regard to the review of the application by System Energy Resources, Inc. ("SERI" or "Applicant") for an early site permit ("ESP") for a new nuclear power plant or plants to be located on the existing Grand Gulf Nuclear Station ("GGNS") site near Port Gibson, Mississippi.

A.2. (GW) I took over Project Management responsibilities in May 2006, following issuance of NUREG-1840, the "Safety Evaluation Report for an Early Site Permit (ESP) at the Grand Gulf Site" ("SER"). I have been responsible for project management activities with respect to the SER since that time.

A.2. (JW) I am the NRC Senior Project Manager for the environmental review of SERI's Grand Gulf ESP application. I was responsible for overseeing the preparation of NUREG-1817, the "Environmental Impact Statement for an Early Site Permit (ESP) at the Grand Gulf ESP Site: Final Report," April 2006 ("FEIS").

A.2. (TC) As part of the NRC Staff's health and safety review of the SERI ESP application, documented in the Grand Gulf Site SER, I reviewed the aspects of the Applicant's Site Safety Analysis Report that concerned geotechnical engineering.

A.2. (GB) As part of the NRC Staff's health and safety review of the SERI ESP application, documented in the Grand Gulf SER, I reviewed the aspects of the Applicant's Site Safety Analysis Report that concerned hydrology.

Q.3. In its November 6, 2006, Order, the Atomic Safety and Licensing Board ("Board") identified certain issues to be addressed in connection with the mandatory hearing. With regard to the continuity between the ESP stage and the combined license ("COL") stage, the Board stated that numerous unresolved items, Applicant commitments, NRC Staff assumptions, deferred issues, COL Action Items, and permit conditions, not currently on any list, should be formally captured for transition to the COL stage. Further, the Board stated that it is not clear how these unresolved items, commitments, assumptions, and deferred issues will be tracked between the ESP and the COL stage, and then subsequently managed (*i.e.*, discovered, implemented, reviewed, and approved), so as to assure that they are satisfactorily completed at the COL stage. In view of the foregoing, please first summarize how reviews were conducted and what steps were taken to assure consistency among the Staff reviewers and contractors.

A.3. (GW) With respect to how reviews were conducted, and the consistency of those reviews, the Staff prepared its Safety Evaluation Report (SER) in accordance with the guidance of RS-002, the Review Standard for "Processing Applications for Early Site Permits," (RS-002). The purpose of RS-002 is to ensure, in part, that evaluations across the spectrum of technical disciplines meet a consistent standard. In addition, RS-002 contains regulatory guidance derived from NUREG-0800, Revision 3, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (hereinafter referred to as the Standard Review Plan or SRP). The Standard Review Plan reflects the NRC Staff's historical experience in establishing and promulgating guidance concerning the safety of nuclear facilities, as well as in evaluating safety assessments.

Each section of RS-002 provides specific guidance on how to prepare the corresponding section of the SER. The sections of RS-002 contain subsections defining 1) the specific areas to be reviewed, 2) the acceptance criteria as contained in the relevant section of the Code of Federal Regulations, 3) the review procedures, and 4) guidance on documenting the review findings. In addition to the section-specific guidance, RS-002 states that "[r]eviewers will ensure that the safety case in all assigned sections is adequately supported by clearly identified references as needed." However, because not all portions of the SRP are within the scope of an early site permit (ESP) proceeding, some sections of those guidance documents are not addressed in RS-002 and/or the SER. These issues would be addressed, as appropriate, in the review of a combined license (COL) application that referenced the Grand Gulf ESP.

After the individual sections of the SER are completed, the technical branches submit them to the safety project manager. The safety project manager is tasked by RS-002 to ensure that the facts stated in the Staff's SER are internally consistent as well as consistent with the statements set forth in the applicant's site safety assessment.

After all sections of the SER are completed and the document is compiled, it is again reviewed for consistency by the project manager, project branch chief, and individual technical branches. The project manager is also tasked with obtaining review by and concurrence from Staff counsel to ensure that the SER is defensible and that counsel has no legal objection to the document.

The Staff does employ contractors from outside the NRC as consultants to work on certain areas of the SER; however, the Staff technical branches retain responsibility for the content of their respective sections. All SER input from outside contractors is submitted through the appropriate technical branch. Many outside contractors are familiar with the guidance of RS-002; however, in any event, the individual Staff technical branches are responsible for ensuring that their respective sections of the SER conform to that guidance.

The Staff employs detailed guidance on preparation of the SER as well as a regimen of peer, supervisory, and legal review. Combined, these features ensure consistency across the entire spectrum of the Staff safety review.

A.3. (JW) The NRC standards for review of an ESP application are outlined in 10 C.F.R. § 52.18. The NRC Staff conducts its environmental reviews of ESP applications in accordance with guidance set forth in review standard RS-002. That review standard draws from the previously published NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants;" as well as from NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants" (ESRP). As provided in 10 C.F.R. Part 51, Subpart A, Appendix A, the techniques of tiering and incorporation by reference were used to aid in the presentation of issues, eliminate repetition, and reduce the size of the environmental impact statement (EIS); for example, the Staff also considered the information and analyses provided in NUREG-1437, the "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" in its review.

Each section of RS-002 provides specific guidance on how to prepare the corresponding section of the EIS. The sections of RS-002 contain subsections defining 1) the specific areas to be reviewed, 2) the acceptance criteria as contained in the relevant section of the Code of Federal Regulations, 3) the review procedures, and 4) guidance on documenting the review findings. However, because not all portions of the SRP are within the scope of an early site permit (ESP) proceeding, some sections of those guidance documents are not addressed in RS-002 or the EIS (*e.g.*, the final balancing of the environmental costs and benefits of construction and operation of a nuclear power plant). These issues would be addressed, as appropriate, in the review of a combined license (COL) application that referenced the Grand Gulf ESP.

After the individual sections of the EIS are completed, the technical branches submit them to the environmental project manager. The environmental project manager is tasked by RS-002 to ensure that the facts stated in the Staff's EIS are internally consistent as well as consistent with the statements set forth in the applicant's environmental report.

After all sections of the EIS are completed and the document is compiled, it is again reviewed for consistency by the project manager, project branch chief, and individual technical branches. The project manager is also tasked with obtaining review by and concurrence from Staff counsel to ensure that the EIS is defensible and that counsel has no legal objection to the document.

The Staff does employ contractors from outside the NRC as consultants to work on certain areas of the EIS; however, the Staff technical branches retain responsibility for the content of their respective sections. All EIS input from outside contractors is submitted through the appropriate technical branch. The contractors from Pacific Northwest National Laboratory are familiar with the guidance of RS-002; however, in any event, the individual Staff technical branches are responsible for ensuring that their respective sections of the EIS conform to that guidance.

The Staff employs detailed guidance on preparation of the EIS as well as a regimen of peer, supervisory, and legal review. Combined, these features ensure consistency across the entire spectrum of the Staff environmental review.

Q.4. With respect to the Board's concerns identified in the previous question, please address whether the Staff is utilizing a consistent approach for formally characterizing the conclusions and limitations of the ESP for unambiguous transition to the COL stage. In doing so, please describe the progression from the ESP to the COL stage in terms of the use of formal lists such as Applicant commitments, Staff assumptions, COL Action Items, etc., and demonstrate that these list(s) are sufficiently comprehensive. Please also discuss the logic behind how the Staff chose which transition items would be formally documented and which would not.

A.4. (GW) With respect to the relationship between the ESP and COL reviews, and the consistency of the Staff's approach to the two reviews, the Board expressed concern about Staff assumptions and applicant commitments and the assurance that these will be tracked so as to be addressed at the COL stage.

In its ESP reviews, the Staff ensures that assumptions and commitments on which an ESP SER relies will be addressed by documenting such assumptions or commitments, either in the SSAR or as Permit Conditions. A Permit Condition is established when 1) the Staff's evaluation in the SER rests on an assumption that is not currently supported; 2) a site physical attribute is not acceptable, standing alone, for the design of structures, systems, or components important to safety; or 3) the Staff's evaluation depends on some future action.

In addition, in instances where the Staff identifies design information that should be provided by any future applicant referencing the ESP at the COL stage, the Staff generates COL Action Items and includes them as an Appendix to the ESP. COL Action Items identify certain design matters that any future applicant referencing the ESP shall address in the site-specific section of the Final Safety Analysis Report (FSAR). These COL Action Items call for a set of design information to be provided by any future applicant referencing the ESP, but this list is not exhaustive; that is, they do not constitute the complete set of information that must be provided by any future applicant. For example, a COL application referencing a Grand Gulf ESP would still need to meet the requirements of 10 CFR Part 52, Subpart C, and the Staff would review the COL application in accordance with the Standard Review Plan.

There are no other lists of commitments or assumptions on which the Staff bases its SER. If a particular assumption, commitment, or COL-stage information need does not rise to the level of a Permit Condition or COL Action Item, the Staff determines that no further formal documentation is necessary beyond the discussion or reference in the SER.

Consequently, in the course of developing the Grand Gulf SER, the Staff created a list of Permit Conditions. These Permit Conditions become a part of any Early Site Permit (ESP) that may be issued. Also in the course of developing the Grand Gulf SER, the Staff also created a list of COL Action Items. The COL Action Items will be listed in an Appendix to any ESP that may be issued. Finally, the Staff notes that while the Staff had identified a set of Open Items in its Draft SER, all of these Open Items were subsequently resolved and their resolution documented in the Staff's Final SER.

The Staff considers its list of Permit Conditions to be comprehensive because the Staff has determined that the Permit Conditions identified are the only ones necessary to ensure that

10 CFR Part 100 is satisfied. The Staff's list of COL Action Items is not comprehensive in the sense of covering all items needing to be reviewed at the COL stage; in that sense, only the Standard Review Plan would be comprehensive. However, the list of COL Action Items is comprehensive with respect to the Staff having exercised its judgment in identifying site-specific issues relating to design that would need special attention at the COL stage.

The Staff believes that its approach to reviewing the health and safety aspects of the Grand Gulf ESP application and documenting the conclusions and limitations of the ESP has been consistent and comprehensive, and that all relevant conditions and future action items are appropriately presented to facilitate the review of any COL application referencing a Grand Gulf ESP.

A.4 (JW) With respect to the relationship between the ESP and COL reviews, and the consistency of the Staff's approach to the two reviews, the Board expressed concern about Staff assumptions and applicant commitments and the assurance that these will be tracked so as to be addressed at the COL stage.

In the course of developing the Grand Gulf FEIS, the Staff created a list of key assumptions, found in Appendix J to the FEIS. An assumption was considered "key" if the assumption was necessary to determine the magnitude of impact for a particular resource at the proposed site. Therefore, while some assumptions, including certain Applicant commitments, were important enough to be considered key assumptions and documented in Appendix J, the Staff did not prepare a list of all commitments or assumptions. The Staff considers Appendix J to be a sufficiently comprehensive list for the purpose of facilitating a future COL environmental review.

The Staff identified COL Action Items in the Grand Gulf SER for specific design matters that the Staff concluded that a future COL applicant should address in a facility Final Safety Analysis Report. As COL Action Items concern the adequacy of the proposed design, and the environmental review does not consider the adequacy of the design, the environmental Staff did not identify COL Action Items. While Appendix J of the FEIS presents assumptions and commitments that the Staff intends to verify at the COL stage, the listing of these assumptions and commitments (unlike COL Action Items) does not necessarily reflect the need for new or additional information from the COL applicant at that time.

Issues were deferred in the Grand Gulf FEIS if the ESP application did not address the issue (*e.g.*, the benefits assessment) or if the issue could not be resolved because 1) the ESP application did not provide sufficient information and 2) other information was not then reasonably available to allow the Staff to reach a conclusion on the impacts. However, the Staff was able to resolve or address all environmental issues required for reaching its conclusion with respect to the ESP; no issues were deferred that were necessary for the Staff to make its determination with respect to whether an environmentally preferable or obviously superior site had been identified.

As just stated, the Staff believes that its approach to reviewing the environmental aspects of the Grand Gulf ESP application and documenting the conclusions and limitations of the ESP has been consistent and comprehensive, and that all relevant conditions and future action items are appropriately presented to facilitate the review of any COL application referencing a Grand Gulf ESP.

However, with that in mind, because the Board's question reflects its concern about the broader relationship between an ESP review and the review of a COL referencing an ESP, it may be helpful at this time to note briefly the process and scope of any COL-stage environmental review that would reference an ESP.

For an early site permit, the NRC prepares an EIS that resolves numerous issues within certain bounding conditions. These issues have issue preclusion at the COL or CP stage, provided certain conditions are met. If the issue (*e.g.*, the benefits assessment) could be deferred and the ESP applicant elected to do so, then the COL applicant would be required to address the issue in its COL or CP application. A COL or CP application must also demonstrate that the design of the facility falls within the parameters specified in the ESP. In addition, the application should indicate whether the site is in compliance with the terms of the ESP. The applicant should maintain, in auditable form, information supporting such a conclusion that the site is in compliance with the ESP. While the NRC is ultimately responsible for completing any required NEPA review – for example, to ensure that the conclusions for a resolved ESP environmental issue remain valid for a COL action -- the COL applicant must identify whether there is new and significant information[1] on any resolved issue. A COL applicant should have a reasonable process to ensure that it becomes aware of new and significant information that may have a bearing on the earlier NRC conclusion, and should document the results of this process in an auditable form even for issues for which the COL applicant does not identify any new and significant information.

Pursuant to 10 CFR 51.70(b), the NRC is required to independently evaluate and be responsible for the reliability of all information used in the EIS, including an EIS prepared for a COL. In carrying out its responsibilities under 10 CFR 50.70(b), the staff may (1) inquire into the continued validity of the information disclosed in an EIS for an ESP that is referenced in a COL application and (2) look for any new information that may affect the assumptions, analysis, or conclusions reached in the ESP EIS.

The initial burden to assess newly identified information and those issues that were deferred to the COL or CP application falls to the applicant. The applicant is required to provide

[1] The Staff, in the context of a COL application that references an ESP, defines "new" in the phrase "new and significant information" as any information that was not considered in preparing the environmental report included in the ESP application or in the ESP EIS, and that was not generally known or publicly available during the preparation of the ESP EIS. This new information may include (but is not limited to) specific design information that was not contained in the application, but has changed by the time of the COL application. Such new information may or may not be significant.

information sufficient to resolve any other significant environmental issue not considered in the ESP proceeding, either for the site or design, and the information contained in the application should be sufficient to aid the Commission in its development of an independent analysis (see 10 CFR 51.45). Therefore, the environmental report must contain new and significant information identified by the COL applicant.

In the NRC environmental review process for a COL application, the COL EIS brings forward the Commission's earlier conclusions from the ESP EIS and articulates the activities undertaken by the NRC staff to ensure that an issue that was resolved need not be reconsidered. If there is new and significant information on a previously resolved issue, then the staff will limit its inquiry to determine whether such information changes the Commission's earlier conclusion. Environmental matters subject to litigation in a COL proceeding mainly include (1) those issues that were not considered or not resolved in the previous proceeding on the site or the design, (2) those issues for which there is new and significant information, and (3) those issues subject to the change or waiver process in 10 CFR Part 52.

Issuance of a COL is a major Federal Action and, in accordance with 10 CFR 51.20, the NRC must prepare an EIS on that action. If there is no new or significant information on an issue resolved at the ESP stage, then the Staff will tier off from the ESP EIS and disclose the NRC conclusion.

As previously stated, the Staff believes that its environmental review of the Grand Gulf ESP application has resolved all matters necessary for the issuance of an ESP and that the Staff's documentation of its ESP review would support the necessary review process for any COL application referencing a Grand Gulf ESP.

Q.5. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the continuity between the ESP stage and the COL stage, the Board stated that there are several Staff proposed conditions to the ESP that appear to be difficult, if not impossible, to achieve during the COL stage due to the absolute nature of the requirements. Specifically the Board identified the site characteristic for stability of subsurface materials and foundation, which is defined as minimum shear wave velocity of soil at the proposed foundation level as 1000 feet per second (fps), as such a condition. Please explain in detail how this can be achieved at the COL stage and whether it will be verified.

A.5. (TC) As indicated in SSAR Figures 2.5-75 through 2.5-77 (Rev. 1), the foundation for a reactor referencing the ESP site would be about 140 ft below the grade (Elevation -5 ft), which is in the old alluvium zone. In Revision 1 of SSAR Figures 2.5-36 and 2.5-37, the shear wave velocity of the old alluvium at Elevation -5 ft is greater than 1000 fps. During the COL stage, the soil above Elevation -5 ft needs to be removed to allow the construction of the proposed powerblock area (PPBA) foundation mat. On this basis, the site characteristic of "shear wave velocity of 1000 fps or greater for the foundation of the power block" can be achieved at the COL stage.

Q.6. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the continuity between the ESP stage and the COL stage, the Board stated that there are several Staff proposed conditions to the ESP that appear to be difficult, if not impossible, to achieve during the COL stage due to the absolute nature of the requirements. Please explain in detail how proposed Permit Condition No. 2 (which requires that an applicant referencing the Grand Gulf ESP design any new unit's radwaste systems with features to preclude any and all accidental releases of radionuclides into any potential liquid pathway) can be achieved at the COL stage:

A.6. (GB) Consistent with 10 CFR Part 52, a specific plant design evaluation was not conducted in this ESP review. The Staff's sole conclusion at the ESP stage is that the requirements postulated in the proposed Permit Condition 2 are not technically unreasonable.

The Staff based this conclusion on recent certified designs and on an understanding of historic inadvertent releases at various nuclear facilities. The Staff concluded that engineering solutions did exist that could have precluded these past releases. The proposed Permit Condition 2 can be met through the use of radwaste facility designs that are already incorporated in some certified designs. These certified designs of advanced and passive reactors locate the radwaste facility on the nuclear island, protected from leakage by stainless steel liner and leakage collection drains. These designs are also provided with high surrounding walls to contain any inadvertent spillage during radwaste handling or any unanticipated component failure. The Staff concluded that preclusion of accidental releases, including inadvertant releases, is technically feasible as in the examples cited above.

November 20, 2006

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	

NRC STAFF PRE-FILED TESTIMONY CONCERNING HEARING ISSUE I
RADIOLOGICAL REVIEWS AND CONFIRMATORY ANALYSES

Q.1. Please state your name, occupation, by whom you are employed and your professional qualifications.

A.1. (JL) Jay Y. Lee. I am employed as a Senior Health Physicist in the Division of Risk Assessment, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission ("NRC").

A.1. (SK) Stephen Klementowicz. I am employed as a Senior Health Physicist in the Division of License Renewal, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission ("NRC")

A.1. (EH) Eva Eckert Hickey. I am employed as a Staff Scientist with the Radiological Science and Engineering Group, Pacific Northwest National Laboratory operated by Battelle. I am providing testimony under a technical assistance contract with the staff of the U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached.

A.1. (JR) James V. Ramsdell, Jr. I am employed as a Staff Scientist with the Atmospheric Chemistry & Meteorology Technical Group at the U. S. Department of Energy's Pacific Northwest National Laboratory operated by Battelle. I am providing testimony under a technical assistance contract with the staff of the U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached.

A.1. (GB) Goutam Bagchi. I am employed as a Senior Advisor in the Division of Engineering, Office of Nuclear Reactor Regulation, NRC. A statement of my professional qualifications is attached.

Q.2. Please describe your professional responsibilities with regard to the review of the application by System Energy Resources, Inc. ("SERI" or "Applicant") for an early site permit ("ESP") for a new nuclear power plant or plants to be located on the existing Grand Gulf Nuclear Station ("GGNS") site near Port Gibson, Mississippi.

A.2. (JL) As part of the NRC Staff's health and safety review of the SERI ESP application, documented in NUREG-1840, "Safety Evaluation Report for an Early Site Permit (ESP) at the Grand Gulf Site" ("SER"), I reviewed the aspects of the Applicant's Site Safety Analysis Report that concerned geography and demography, and the radiological consequences of design basis accidents ("DBAs").

A.2. (SK) As part of the NRC Staff's health and safety review of the SERI ESP application, documented in NUREG-1840, "Safety Evaluation Report for an Early Site Permit (ESP) at the Grand Gulf Site" ("SER"), I reviewed the aspects of the Applicant's Site Safety Analysis Report that concerned the radioactive waste treatment system and the radiological impacts from routine operation to plant workers, members of the public, and to the environment. I was also part of the NRC Staff's environmental review of the SERI ESP application, documented in NUREG-1817, "Environmental Impact Statement for an Early Site Permit (ESP) at the Grand Gulf ESP Site: Final Report," April 2006 ("FEIS"). I reviewed the aspects of the Applicant's Environmental Report that concerned the radioactive waste treatment system and the radiological impacts from routine operation to plant workers, members of the public, and to the environment.

A.2. (EH) As part of the NRC Staff's environmental review of the SERI ESP application, documented in NUREG-1817, "Environmental Impact Statement for an Early Site Permit (ESP) at the Grand Gulf ESP Site: Final Report," April 2006 ("FEIS"), I assisted the NRC staff in its analysis of the aspects of the Applicant's Environmental Report that concerned health effects from radiological and non-radiological impacts, uranium fuel cycle impacts and decommissioning.

A.2. (JR) As part of the NRC staff's environmental review of the SERI ESP application, documented in the Grand Gulf FEIS, I assisted the NRC staff in its analysis of the aspects of the Applicant's Environmental Report that concerned meteorology, air quality, and the impact of postulated accidents.

A.2. (GB) As part of the NRC staff's health and safety review of the SERI ESP application, documented in the Grand Gulf SER, I reviewed the aspects of the Applicant's Site Safety Analysis Report that concerned hydrology.

Q.3. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the Staff's radiological reviews and confirmatory analyses, the Board requested an overview of the radiological analyses performed by SERI and the NRC Staff's review of these analyses, including details regarding the nature of confirmatory analyses performed (or not performed) by the NRC Staff or its contractors. For normal releases, please provide an overview of the radiological analyses and results, and discuss the Staff review that was performed including the method and results of the confirmatory analyses.

A.3. (EH, SK) With respect to the radiological environment, the Staff reviewed annual radioactive effluent release reports for calendar years 2001, 2002, and 2003, (see ADAMS Accession Nos. ML021200537, ML031120162, and ML041260549, respectively) and found that doses to the maximally exposed individuals around GGNS Unit 1 were a small fraction of the limits specified in Federal environmental radiation standards, 10 C.F.R. Part 20; 10 C.F.R. Part 50, Appendix I; and 40 C.F.R. Part 190. FEIS at 2-19.

The Staff reviewed the documentation for SERI's proposed radiological environmental monitoring program ("REMP"). The Staff found the proposed REMP to be adequate, noting that SERI will provide an annual Radiological Environmental Operating Report for the entire site (including both GGNS Unit 1 and the new nuclear unit(s)) to compare data with those for previous years; that the REMP would utilize the sampling locations used by the GGNS Unit 1; and that SERI will implement a quality assurance program for the REMP. Both surface and groundwater are monitored under the Radiological Environmental Monitoring Program (REMP). The REMP includes 3 samples of surface water (1 upstream, 1 downstream, and 1 downstream during a liquid radwaste discharge) and 2 samples of groundwater taken at two different wells on an annual basis. All five of these samples are submitted for gamma isotopic and tritium analyses. This monitoring is an operational program, and the results are reported annually in the Grand Gulf Nuclear Station Annual Radiological Environmental Monitoring Program Summary. For the purposes of the ESP analysis, the Staff determined that the REMP for the operation of Unit 1 was also adequate for determining the baseline for comparison with the expected impacts to the environment related to construction and operation of any proposed new unit(s). FEIS at 5-61 to 5-62.

With respect to radiological health impacts, after reviewing SERI's estimate of dose to site preparation workers during construction activities (from direct radiation as well as from gaseous and liquid effluents), the Staff found the doses to be well within NRC exposure limits designed to protect the public health. The Applicant's evaluation included an annual dose estimate for the site preparation workers of approximately 0.36 mSv (36 mrem), which is less than the 1 mSv (100 mrem) annual dose limit to an individual member of the public found in

10 C.F.R. § 20.1301. Therefore, assuming the location of the proposed new nuclear unit does not change, the Staff concluded that the impacts of radiological exposures to site preparation workers would be SMALL. FEIS at 4-56.

The Staff evaluated the health impacts from routine gaseous and liquid radiological effluent releases from a new nuclear unit at the Grand Gulf ESP site. After independently evaluating SERI's assessment of likely exposure pathways and its use of the LADTAP II and GASPAR II modeling programs to calculate the dose to a maximally exposed individual and a collective whole body dose for the population within 80 km (50 mi) of the Grand Gulf ESP site, and comparing the calculated doses to regulatory design objectives, the Staff concluded that there would be no observable health impacts to the public from normal operation of a new nuclear unit, and therefore the health impacts would be SMALL. FEIS at 5-51 to 5-58. Furthermore, the Staff concluded that the health impacts from occupational radiation exposure would be SMALL. This conclusion is based on the determination that: the occupational exposures for the new nuclear unit would likely be bounded by occupational exposures from currently operating LWRs and the licensee of a new plant will need to apply the ALARA process to maintain individual doses to workers as low as reasonably achievable below the 0.05 Sv (5 rem) annual limit, as specified in 10 C.F.R. § 20.1201. FEIS at 5-58.

The Staff examined the Applicant's estimated doses to surrogate biota species for both liquid and gaseous effluent pathways. FEIS at 5-59. The Staff's independent evaluation of biota doses produced results similar to those generated by the Applicant. FEIS at 5-60. As stated in Appendix H, the Staff used the LADTAP II code, GASPAR II code, and input parameters supplied by SERI in its ER to calculate doses to the biota. As part of its independent review, the Staff requested SERI's input values for these codes, and reviewed them for reasonableness. It then ran the codes using SERI's input and default values from Regulatory Guide 1.109 (when input values were not provided) to verify the results of SERI's dose assessment. The Staff concluded that there was sufficient protection because the cumulative effects of the GGNS unit 1 and the new nuclear unit(s) would result in dose rates significantly less than those noted in studies by the National Council on Radiation Protection and Measurements ("NCRP") and International Atomic Energy Agency ("IAEA"), both of which found adequate protection for biota. Therefore, the Staff concluded that the radiological impact on biota) other than members of the public from routine operation would be SMALL. FEIS at 5-59 to 5-61.

Q.4. In its November 6, 2006, Order, the Atomic Safety and Licensing Board ("Board") identified certain issues to be addressed in connection with the mandatory hearing. With regard to the Staff's radiological reviews and confirmatory analyses, the Board requested an overview of the radiological analyses performed by SERI and the NRC Staff's review of these analyses, including details regarding the nature of confirmatory analyses performed (or not performed) by the NRC Staff or its contractors. Please discuss the selection of the design basis accidents and explain the difficulties associated with event names that appear in the SSAR, FSER, and FEIS.

A.4. (JL) The Staff used the design basis accidents ("DBAs") that are listed and analyzed in: (1) RG 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors"; (2) NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Report for Nuclear Power Plants," Section 15.0.1, "Radiological Consequence Analyses Using Alternative Source Terms"; and (3) NUREG-1555, "Standard Review Plan for Environmental Reviews for Nuclear Power Plants." The DBA event names, which appear in the SSAR, FSER, and FEIS, are reconciled and summarized in Staff Exhibit 10.

Q.5. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the Staff's radiological reviews and confirmatory analyses, the Board requested an overview of the radiological analyses performed by SERI and the NRC Staff's review of these analyses, including details regarding the nature of confirmatory analyses performed (or not performed) by the NRC Staff or its contractors. For accidental releases, please provide an overview of the radiological analyses and results for the design basis events (including the key input, assumptions, and methodology) and discuss the Staff review that was performed, including the method and results of any confirmatory analyses.

A.5. (JL) The Applicant did not select a particular reactor design, but instead used surrogate reactor designs (ABWR and AP1000) to demonstrate the site suitability of the proposed ESP site. Therefore, as stated in the FSER, Section 15.3.4 (page 15-8), the Staff did not perform independent confirmatory radiological consequence analysis reviews of the Grand Gulf ESP application, because the Applicant based its radiological analyses and design basis events on the AP1000 and ABWR designs.

The Staff did, however, perform an independent confirmatory review at the time of the design certifications of the AP1000 and ABWR. The Applicant did not perform a new radiological consequence analysis, but instead directly extracted the radiological consequence analysis results from design certification documentation previously submitted to and reviewed by the NRC in connection with the design certification applications.

The Applicant used either: (1) the ratio of the site-specific atmospheric dispersion factors (χ/Q values) to the postulated design χ/Q values along with the calculated doses in the certification document to assess the suitability of the proposed ESP site for the AP1000 DBAs and ABWR Loss of Coolant Accident (LOCA) (see Staff Exhibit 11] for the methodology used by the Applicant - Case 1); or (2) calculated a site-specific dose using the source term releases in the certified ABWR Design Control Document (DCD) for ABWR DBAs other than LOCA (see Staff Exhibit 11 for the methodology used by the Applicant - Case 2).

The Commission approved the key input, assumptions, and methodology used by the Applicant, and the Staff in its review, for each DBA, including the results of the Staff's confirmatory radiological consequence analyses for the referenced standard reactor design certifications (ABWR and AP1000). This information is documented in NUREG-1503, "Final Safety Evaluation Report Related to the Certification of the Advanced Boiling Water Reactor Design,"and NUREG-1793, "Final Safety Evaluation Report Related to the Certification of the AP1000 Standard Design."

A.5. (JR) In the SSAR, ER, FSER, and FEIS, the Applicant and the Staff considered a range of design basis accidents for the ABWR and AP1000 reactor designs and a loss-of-coolant accident for the ACR-700 reactor design. The Staff has evaluated design basis accidents for the ABWR and AP1000 reactors at length as part of the design certification process for those reactors. As a result of this process, appropriate design basis accidents and source terms for each accident have been established. In addition, a design dispersion factor has been established for each design. This dispersion factor is a metric, which characterizes how good the atmospheric dispersion has to be at a site to ensure that doses resulting from design basis accidents will fall below regulatory evaluation criteria. This dispersion factor is a design characteristic, not a site characteristic.

The Staff assumes that information related to the ABWR and AP1000 designs from the design certification process is an appropriate starting point for review of design basis accidents related to the SERI application for the Grand Gulf site. The Staff compared the selection of accidents for these designs with accidents evaluated in the design certification process and with accidents listed in various guidance documents such as standard review plans (e.g. RS-002, NUREG-0800, and NUREG-1555) and in Regulatory Guides (e.g., Regulatory Guides 1.3 and 1.183) and determined that the set of design basis accidents considered in the SSAR and ER is appropriate. The Staff also determined that the design basis accident source terms and evaluation methods used by the Applicant were generally appropriate.

The Staff also evaluated the Applicant's site-specific information (i.e., meteorological data and distances to the exclusion area boundary and outer boundary of the low population zone) to ensure that the information was appropriate for estimating the potential consequences of design basis accidents. This information was found to be acceptable with the exception of the atmospheric dispersion factors used to evaluate the consequences of design basis accidents in the Environmental Report (ER).

Having reviewed the selection of DBAs, the calculational methods, and the input to the DBA calculation, Staff concludes that the Applicant's DBA analysis presented in the SSAR are acceptable for the safety review of the ESP application.

The atmospheric dispersion factors used in the ER are the same as those used in the SSAR. This is inconsistent with NRC guidance and with the intent of NEPA. The atmospheric dispersion factors used in safety analyses are for adverse meteorological conditions, while those used in environmental reviews are for typical meteorological conditions. Adverse meteorological conditions are those conditions that result in doses that are exceeded no more than about 5% of the time; typical meteorological conditions are those conditions that are exceeded 50% of the time. NEPA reviews are focused on realistic estimates of impacts, not worst-case estimates.

The Staff extracted realistic site-specific atmospheric dispersion factors from data provided by the Applicant and used those factors in its DBA review in the FEIS. With this exception, the DBA analyses performed for the FEIS were identical to those performed for the FSER. The results of the Staff's DBA analyses are presented in the FEIS. On the basis of the Staff's results, the Staff concludes that the environmental impacts of postulated DBAs would be of small significance at the Grand Gulf ESP site.

The Staff also reviewed the potential consequences of an ACR-700 loss-of-coolant accident. The ACR-700 design has not been submitted for design certification. However, the Staff notes that given the information provided by the Applicant, the consequences of a postulated loss-of-coolant accident for the ACR-700 reactor design are smaller than those of an AP1000 design.

Q.6. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the Staff's radiological reviews and confirmatory analyses, the Board requested an overview of the radiological analyses performed by SERI and the NRC Staff's review of these analyses, including details regarding the nature of confirmatory analyses performed (or not performed) by the NRC Staff or its contractors. For the severe accidents discussed in the FEIS, please provide an overview of the MACCS2 analyses, results, and the nature of the NRC Staff's review, including the results of any confirmatory analyses for the air and water ingestion pathways. In addition, for the non-MACCS2 severe accident effects, such as groundwater release, please elaborate further on the basis for the conclusion that the risks for these pathways are acceptably small.

A.6. (JR) The potential impacts of severe accidents are evaluated as part of the environmental review of an ESP application. In its application, SERI evaluated the potential impacts of severe accidents using general correlations between severe accidents and impacts presented in NUREG-1437,"Generic Environmental Impact Statement for License Renewal of Nuclear Plants." The Staff believes that a site-specific evaluation of these potential impacts is more appropriate. Consequently, the Staff requested that SERI provide such evaluations; SERI complied with this request and provided the Staff with input to and output from the MACCS2 computer code for postulated severe accidents for both ABWR and AP1000 reactor designs at the Grand Gulf ESP site. The Staff reviewed SERI's input to the MACCS2 code and then used the input to rerun the code. When the results of the SERI and Staff code runs were compared, there were no differences in the output. In addition to providing the Staff with code input and output, SERI provided its summarized results, which the Staff reviewed. Ultimately, the Staff extracted pertinent results from the computer code output for the evaluation presented in the FEIS rather than using the information in the SERI summary.

The MACCS2 computer code is a second generation code used for assessing the environmental consequences of severe accidents. It was developed by Sandia National Laboratory for both the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy. It uses time-varying site-specific meteorology to evaluate transport, dispersion, and deposition of radionuclides, which might be released to the atmosphere during a severe accident. Other input to the code includes land use patterns and population distributions. Given this input, MACCS2 estimates probability distributions for health and economic impacts of these releases and accounts for short- and long-term mitigative actions.

MACCS2 deals with the atmospheric pathway and, to the extent that surface water is contaminated by the deposition of radionuclides, the surface water pathway. MACCS2 does not deal with the contamination of surface water due to liquid spills or due to the contamination of ground water as a result of core damage followed by basemat melt-through.

The FEIS presents a limited discussion of the groundwater pathway, based on the NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants," evaluation of the groundwater pathway for severe accidents at current generation nuclear power plants. This NUREG discusses the probability of a severe accident followed by basemat melt through, which was assumed to be $1x10^{-4}$ Ryr^{-1}. Using this assumption, NUREG-1437 estimates, based on the Liquid Pathway Generic Study (NUREG-0440), that for large river sites (e.g. Grand Gulf) the population risk is approximately 12 person-rem per reactor year, but notes that interdiction can reduce the risk by an order of magnitude.

The basemat melt-through assumed in NUREG-1437 is unrealistically conservative for the ABWR and AP1000 reactor designs. The total core damage frequencies from internal events for the ABWR and AP1000 reactor designs are about 2×10^{-7} Ryr^{-1}. It is unrealistic to assume that the probability of basemat melt-through is greater than the core damage frequency. The Staff believes that for advanced light water reactors, a basemat melt-through probability of $1x10^{-6}$ Ryr^{-1} would be bounding and a probability of $1x10^{-7}$ Ryr^{-1} would be reasonable because 1) not all core damage events lead to basemat melt-through, and 2) advanced light-water reactors have design features intended to prevent melt-through (e.g., systems to flood the reactor cavity). Thus, the Staff believes that the risks associated with the groundwater pathway are acceptably small.

Q.7. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the Staff's radiological reviews and confirmatory analyses, the Board requested an overview of the radiological analyses performed by SERI and the NRC Staff's review of these analyses, including details regarding the nature of confirmatory analyses performed (or not performed) by the NRC Staff or its contractors. Please explain why the contribution of external events was not specifically factored into the core damage frequencies used in the presentation of the analysis results.

A.7. (JR) The Staff has considered external initiating events for severe accidents. NUREG-1742, "Perspectives Gained From the Individual Plant Examination of External Events (IPEEE) Program," presents a detailed discussion of external initiating events at current power plants. It shows that core damage frequencies from external events are, in general, not significantly larger than those from internally initiated events, and in many cases are smaller.

In the design certification process, the Staff considered external initiating events for ABWR and AP1000 severe accidents. Specifically, Chapter 19 of the ABWR design control document and Chapter 19 of the AP1000 FSER consider seismic events, internal fires, and internal floods; the ABWR DCD also considers tornadoes. The AP1000 FSER has some numerical core damage frequency values supplied by the vendor. In contrast, the ABWR DCD does not include core damage frequency values; instead, it makes qualitative statements related to CDFs such as "extremely small."

The AP1000 FSER has some numerical core damage frequency values supplied by the vendor. However, the Staff did not adopt these values because it believes that such conclusions are not possible without a detailed PRA. Rather, the FSER makes qualitative statements related to CDFs, as in the case of internal fires where it states: "the AP1000 design is capable of withstanding severe accident challenges from internal fires in a manner superior to most, if not all, operating plant designs." Section 19.1.5.2.1 of the FSER, page 19-83.

Finally, the Staff compared the risks from internally initiated severe accidents with the Commission's safety goals and determined that those risks are significantly below the risks set forth in the goals.

For these reasons, the Staff concluded that an attempt at detailed consideration of external initiating events would not contribute significantly to the purposes of the FEIS or NEPA.

Q.8. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the Staff's radiological reviews and confirmatory analyses, the Board requested an overview of the radiological analyses performed by SERI and the NRC Staff's review of these analyses, including details regarding the nature of confirmatory analyses performed (or not performed) by the NRC Staff or its contractors. Please address whether or not ESP Permit Condition 2 (FSER, App. A, Table A.1) precludes the need to perform an analysis of the liquid radwaste tank failure event at the COL stage, or to what extent it impacts the assumptions associated with the analysis of such an event.

A.8. (GB) The Staff's proposed Permit Condition 2 requires the preclusion of any and all accidental releases of radionuclides to any potential liquid pathway. Permit Condition 2 does not address the analysis of radwaste tank failure events or the design of the tank itself. No radwaste tank failure analysis is needed at the COL stage for reactor designs that incorporate the same design criteria as the entire seismic Category I structures, systems and components for the selected reactor design, and that incorporate features, such as suitable barriers, to contain any accidental spillage of radioactive liquid effluents due to random component failure. Therefore, Permit Condition 2 does not impact the need to perform an analysis of the tank failure event at the COL stage. The preclusion of accidental spillage of liquid radwaste effluents is achievable by design, it has already been incorporated into some certified designs. There is therefore no need to use a COL Action Item to require a review of a postulated radwaste tank failure.

Geotechnical and Hydrology Issues and Errata were admitted into evidence.)

JUDGE MCDADE: Let me let you take care of certain of the administrative things because I have certain questions with regard to those latter two. The latter two appeared to be a follow-up on the proposed findings of fact and conclusions of law that the staff submitted and I just want to make sure that we are correctly viewing these. So I've got a couple of questions about them for the staff before we proceed further.

MR. RUND: Yes, Your Honor.

JUDGE MCDADE: But I don't want you to be doing three things at once, so.

MR. WEISMAN: I can address those questions, Your Honor.

JUDGE MCDADE: Okay, specifically with regard to the hydrology supplemental testimony. Can you describe the purpose of that?

MR. WEISMAN: Yes, Your Honor. In our proposed findings of fact that we filed on August 11, 2006, we identified in footnotes several matters that the staff felt the SER needed clarification. And in those footnotes, which are Footnotes 6 - 12

November 22, 2006

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	

NRC STAFF SUPPLEMENTAL PRE-FILED TESTIMONY
CONCERNING HYDROLOGY

Q.1. Please state your name, occupation, by whom you are employed and your professional qualifications.

A.1. Goutam Bagchi. I am a Senior Advisor in the Nuclear Regulatory Commission's (NRCs), Office of Nuclear Reactor Regulation (NRR), Division of Engineering (DE). A statement of my professional qualifications was attached to the NRC Staff's pre-filed testimony submitted on November 20, 2006, in response to hearing issues identified by the Board.

Q.2. Please describe your professional responsibilities with regard to the review of the application by System Energy Resources, Inc. ("SERI" or "Applicant") for an early site permit ("ESP") for a new nuclear power plant or plants to be located on the existing Grand Gulf Nuclear Station ("GGNS") site near Port Gibson, Mississippi.

A.2. As part of the NRC staff's health and safety review of the SERI ESP application, documented in NUREG-1840, the "Safety Evaluation Report for an Early Site Permit (ESP) at the Grand Gulf Site," April 2006 ("SER"), I reviewed the aspects of the Applicant's Site Safety Analysis Report that concerned hydrology.

Q.3. In the "NRC Staff's Proposed Findings of Fact and Conclusions of Law in the Mandatory Hearing," filed with the Board on August 11, 2006, the Staff indicated that it intended to clarify certain points in NUREG-1840 in pre-filed testimony. With respect to section 2.4.2.3 of NUREG-1840, please explain the difference between the effects of intense precipitation in the local site area and that in site region that leads to a probable maximum flood ("PMF").

A.3. In Section 2.4.2.3 of NUREG-1840, the Staff described how it used the National Oceanic and Atmospheric Administration ("NOAA") Hydrometeorological Report ("HMR") 52 guidelines to estimate the 1-hour 1-mi^2 probable maximum precipitation depth for the ESP site. However, the Staff did not explain the difference between the effects of intense precipitation in the local site area and those in the site region that lead to a probable maximum flood ("PMF").

Flooding can occur at a site through different mechanisms, two of which are the PMF and local intense precipitation. Local intense precipitation is a measure of the extreme amount of water falling in the immediate vicinity of the site no more than one square mile in area that is considered in the engineering design of local site drainage. In response to local intense precipitation, immediate flooding by ponding at the site may occur due to inadequate infiltration capacity and a lack of an efficient drainage system. The difference between the floods caused by local intense precipitation and PMF is that the former occurs at an immediate site, whereas PMF is the routed discharge from a probable maximum precipitation ("PMP") event occurring over an entire watershed within which a site is located.

PMF is derived by routing a PMP event through the watershed. NOAA Hydrometeorological Reports provide methods for estimation of PMP in watersheds of ten to 20,000 square miles for several durations (six to 72 hours). HMRs also provide methods for estimation of so-called "point" PMP of one-hour duration. NOAA recommends that a "point" be interpreted as a one square-mile area. HMRs provide maps to determine PMP values for durations less than one hour for a point (one square-mile area); this PMP is the local intense precipitation (SER Tables 2.4-2 and 2.4-2a).

Q.4. Please clarify how mitigation measures for these two flooding mechanisms are different.

A.4. Protection from PMF may be provided by siting the plant above the PMF flood elevation, but flooding from local intense precipitation cannot be controlled by siting. Rather, flooding from local intense precipitation must be mitigated by an effective and efficient site drainage system.

Q.5. Please clarify what guidance the Staff used for estimating the design-basis flooding considering the worst single phenomenon, as well as combinations of less severe phenomena.

A.5. The Staff used RG 1.59, Rev. 2, "Design Basis Floods for Nuclear Power Plants," August 1977, and ANSI/ANS-2.8-1992, "Determining Design Basis Flooding at Power Reactor Sites," July 1992, for estimating the design-basis flooding considering the worst single phenomenon, as well as combinations of less severe phenomena. SER at 2-85. The Staff also used USGS, NOAA, Natural Resources Conservation Service (formerly the Soil Conservation Service), USACE, and applicable State and river basin authority publications to verify the Applicant's data relating to extreme events in the region. SER at 2-85.

Q.6. Please clarify the Staff's analysis of the Applicant's PMP depth estimates and of flooding effects of local intense precipitation for the Grand Gulf ESP site .

A.6. With respect to the Applicant's revised estimates of PMP depth, the Staff determined that these conformed to the latest HMR-52 criteria. SER at 2-88. The Staff also prepared its own estimates of PMP depths, and the Applicant's estimates closely matched those of the Staff. SER at 2-88. Therefore, the Staff concluded that the Applicant's PMP depth estimates were acceptable. SER at 2-88. Accordingly, the Staff established a site characteristic for local intense precipitation, or PMP, of 19.2 inches per hour, of which 6.2 inches falls during the first 5 minutes. SER Table 2.4.14-1 at 2-141. This PMP is for a one square mile area, and is considered as local intense precipitation that would fall on the Grand Gulf ESP site rather than a PMF in the Mississippi River near the site caused by a PMP event in the Mississippi River Basin. The local intense precipitation will also be used to determine the flooding elevation in Streams A and B (located on the site, see SER at 2-74) and to design the site grading as described below.

The Staff noted that the area of Basin A (located on the site, see SER at 2-72) is 2.94 square miles, and that there is no guidance for determination of PMP values for areas that are larger than one square mile but smaller than ten square miles. Nonetheless, the PMP value for an area exceeding one square mile in size will be less than that for a one square-mile area (a point), and greater than that for a ten square-mile area. Therefore, one-square mile PMP (point PMP or local intense precipitation) is a conservative estimate (greater than the true value) for the PMP value for Basin A. Accordingly, flooding resulting from local intense precipitation based on a one-square mile PMP value for Basin A will also be conservative (more severe than the true value).

Based on the physical site topography and the location of the proposed powerblock area (PPBA) to the west of the site access road and downstream of existing culverts, the Staff found that it is reasonable to expect that flood water elevation in Streams A and B adjacent to the PPBA would be substantially less than that of the proposed ESP site grade. SER at 2-79. While a comprehensive flood water elevation analysis for the site cannot now be carried out, the Staff found further that, given the topographic location of the ESP site in relation to Streams A and B, an effective drainage system can be designed when a COL application is filed that references any ESP that might be issued. SER at 2-79, 2-80. Accordingly, the Staff established COL Action Item 2.4-3, which relates to the design of site grading. SER at 2-80.

The design of this grading will afford flood protection to safety-related structures for any new unit at the ESP site based on a comprehensive flood water routing analysis for a local PMP (local intense precipitation) event. SER at 2-80. Similarly, since the maximum water surface elevation depends on the site grade and locations of safety-related structures, as well as local intense precipitation, the Staff established COL Action Item 2.4-5, which relates to plant grade and drainage system design based on the maximum water surface elevation on the site. SER at 2-89. COL Action Item 2.4-5 provides that a COL or construction permit applicant should demonstrate that the ESP plant grade is safe from the flooding effects of maximum water surface elevation during local intense precipitation without relying on any active surface drainage systems that may be blocked during this event. SER at 2-89; SER Appendix A.2, Action Item No. 2.4-5.

Q.7. Please clarify the Staff's analysis with respect to the PMF from the Mississippi River.

A.7. In analyzing the PMF from the Mississippi River, the Staff determined a maximum wave height of 10.9 feet, and added this to the Mississippi River DPF to arrive at maximum water surface elevation. SER at 2-96. The Staff also agreed that the water surface elevation at peak PMF discharge will not be appreciably higher than 103 feet above MSL, the top surface elevation of the levee on the west bank of the Mississippi River. SER at 2-89. In this regard, the Staff established a site grade of 132.5 feet above MSL as a characteristic of the ESP site. SER at A-16. In view of the above, the Staff estimated that the highest water surface elevation in the Mississippi River as a result of the DPF, wind setup, and wave runup will not impact the ESP site since the maximum water surface elevation is significantly below the ESP site grade. SER at 2-87; SER § 2.4.3. Accordingly, a PMF on the Mississippi River will not cause flooding of the proposed Grand Gulf ESP site.

Based on the facts and reasoning documented in the SER, as well as those just mentioned, the Staff found that the Applicant provided sufficient information pertaining to floods.

November 22, 2006

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	

NRC STAFF SUPPLEMENTAL PRE-FILED TESTIMONY
CONCERNING GEOTECHNICAL ISSUES

Q.1. Please state your name, occupation, by whom you are employed and your professional qualifications.

A.1. Thomas M. Cheng. I am employed as a Senior Structural/Geotechnical Engineer in Geosciences and Civil Engineering Branch A (EGCA), Division of Engineering (DE), Office of Reactor Regulation (NRR), Nuclear Regulatory Commission (NRC). A statement of my professional qualifications was attached to the NRC Staff's pre-filed testimony submitted on November 20, 2006, in response to hearing issues identified by the Board.

Q.2. Please describe your professional responsibilities with regard to the review of the application by System Energy Resources, Inc. ("SERI" or "Applicant") for an early site permit ("ESP") for a new nuclear power plant or plants to be located on the existing Grand Gulf Nuclear Station ("GGNS") site near Port Gibson, Mississippi.

A.2. As part of the NRC Staff's health and safety review of the SERI ESP application, documented in NUREG-1840, the "Safety Evaluation Report for an Early Site Permit (ESP) at the Grand Gulf Site" ("SER"), I reviewed the aspects of the Applicant's Site Safety Analysis Report that concerned geotechnical engineering related issues.

Q.3. In the "NRC Staff's Proposed Findings of Fact and Conclusions of Law in the Mandatory Hearing," filed with the Board on August 11, 2006, the Staff indicated that it intended to clarify certain points in NUREG-1840 in pre-filed testimony. Please clarify the Staff's discussion in NUREG-1840 with respect to stability of subsurface materials and foundations.

A.3. With respect to stability of subsurface materials and foundations overall, the Staff concluded that the Applicant adequately determined the engineering properties of the soil encountered during its field and laboratory investigations, and that the Applicant provided sufficient technical information in the geotechnical area to demonstrate the suitability of the ESP site for building a new nuclear power plant. SER at 2-241. The Staff found that the Applicant used the latest field and laboratory methods, in accordance with RGs 1.132, 1.138, and 1.198, "Procedures and Criteria for Assessing Seismic Soil Liquefaction at Nuclear Power Plant Sites," issued November 2003, to determine these properties. SER at 2-241. With respect to field investigations and laboratory testing necessary for the design of safety-related structures, however, the Staff also concluded that the Applicant did not perform activities sufficient to adequately define the overall subsurface profile, as well as the potential variability of the properties of the soil underlying the ESP site; the Staff therefore noted the Applicant's commitment to perform additional field investigations, once it has selected the locations and facilities for safety-related structures at the COL stage. SER at 2-241. In this regard, the COL action items included in SER Appendix A that relate to the stability of subsurface materials and foundations will prompt an applicant for a COL or CP to address the adequacy of the design of structures that would be built if a COL or CP were later granted.

Q.4. Please clarify the Staff's discussion in NUREG-1840 with respect to embankments and dams.

A.4. The Staff found that no impoundment structures lie within the ESP area. SER at 2-246. The Staff also found that the Applicant provided sufficient descriptions of the embankments and dams in the site vicinity to support its ESP application. SER at 2-246. The Staff, in SER §§ 2.4.4 and 2.5.5, discussed all other issues relevant to dams and embankments, respectively. Since the Applicant did not evaluate the effect of potential flooding of the Mississippi River and possible future erosion of the bluff, as discussed in SER Section 2.5.5.1 (SER at 2-242), the Staff established COL Action Item 2.5-11, which provides that a COL or CP applicant should evaluate the effect of potential flooding of the Mississippi River and possible future erosion of the bluff, including their impacts on soil-structure interaction (SSI) effects of the plant. SER at 2-246, A-8. On this basis, the Staff concluded that the assessment of embankments and dams presented in this SSAR section is acceptable for the ESP application. SER at 2-246.

in the staff proposed findings, we included testimony in the NRC staff supplemental pre-filed testimony concerning hydrology to address those matters. They're simply to clarify the SER and make sure that the staff's position is well understood.

JUDGE MCDADE: Okay. And also just to note that in those proposed findings of fact and conclusions of law, when you originally submitted it you indicated in those footnotes, those several footnotes, that you would be submitting the supplemental testimony, and this is the follow-up on that.

MR. WEISMAN: Yes, Your Honor.

JUDGE MCDADE: Okay. And then with regard to the next one on geotechnical issues, that basically is the same thing -

MR. WEISMAN: Yes.

JUDGE MCDADE: - except with regard to different issues and different footnotes.

MR. WEISMAN: Yes, Footnotes 14 and 15 in the proposed findings.

JUDGE MCDADE: Okay. Does SERI need any further clarification on that?

MS. SUTTON: No, Your Honor.

JUDGE MCDADE: Okay. Now, also the

staff submitted various exhibits. The exhibits, we had directed that they be pre-marked and pre-filed. Do you have at this point a full index of the proposed staff exhibits and a copy of those exhibits that can be furnished to the court reporter?

MR. RUND: We have all but the exhibits from the engineering report that's mentioned I believe in the staff's testimony on Hearing Issue D.

JUDGE MCDADE: Okay, that was specifically SERI Engineering Report 02, is that correct?

MR. RUND: That's correct.

JUDGE MCDADE: Okay.

MR. RUND: We're in the process of getting copies of the figures or tables I believe that are mentioned in that testimony, and we should be able to have them to you hopefully by - definitely by the end of the hearing, probably by the end of the day.

JUDGE MCDADE: Okay, that's fine. What exhibit number will that be? Is it listed on your current index?

MR. RUND: It's not currently listed, but it would just follow. I believe it would be the next three, and then I think the Board also requested the draft ESP template. That would just follow after those three.

JUDGE MCDADE: Okay. Can you hand up the exhibits and the index for the exhibits?

MR. RUND: Yes.

JUDGE MCDADE: Okay. And SERI, you have had an opportunity to review these exhibits?

MS. SUTTON: No, Your Honor.

JUDGE MCDADE: Okay. What I'd do then, before you hand them up to us, just to make sure that SERI sees them and before I accept them into evidence here I just want to make sure that SERI does not have any objections, and if they do we can resolve those objections before they're admitted rather than after.

MS. SUTTON: One point of clarification while we're getting the documentation. The cover page to ER 02 per your instruction yesterday is included in our exhibits as SERI Exhibit 8 which you will see later when that's entered into evidence. And in addition we will provide the figures referenced by Mr. Rund this morning.

JUDGE MCDADE: Thank you. Let me note for the record that we have received Staff Exhibits 1 through 45 and we would be predisposed to admitting those into evidence at this point absent any objection from SERI. So take your time and let us know.

MS. SUTTON: Your Honor, at this time we have no objection. However, we note that Staff Exhibits 15 through 19 include the presentation slides for Hearing Issues E through I. To the extent that we have any objections we'll make them during the presentations or prior thereto.

JUDGE MCDADE: Okay.

MS. SUTTON: Once we've had an opportunity to review the slides.

JUDGE MCDADE: Okay, what I will do is this then. I will admit at this point Staff Exhibits 1 through 45. They are admitted into evidence.

(Whereupon, the documents marked as Staff Exhibit Nos. 1-45 for identification were admitted into evidence.)

JUDGE MCDADE: If during the course of the hearing the applicant has an objection to any one of those and asks that it be withdrawn from evidence they can make that objection and we can rule on it at that point in time. If there is any objection. So we can move forward, accept them and absent further objection ruling they are admitted into evidence.

MS. SUTTON: Thank you, Your Honor.

JUDGE MCDADE: Okay. Does the staff have anything further preliminarily before we begin with Hearing Issue A?

MR. CAMPBELL: Yes, Your Honor. The staff would like to note that on the -

JUDGE MCDADE: One thing, please, if you could just state your name so that the court reporter has it.

MR. CAMPBELL: Tison Campbell for the staff.

JUDGE MCDADE: Thank you.

MR. CAMPBELL: We would like to note that on the CD which was provided to the Board and the applicant, Exhibit 18 appears as HearingIssueH.pdf.

JUDGE MCDADE: I'm sorry, H-?

MR. CAMPBELL: ".pdf".

JUDGE MCDADE: Oh, okay. Thank you. Again, anything preliminary from the staff before we begin with Issue A?

MR. RUND: We have nothing further. We're just sorting through the exhibits. We had quite a few that were added at the last minute so it will take us some time.

JUDGE MCDADE: Okay. Can you do that while I sort of address the same questions that I just had to you I can address to SERI and get their testimony in and their exhibits in while you're doing that?

MR. RUND: That'd be fine. I think that might move things along.

JUDGE MCDADE: Okay. Again, with regard to the various hearing issues A through I we received pre-filed testimony from SERI. Do you have any changes to that testimony that was submitted?

MS. SUTTON: We do, Your Honor. Mr. O'Neill will bring you a copy of the errata sheet and clean copies per your instruction yesterday of all pre-filed testimony on those issues.

JUDGE MCDADE: Okay. And at this point do you move the admission of those statements?

MS. SUTTON: We do, Your Honor.

JUDGE MCDADE: Okay. And are those statements at this point all sworn to that they are made subject to the penalties of perjury and are true and correct?

MS. SUTTON: That is correct, Your Honor. We have affidavits from each of our witnesses appended to the testimony Mr. O'Neill will give you.

JUDGE MCDADE: Does the staff have any objection to our receiving that testimony from the applicant?

MS. HODGDON: No objection.

JUDGE MCDADE: Okay. Then the pre-filed testimony on Hearing Issues A through I submitted by SERI is received.

(Whereupon, SERI's Pre-Filed Testimony on Hearing Issues and Errata were admitted into evidence.)

JUDGE MCDADE: The next is with regard to exhibits. Do you have pre-marked exhibits from SERI?

MS. SUTTON: We do, Your Honor. We have SERI Exhibits 1 through 30.

JUDGE MCDADE: Okay. And if at this point you could hand up the pre-marked exhibits and the index for Exhibits 1 through 30 and I would do

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the matter of	)	Docket No. 52-009-ESP
	)	
SYSTEM ENERGY RESOURCES, INC.	)	ASLBP No. 04-823-03-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	November 28, 2006

ERRATA NOTICE

System Energy Resources, Inc., ("SERI"), Applicant in the above-captioned matter, has made the following changes to its November 22, 2006, filing relating to pre-filed testimony on Hearing Issues A, D, E, F, G, and H; Exhibit 1 (Statements of Professional Qualifications of SERI Witnesses); and the accompanying list of SERI pre-filed hearing exhibits.

Respectfully submitted,

Kathryn M. Sutton
Paul M. Bessette
MORGAN, LEWIS & BOCKIUS, LLP
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Telephone: (202) 739-5738
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COUNSEL FOR SYSTEM
ENERGY RESOURCES, INC.

Dated at Washington, District of Columbia,
this 29th day of November, 2006

1. PRE-FILED TESTIMONY OF LORI M. EVANS, WILLIAM R. LETTIS, AND JEFFREY L. BACHHUBER ON BEHALF OF APPLICANT CONCERNING HEARING ISSUE A (SITE CHARACTERIZATION)

- Page 3, second sentence of fourth paragraph, A4 (JLB),

  Change:

  "...cone penetrometer soundings, borehole P-S velocity surveys and SASW surface surveys."

  to:

  "...cone penetrometer soundings, and borehole P-S velocity surveys."

- Page 8, last sentence of first paragraph, A8 (WRL,JLB),

  Change:

  "Upland Complex alluvium at, or below, the bottom of loess deposits at approximately elevation 97 feet MSL (depth of 36 feet) or lower where the average shear wave velocity exceeds 1,000 feet per second and materials consist of dense alluvium"

  to:

  "Upland Complex alluvium at, or below, the bottom of loess deposits at approximately elevation 97 feet MSL (depth of 36 feet) or lower."

- Page 8, last paragraph, A8 (WRL, JLB),

  Change:

  "Plant basemat (foundation) elevations above this level would require overexcavation of soils down to material exhibiting an average shear wave velocity of 1,000 fps, or alternatively, in-situ improvement (*e.g.* grouting). Excavated soils would be replaced by engineered-fill (*e.g.* lean concrete) that exhibits a Vs of 1,000 fps or greater"

  to:

  "The minimum shear wave velocity exceeds 1,000 fps at, and below, approximately elevation -7 feet MSL (depth of about 140 feet below assumed finished plant grade). Plant basemat (foundation) elevations above this level would require overexcavation and replacement of soils down to material exhibiting a minimum shear wave velocity of 1,000 fps, or alternatively, in-situ ground improvement (*e.g.* grouting) and/or further engineering design analyses."

- Page 9, first sentence, A8 (WRL, JLB): Delete entire sentence.

2 PRE-FILED TESTIMONY OF WILLIAM R. LETTIS AND JEFFREY L. BACHHUBER ON BEHALF OF APPLICANT CONCERNING HEARING ISSUE D (SLOPE AND FOUNDATION STABILITY)

- Page 3, first paragraph, A4 (JLB),

  Change:

  "...cone penetrometer soundings, borehole P-S velocity surveys and SASW surface surveys."

  to:

  "...cone penetrometer soundings, and borehole P-S velocity surveys."

- Page 7, first paragraph, A9 (JLB),

  Change:

  "Upland Complex alluvium at, or below, the bottom of loess deposits at approximately elevation 97 feet MSL (depth of 36 feet) or lower where the average shear wave velocity exceeds 1,000 feet per second and materials consist of dense alluvium"

  to:

  "Upland Complex alluvium at, or below, the bottom of loess deposits at approximately elevation 97 feet MSL (depth of 36 feet) or lower."

- Page 7, last paragraph, A9 (JLB),

  Change:

  "Plant basemat (foundation) elevations above this level would require overexcavation of soils down to material exhibiting an average shear wave velocity of 1,000 fps, or alterntively, in-situ improvement (*e.g.* grouting). Excavated soils would be replaced by engineered fill (*e.g.* lean concrete) that exhibits a Vsof 1,000 fps or greater"

  to:

  "The minimum shear wave velocity exceeds 1,000 fps at, and below, approximately elevation -7 feet MSL (depth of about 140 feet below assumed finished plant grade). Plant basemat (foundation) elevations above this level would require overexcavation and replacement of soils down to material exhibiting a minimum shear wave velocity of 1,000 fps, or alternatively, in-situ ground improvement (*e.g.* grouting) and/or further engineering design analyses."

- Page 8, first sentence, A9 (JLB): Delete entire sentence.

3. PRE-FILED TESTIMONY OF JOHN G. CESARE, GEORGE A. ZINKE, KYLE H. TURNER, AND MICHAEL D. BOURGEOIS ON BEHALF OF APPLICANT CONCERNING HEARING ISSUE E (ALTERNATIVE ANALYSES)

- Page 2, second paragraph, A3 (GAZ),

  Change:

  "I have over 30 years of technical and management experience in the commercial nuclear power industry. Since joining Entergy Nuclear, Inc., as a project manager in 1997, I have focused principally on business development matters involving the company's GGNS Early Site Permit and COL Development projects, as well as the NuStart COL Development Project. Prior to that, I held various managerial and supervisory positions at the Maine Yankee and GGNS facilities, where I was responsible for overseeing various licensing, system engineering, quality assurance, worker concerns, emergency preparedness, and environmental programs related to facility operation and decommissioning."

  to:

  "I have 30 years of technical and management experience in the commercial nuclear power industry. Since 2001, as a Project Manager with Entergy Nuclear, Inc., I have focused principally on licensing matters involving the company's Grand Gulf Nuclear Station ("GGNS") ESP and combined operating license ("COL") Development projects, as well as the NuStart COL Development Project. Prior to that, I held various managerial and supervisory positions at the Maine Yankee, River Bend, and GGNS facilities, where I was responsible for overseeing various licensing, system engineering, quality assurance, worker concerns, emergency preparedness, and environmental programs related to facility construction, operation, and decommissioning."

4. PRE-FILED TESTIMONY OF JOHN CESARE, DAVID J. BEAN, AND MARVIN MORRIS ON BEHALF OF APPLICANT CONCERNING HEARING ISSUE F (EVALUATION OF CUMULATIVE SITE IMPACTS)

- Page 1 of Exhibit, change title of exhibit from "SERI EXHIBIT xx" to "SERI EXHIBIT 2."

5. PRE-FILED TESTIMONY OF JOHN CESARE, AL SCHNEIDER, AND GEORGE ZINKE ON BEHALF OF APPLICANT CONCERNING HEARING ISSUE G (EVALUATION OF PLANT PARAMETER ENVELOPE)

- Page 2, last paragraph, A3 (GAZ),

  Change:

  "Since joining Entergy Nuclear, Inc., as a project manager in 1997, I have focused principally on business development matters involving the company's GGNS Early Site Permit and COL Development projects, as well as the NuStart COL Development Project. Prior to that, I held various managerial and supervisory positions at the Maine Yankee and GGNS facilities, where I was responsible for overseeing various licensing, system engineering, quality assurance, worker concerns, emergency preparedness, and environmental programs related to facility operation and decommissioning."

  to:

  "Since 2001, as a Project Manager with Entergy Nuclear, Inc., I have focused principally on licensing matters involving the company's Grand Gulf Nuclear Station ("GGNS") ESP and combined operating license ("COL") Development projects, as well as the NuStart COL Development Project. Prior to that, I held various managerial and supervisory positions at the Maine Yankee, River Bend, and GGNS facilities, where I was responsible for overseeing various licensing, system engineering, quality assurance, worker concerns, emergency preparedness, and environmental programs related to facility construction, operation, and decommissioning."

- Page 5, last paragraph, second sentence, A6 (JGC, AJS, GAZ):

  Change "Hearing Issue F" to "Hearing Issue G."

6. PRE-FILED TESTIMONY OF GEORGE A. ZINKE, MARVIN MORRIS, JOHN G. CESARE, WILLIAM R. LETTIS, AND JEFFREY L. BACHHUBER ON BEHALF OF APPLICANT CONCERNING HEARING ISSUE H (CONTINUITY BETWEEN THE ESP STAGE AND COL STAGE)

- Page 2, last paragraph, A3 (GAZ),

  Change:

  "I have over 30 years of technical and management experience in the commercial nuclear power industry. Since joining Entergy Nuclear, Inc., as a project manager in 1997, I have focused principally on business development matters involving the company's GGNS Early Site Permit and COL Development projects, as well as the NuStart COL Development Project. Prior to that, I held various managerial and supervisory positions at the Maine Yankee and GGNS facilities, where I was responsible for overseeing various licensing, system engineering, quality assurance, worker concerns, emergency preparedness, and environmental programs related to facility operation and decommissioning."

to:

"I have 30 years of technical and management experience in the commercial nuclear power industry. Since 2001, as a Project Manager with Entergy Nuclear, Inc., I have focused principally on licensing matters involving the company's Grand Gulf Nuclear Station ("GGNS") ESP and combined operating license ("COL") Development projects, as well as the NuStart COL Development Project. Prior to that, I held various managerial and supervisory positions at the Maine Yankee, River Bend, and GGNS facilities, where I was responsible for overseeing various licensing, system engineering, quality assurance, worker concerns, emergency preparedness, and environmental programs related to facility construction, operation, and decommissioning."

7. EXHIBIT 1 (STATEMENTS OF PROFESSIONAL QUALIFICATIONS OF SERI WITNESSES)

- Added resume of George A. Zinke.
- Added supporting expert witness affidavits

8. SERI PRE-FILED HEARING EXHIBITS

- Updated SERI Pre-filed Hearing Exhibits to include Exhibits 6 through 30.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	ASLBP No. 04-823-03-ESP

PRE-FILED TESTIMONY OF LORI M. EVANS, WILLIAM R. LETTIS, AND JEFFREY L. BACHHUBER ON BEHALF OF APPLICANT CONCERNING HEARING ISSUE A (SITE CHARACTERIZATION)

Q1. Please state your name, current position, and by whom you are employed.

A1. My name is Lori M. Evans ("LME"). I am employed as Senior Project Manager for ENERCON Services, Inc.

A1. My name is William R. Lettis ("WRL"). I am employed as the President and Principal Geologist of William Lettis & Associates, Inc.

A1. My name is Jeffrey L. Bachhuber ("JLB"). I am employed as the Vice President, Senior Principal Engineering Geologist of William Lettis & Associates, Inc.

Q2. On whose behalf will are you testifying in this proceeding?

A2. (LME, WRL, JLB) We are providing testimony on behalf of the applicant in this early site permit ("ESP") proceeding, System Energy Resources, Inc. ("SERI" or the "Applicant").

Q3. Please describe your professional qualifications.

A3. (LME) I hold a B.S. degree in Geology from Tennessee Technological University. I have over fourteen years of experience that includes project management, a varied technical background, and environmental risk analysis. I have acted as task leader for hydrologic analyses for a proposed expansion of an existing nuclear power plant, have assisted in development of new bank environmental policy guidance documents, and have been responsible for managing multiple-site Phase I environmental site assessment projects. A full statement of my professional qualifications is contained in SERI Exhibit 1.

A3. (WRL) I hold a Ph.D. and an M.S degree in Geology from the University of California, Berkeley, and a B.S. degree in Geology and a B.S. degree in Forestry from Humboldt State University. I have over 20 years experience performing regional and site investigations to assess geologic and seismic hazards for large engineered facilities, including bridges, dams, nuclear and fossil fuel plants, pipelines, and liquid natural gas ("LNG") terminals. A full statement of my professional qualifications is contained in SERI Exhibit 1.

A3. (JLB) I hold M.S. and B.A. degrees in Geology from San Jose State University. I am a Certified Engineering Geologist in California with over 20 years of professional experience performing geologic/geotechnical studies for nuclear and other critical facilities throughout the United States, Peru, Dominican Republic, Puerto Rico, Korea, Indonesia, Japan, and Turkey. I have performed detailed site investigations in a variety of geologic settings, in addition to regional hazard mapping and facility siting and routing studies. These projects involved assessment of earthquake hazard and sources, fault rupture and ground failure analysis, slope stability analysis and mitigation design, karst and void identification and treatment, foundation characterization with borings and geophysical techniques, laboratory testing, failure mode assessment, and development of foundation criteria for detailed static and dynamic stability and site response analyses (including soil-structure interaction) A full statement of my professional qualifications is contained in SERI Exhibit 1.

Q4. Please describe your professional responsibilities with regard to the Grand Gulf ESP application, including the basis for your familiarity with that application.

A4. (LME) I am task leader for the hydrologic analysis sections of the Grand Gulf ESP application. As task leader, I was responsible for assessing the potential impacts on the surface water and groundwater of constructing and operating a nuclear power generating facility at the Grand Gulf site.

A4. (WRL) As Project Manager for the seismic and geotechnical work in support of the Entergy Grand Gulf Nuclear Station ("GGNS") ESP, my responsibilities include preparation of Sections of 2.5.1 through 2.5.6 of the SSAR, including seismic source characterization and probabilistic seismic hazard analysis to develop the safe shutdown earthquake ("SSE") design ground motion in compliance with Regulatory Guide 1.165, and, geotechnical characterization of the site in partial compliance with Regulatory Guides 1.138 and 1.132.

A4. (JLB) I was responsible for developing detailed site geotechnical characterization for the Grand Gulf ESP site. My work regarding the Grand Gulf ESP included developing quality assurance/quality control ("QA/QC") technical procedures and workplans to guide all field and laboratory activities, directing field investigations consisting of geologic mapping, deep mud rotary borings, cone penetrometer soundings, and borehole P-S velocity surveys. I also prepared Sections 2.5.4 to 2.5.6 for the site safety analysis report ("SSAR"), responded to Nuclear Regulatory Commission ("NRC") requests for additional information ("RAIs"), and presented the project to the Advisory Committee on Reactor Safeguards ("ACRS") in a formal meeting.

Q5. In an Order (Requesting Specific Summary Exhibits and Supplemental Briefs; Identifying Hearing Issues and Requesting Evidentiary Presentations on Specific Issues) of

November 6, 2006, the Atomic Safety and Licensing Board ("Board") identified a series of hearing issues on which the Board has required testimony and presentations from the NRC Staff. The Staff submitted its pre-filed testimony on November 20, 2006. *See* NRC Staff Pre-Filed Testimony Concerning Hearing Issue A: "Site Characterization" (Nov. 20, 2006). Have you reviewed the Staff's testimony on Hearing Issue A?

A5. (LME, WRL, JLB) Yes.

Q6. During the October 31, 2006, pre-hearing conference, the Board expressly authorized the Applicant, as appropriate, to submit supplemental pre-filed testimony for the limited purpose of clarifying and/or providing additional factual information that may inform the Board's mandatory hearing review and decision-making process. *See* Transcript of October 31, 2006, Prehearing Conference at 8. Do you wish to provide any such supplemental testimony at this time?

A6. (WRL, JLB) Yes. We are offering supplemental testimony with respect Answers 5 and 11 of the NRC Staff's pre-filed testimony.

A6. (LME) Yes. I am offering supplemental testimony with respect to Answer 3 of the NRC Staff's pre-filed testimony.

Q7. Turning to Answer 5 of the Staff's pre-filed testimony, please provide any additional information that you believe is necessary.

A7. (WRL, JLB) In Answer 5 of its pre-filed testimony (under the section entitled "Characterization Relating to Potential Karst Formation,") the NRC Staff states that "materials below the plant are calcareous and therefore potentially susceptible to the effects of dissolutioning." Staff Issue A Testimony, A.5 at 8. Although SERI agrees with this general comment, it warrants mention that these calcareous deposits beneath the site occur at a minimum depth of 390 feet below the surface, over 200 feet below the maximum embedment depth for any reactor considered in the ESP application.

The Staff further indicates that deep borings are "most likely inappropriate" to investigate the potential for dissolutioning or karst formation within these calcareous materials at the site, and that the "Applicant should search and investigate the available data base of information for the known site materials, and determine the opinions of recognized geologic experts versed in the area" Staff Issue A Testimony, A.5 at 8. SERI concurs with the Staff position. In fact, in response to Staff RAI 2.5.4-9, SERI performed a three-part investigation of the potential for karst formation at the site. That investigation included: (1) evaluating and documenting the presence or absence of karst features in the Site Area; (2) evaluating and documenting the presence or absence of karst features in outcrop areas of the Vicksburg Group in the Site Area and Site Region, including discussions with recognized geologic experts; and (3) evaluating the zone of influence of any new proposed foundation on the Vicksburg Group strata, assuming that dissolutioning might occur. Each of these evaluations showed that karst development is not present in the site area; that the Glendon Limestone within the Vicksburg Group is not susceptible to dissolutioning; and that even if dissolutioning were to occur within the Glendon Limestone at a depth of 390 feet or more, it would be below the zone of foundation influence at the site. Nevertheless, as discussed in the FSER at 2-236 (Section 2.5.4.3.6), and as required by COL Action Item 2.5-8, a deep boring program will be implemented during the COL geotechnical program to evaluate the potential for karst formation and dissolutioning within the Glendon Limestone beneath the site.

As a final clarification regarding the Staff's testimony on karst formation, SERI is unaware of any Staff requirement to perform chemical evaluations of available soil samples prior to planning any deep boring program during the COL site investigation. *See* Staff Issue A Testimony, A.5 at 9. Consistent with COL Action Items 2.5-3 and 2.5-4, SERI will undertake additional borings, laboratory testing, geophysical surveys, and geotechnical investigations during the COL phase.

Q.8 Turning to Answer 11 of the Staff's pre-filed testimony, please provide any additional information that you believe is necessary.

A.8 (WRL, JLB) In Hearing Issue A, Answer A.11 of the NRC Staff pre-filed testimony, the Staff discussed issues related to stability of the river bluff, plant foundation embedment depth, and minimum required shear wave velocity. This testimony provides additional clarification of these issues.

Setback from River Bluff

SERI Exhibit 3 provides a graphic representation of the relationships between the river bluff slope and ESP proposed plant reactor building envelope. This figure shows that the ESP setback distance provides a sufficient safety buffer against any reasonable potential failure surfaces from intersection of the proposed plant envelope. In order to reach the proposed plant envelope area, a failure plane extending from the river bluff would have an inclination significantly less than 15 degrees (above horizontal), which is far below typical estimated residual angles of internal friction (angle of repose) for the loess soil that forms the river bluff and typically stands vertically in excavated cuts.

Existing Fill

Existing fill underlying the ESP proposed reactor building envelope is localized and shallow (depth of fill above approximate elevation 100 feet; SERI Exhibit 3), and does not extend to the foundation depth ranges of planned power plants.

Foundation Depth

The Environmental Report plant parameters envelope (PPE; Table 3.0-1) lists the ESP bounding foundation embedment depth as 140 feet. This depth is the maximum depth of the bottom of the foundation basemat, as measured from the finished plant grade (assumed at approximately elevation 133 feet above mean sea level ("MSL")) for any reactor design considered in the ESP Application. The relative location and elevation of this bounding depth with respect to the existing ground surface is shown on SSAR Figures 2.5-75 through 2.5-77 (geologic cross sections A-A', B-B', and C-C'), and labeled as "likely maximum foundation depth range within Proposed PPBA" (Proposed Power Block Area). The corresponding elevation of this maximum bounding embedment depth is approximately elevation (-)7 feet MSL.

Other plant technologies considered in the ESP Application have basemat elevations that are shallower than the bounding embedment depth, typically within the range of about 30 to 70 feet below finished plant grade. The stability and foundation suitability of subsurface materials that occur between assumed finished plant grade and the bounding maximum foundation depth range (and below this depth range throughout the likely range of foundation influence) were specifically evaluated with respect to the varying technologies and possible embedment depths. This evaluation included compilation and review of about twenty existing borings from the Unit 1 Updated Final Safety Analysis Report ("UFSAR") that are within and adjacent to the ESP reactor building envelope (See SERI Exhibit 3; SSAR Figure 2.5-69), drilling and sampling of three ESP borings, four ESP cone penetrometer soundings, seismic velocity surveys in the ESP borings, and laboratory static and dynamic testing of ESP borehole samples. On the basis of this evaluation, Section 2.5.4.6 of the SSAR recommends that the plant foundations be founded in

Upland Complex alluvium at, or below, the bottom of loess deposits at approximately elevation 97 feet MSL (depth of 36 feet) or lower.

Responses provided by NRC Staff in pre-filed testimony reference foundation embedment depths of between 120 and 140 feet (average depth of 130 feet). This depth correlates to the PPE bounding embedment depth for ESP foundations, rather than a minimum or design depth that could be at shallower depths according to the ESP evaluation.

Shear Wave Velocity

Some plant designs considered in the ESP Application reference a minimum 1,000 feet-per-second ("fps") shear wave velocity ("Vs") requirement for soils below the safety-related plant foundation basemat. Shear wave measurements of site subsurface materials were obtained by borehole P-S suspension surveys in each of the three ESP borings distributed within the proposed reactor building envelope (SSAR Figure 2.5-80). Based on the results from the ESP velocity surveys, Section 2.5.4.6 of the SSAR states that the average Vs exceeds 1,000 fps (in Upland Complex Alluvium) at, and below, approximately elevation 97 feet MSL (depth of about 36 feet below assumed finished plant grade elevation 133 feet MSL). The minimum shear wave velocity exceeds 1,000 fps at, and below, approximately elevation -7 feet MSL (depth of about 140 feet below assumed finished plant grade). Plant basemat (foundation) elevations above this level would require overexcavation and replacement of soils down to material exhibiting a minimum shear wave velocity of 1,000 fps, or alternatively, in-situ ground improvement (*e.g.* grouting) and/or further engineering design analyses.

Q9. Turning to Answer 3 of the Staff's pre-filed testimony, please provide any additional information that you believe is necessary.

A9. (LME) In Answer 3 of the Staff's pre-filed testimony, the Staff refers in several instances to three ground water wells in the Catahoula formation that are used to supply water for general site purposes of the existing plant, referencing SSAR Table 2.4-25. The Staff further states that based on available groundwater characterization data, the Staff determined that it is not unreasonable to expect that a suitable system of groundwater wells can be designed to extract water at a maximum rate of 3570 gpm from the Catahoula formation. The Staff further states in Answer 3 that impacts to the Catahoula aquifer was "unresolved" and if SERI continues to propose to withdraw water from the Catahoula Formation for construction and operation of the ESP facility, the Staff will require further characterization of the Catahoula aquifer.

Regarding the location of the three GGNS ground water wells currently in service, SERI provides the following correction based on current information and recent site investigations conducted as part of the ongoing COLA activities at the GGNS site. The withdrawal permit for two of three wells (TW-1A and TW-1B) referenced by the Staff was renewed in 1996, and the renewal application lists the source as the Catahoula aquifer. The withdrawal permit for the two wells that are currently in routine use was renewed in 2006, and the renewal application lists the source as the Miocene aquifer system (which includes the Catahoula Formation). The ESP application consistently references the source of potable water as the Catahoula formation, based on the information provided in these recent withdrawal permits. Soil characterization results from recent COLA site investigations, however, in the general area of the location of these wells and review of historical well installation records for the wells, indicate that the wells are in fact screened in terrace materials overlying the Catahoula Formation.

COL Action Item 2.4-8 in FSER Appendix A requires that the COL applicant referencing the GGNS ESP demonstrate that an adequately designed ground water well system is provided for the ESP facility. Regardless of the source of the ground water, *i.e.*, Catahoula or terrace deposits, this COL Action Item still requires satisfactory resolution. Construction and operational impacts on water use and water quality are unresolved in the Environmental Impact Statement ("EIS"); thus, additional characterization of ground water will be required for a COL application, regardless of the eventual source of ground water to provide plant potable water and other possible needs.

Q10. Does this conclude your testimony?

A10. (LME, WRL, JLB) Yes.

1-WA/2661766.2

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	ASLBP No. 04-823-03-ESP

PRE-FILED TESTIMONY OF LORI M. EVANS, WILLIAM R. LETTIS, AND MARVIN MORRIS ON BEHALF OF APPLICANT CONCERNING HEARING ISSUE B (MONITORABILITY OF INADVERTENT RADIOLOGICAL RELEASES)

Q1. Please state your name, current position, and by whom you are employed.

A1. My name is Lori M. Evans ("LME"). I am employed as Senior Project Manager for ENERCON Services, Inc.

A1. My name is William R. Lettis ("WRL"). I am employed as the President and Principal Geologist of William Lettis & Associates, Inc.

A1. My name is Marvin Morris ("MM"). I am employed as a consulting engineer and analyst for ENERCON Services, Inc..

Q2. On whose behalf are you testifying in this proceeding?

A2. (LME, WRL, MM) We are testifying on behalf of the applicant in this early site permit ("ESP") proceeding, System Energy Resources, Inc. ("SERI" or the "Applicant").

Q3. Please describe your professional qualifications.

A3. (LME) I hold a B.S. degree in Geology from Tennessee Technological University. I have over fourteen years of experience that include project management, a varied technical background, and environmental risk analysis. I have acted as task leader for hydrologic analyses for a proposed expansion of an existing nuclear power plant, have assisted in development of new bank environmental policy guidance documents, and have been responsible for managing multiple-site Phase I environmental site assessment projects. A full statement of my professional qualifications is contained in SERI Exhibit 1.

A3. (WRL) I hold a Ph.D. and an M.S degree in Geology from the University of California, Berkeley, and a B.S. degree in Geology and a B.S. in Forestry from Humboldt State University. I have over 20 years experience performing regional and site investigations to assess geologic and seismic hazards for large engineered facilities, including bridges, dams, nuclear and fossil fuel plants, pipelines, and Liquid Natural Gas ("LNG") terminals. A full statement of my professional qualifications is contained in SERI Exhibit 1.

A3. (MM) I hold a B.S. degree in Mathematics from the University of Texas, Pan American, and an M.S. degree in Physics from Sam Houston State University. I have over 30 years of experience in the nuclear industry in areas of design, analysis, licensing and operations support. A full statement of my professional qualifications is contained in SERI Exhibit 1.

Q4. Please describe your professional responsibilities with regard to the Grand Gulf ESP application, including the basis for your familiarity with that application.

A4. (LME) I am task leader for the hydrologic analysis sections of the Grand Gulf ESP application. As task leader, I was responsible for assessing the potential impacts on the surface water and groundwater of constructing and operating a nuclear power generating facility at the Grand Gulf site.

A4. (WRL) As Project Manager for the seismic and geotechnical work in support of the Entergy Grand Gulf Nuclear Station ("GGNS") ESP, my responsibilities include Sections of 2.5.1 through 2.5.6 of the Site Safety Analysis Report ("SSAR"), including seismic source characterization and probabilistic seismic hazard analysis to develop the Safe Shutdown Earthquake ("SSE") design ground motion in compliance with Regulatory Guide 1.165, and geotechnical characterization of the site in partial compliance with Regulatory Guides 1.138 and 1.132.

A4. (MM) As part of a larger ENERCON team, I served as a consultant to SERI and supported the development of the ESP application that seeks to demonstrate site suitability for a new commercial nuclear power plant at the GGNS site. As a senior engineer, I was responsible for analyses supporting the application in the areas of offsite hazards, atmospheric dispersion, design basis accidents, and severe accidents. My responsibilities included Sections 2.3, 3.2, and 3.3 of the SSAR and Sections 2.7, 5.4, and 7.1 of the Environmental Report ("ER").

Q5. In its Order (Requesting Specific Summary Exhibits and Supplemental Briefs; Identifying Hearing Issues and Requesting Evidentiary Presentations on Specific Issues) of November 6, 2006, the Atomic Safety and Licensing Board ("Board") identified a series of hearing issues on which the Board has required testimony and presentations from the Nuclear Regulatory Commission ("NRC") Staff. The Staff submitted its pre-filed testimony on November 20, 2006. *See* NRC Staff Pre-Filed Testimony Concerning Hearing Issue B: "Monitorability of Inadvertent Radiological Releases" (Nov. 20, 2006) ("Staff Issue B Testimony"). Have you reviewed the Staff's testimony on Hearing Issue B?

A5. (LME, WRL, MM) Yes.

Q6. During the October 31, 2006, pre-hearing conference, the Board expressly authorized the Applicant, as appropriate, to submit supplemental pre-filed testimony for the limited purpose of clarifying and/or providing additional factual information that may inform the Board's mandatory hearing review and decision-making process. *See* Transcript of October 31, 2006, Pre-hearing Conference at 8. Do you wish to provide any such supplemental testimony at this time?

A6. (LME, MM) Yes. We are offering supplemental testimony with respect to Answers 5 and 6 of the Staff's pre-filed testimony.

A6. (WRL) No. I will be available, however, to respond to any questions that the Board might pose to the Applicant during the evidentiary hearing that relate specifically to geologic data for the Grand Gulf ESP site, as referred to in Hearing Issue B(3).

Q7. Turning to Answer 5 of the Staff's pre-filed testimony, please provide any additional information or clarification that you believe is necessary.

A7. (LME, MM) The last sentence of Answer 5 of the NRC Staff's pre-filed testimony states that "[t]he Staff did not receive any data in the SERI application on radiological conditions at the site." Staff Issue B Testimony, A.5 at 5. As a clarification, SERI notes that one of the wells that is routinely sampled as part of the current GGNS radiological environmental monitoring plan ("REMP") is located on the ESP site, near the ESP power block area. SSAR Table 2.4-36 (and ER Table 6.2-1) provides a list of REMP sampling locations, sampling parameters, sample frequency and types of analyses performed. ER Table 6.2-2 provides REMP sampling results for years 2002 and 2003.

Q7. Turning next to Answer 6 of the Staff's pre-filed testimony, please provide any additional information or clarification that you believe is necessary.

A7. (MM) As Question 6 of the Staff's pre-filed testimony reflects, in Hearing Issue B(3), the Board inquired about "meteorological, geologic, and hydrogeologic data than can be used to estimate migration pathways for future impact from plant(s) at the site." The Staff's response to this question did not explicitly address meteorological data that could be used to evaluate the consequences of inadvertent radiological releases, presumably because the Board's question appears to contemplate a potential liquid radionuclide release to "surface water, ground water, and shallow soil and sediments." *See* Staff Issue B Testimony, A.6 at 5. SERI notes that site meteorological data could be used to assess the offsite consequences of a potential normal or inadvertent gaseous radionuclide release in accordance with the Technical Specifications and the Offsite Dose Calculation Manual for the new plant.

Q7. Does this conclude your pre-filed testimony on Hearing Issue B?

A7. (LME, WRL, MM) Yes.

1-WA/2661767.1

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	ASLBP No. 04-823-03-ESP

PRE-FILED TESTIMONY OF WILLIAM R. LETTIS AND JEFFREY L. BACHHUBER ON BEHALF OF APPLICANT CONCERNING HEARING ISSUE C (SEISMIC IMPACTS)

Q1. Please state your name, current position, and by whom you are employed.

A1. My name is William R. Lettis ("WRL"). I am employed as the President and Principal Geologist of William Lettis & Associates, Inc.

A1. My name is Jeffrey L. Bachhuber ("JLB"). I am employed as the Vice President, Senior Principal Engineering Geologist of William Lettis & Associates, Inc.

Q2. On whose behalf are you testifying in this proceeding?

A2. (WRL, JLB) We are providing testimony on behalf of the applicant in this early site permit ("ESP") proceeding, System Energy Resources, Inc. ("SERI" or the "Applicant").

Q3. Please describe your professional qualifications.

A3. (WRL) I hold a Ph.D. and an M.S degree in Geology from the University of California, Berkeley, and a B.S. degree in Geology and a B.S. degree in Forestry from Humboldt State University. I have over 20 years of experience performing regional and site investigations to assess geologic and seismic hazards for large engineered facilities, including bridges, dams, nuclear and fossil fuel plants, pipelines, and Liquid Natural Gas ("LNG") terminals. A full statement of my professional qualifications is contained in SERI Exhibit 1.

A3. (JLB) I hold an M.S. and B.A. degrees in Geology from San Jose State University. I am a Certified Engineering Geologist in California with over 20 years of professional experience performing geologic/geotechnical studies for nuclear and other critical facilities throughout the United States, Peru, Dominican Republic, Puerto Rico, Korea, Indonesia, Japan, and Turkey. I have performed detailed site investigations in a variety of geologic settings, in addition to regional hazard mapping and facility siting and routing studies. These projects involved assessment of earthquake hazard and sources, fault rupture and ground failure analysis, slope stability analysis and mitigation design, karst and void identification and treatment, foundation characterization with borings and geophysical techniques, laboratory testing, failure mode assessment, and development of foundation criteria for detailed static and dynamic stability and site response analyses (including soil-structure interaction) A full statement of my professional qualifications is contained in SERI Exhibit 1.

Q4. Please describe your professional responsibilities with regard to the Grand Gulf Nuclear Station ("GGNS") ESP application, including the basis for your familiarity with that application.

A4. (WRL) As Project Manager for the seismic and geotechnical work in support of the GGNS ESP, my responsibilities included preparation of Sections of 2.5.1 through 2.5.6 of the Site Safety Analysis Report ("SSAR"), including seismic source characterization and probabilistic seismic hazard analysis used to develop the Safe Shutdown Earthquake ("SSE") design ground motion in compliance with Regulatory Guide 1.165, and geotechnical characterization of the site in partial compliance with Regulatory Guides 1.138 and 1.132.

A4. (JLB) I was responsible for developing detailed site geotechnical characterization for the Grand Gulf ESP site. My work regarding the Grand Gulf ESP included developing Quality Assurance/Quality Control ("QA/QC") technical procedures and workplans to guide all field and laboratory activities, directing field investigations consisting of geologic mapping, deep mud rotary borings, cone penetrometer test ("CPT") soundings, borehole compression wave/shear wave ("P-S") velocity surveys, and spectral analysis of surface waves ("SASW") surface surveys. I also prepared Sections 2.5.4 to 2.5.6 for the Safety Analysis Report ("SAR"), responded to Nuclear Regulatory Commission ("NRC") requests for additional information ("RAIs"), and presented the project to the Advisory Committee on Reactor Safeguards ("ACRS") in a formal meeting.

Q5. In an Order (Requesting Specific Summary Exhibits and Supplemental Briefs; Identifying Hearing Issues and Requesting Evidentiary Presentations on Specific Issues) of November 6, 2006, the Atomic Safety and Licensing Board ("Board") identified a series of hearing issues on which the Board has required testimony and presentations from the NRC Staff. The Staff submitted its pre-filed testimony on November 20, 2006. *See* NRC Staff Pre-Filed Testimony Concerning Hearing Issue C: "Seismic Impacts" (Nov. 20, 2006). Have you reviewed the Staff's testimony on Hearing Issue C?

A5. (WRL, JLB) Yes.

Q6. During the October 31, 2006, pre-hearing conference, the Board expressly authorized the Applicant, as appropriate, to submit supplemental pre-filed testimony for the limited purpose of clarifying and/or providing additional factual information that may inform the Board's mandatory hearing review and decision-making process. *See* Transcript of October 31, 2006, Pre-hearing Conference at 8. Do you wish to provide any such supplemental testimony at this time?

A6. (WRL, JLB) No. We are prepared, however, to respond orally to any questions germane to Hearing Issue C that the Board may ask of us during the evidentiary hearing.

1-WA/2661768.1

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	ASLBP No. 04-823-03-ESP

PRE-FILED TESTIMONY OF WILLIAM R. LETTIS AND JEFFREY L. BACHHUBER ON BEHALF OF APPLICANT CONCERNING HEARING ISSUE D (SLOPE AND FOUNDATION STABILITY)

Q1. Please state your name, current position, and by whom you are employed.

A1. My name is William R. Lettis ("WRL"). I am employed as the President and Principal Geologist of William Lettis & Associates, Inc.

A1. My name is Jeffrey L. Bachhuber ("JLB"). I am employed as the Vice President, Senior Principal Engineering Geologist of William Lettis & Associates, Inc.

Q2. On whose behalf are you testifying in this proceeding?

A2. (WRL, JLB) We are providing testimony on behalf of the applicant in this early site permit ("ESP") proceeding, System Energy Resources, Inc. ("SERI" or the "Applicant").

Q3. Please describe your professional qualifications.

A3. (WRL) I hold a Ph.D. and an M.S degree in Geology from the University of California, Berkeley, and a B.S. degree in Geology and a B.S. degree in Forestry from Humboldt State University. I have over 20 years of experience performing regional and site investigations to assess geologic and seismic hazards for large engineered facilities, including bridges, dams, nuclear and fossil fuel plants, pipelines, and Liquid Natural Gas ("LNG") terminals. A full statement of my professional qualifications is contained in SERI Exhibit 1.

A3. (JLB) I hold M.S. and B.A. degrees in Geology from San Jose State University. I am a Certified Engineering Geologist in California with over 20 years of professional experience performing geologic/geotechnical studies for nuclear and other critical facilities throughout the United States, Peru, Dominican Republic, Puerto Rico, Korea, Indonesia, Japan, and Turkey. I have performed detailed site investigations in a variety of geologic settings, in addition to regional hazard mapping and facility siting and routing studies. These projects involved assessment of earthquake hazard and sources, fault rupture and ground failure analysis, slope stability analysis and mitigation design, karst and void identification and treatment, foundation characterization with borings and geophysical techniques, laboratory testing, failure mode assessment, and development of foundation criteria for detailed static and dynamic stability and site response analyses (including soil-structure interaction) A full statement of my professional qualifications is contained in SERI Exhibit 1.

Q4. Please describe your professional responsibilities with regard to the Grand Gulf ESP application, including the basis for your familiarity with that application.

A4. (WRL) As Project Manager for the seismic and geotechnical work in support of the Entergy Grand Gulf Nuclear Station ("GGNS") ESP, my responsibilities included preparation of Sections of 2.5.1 through 2.5.6 of the Site Safety Analysis Report ("SSAR"), including seismic source characterization and probabilistic seismic hazard analysis used to develop the Safe Shutdown Earthquake ("SSE") design ground motion in compliance with Regulatory Guide 1.165, and geotechnical characterization of the site in partial compliance with Regulatory Guides 1.138 and 1.132.

A4. (JLB) I was responsible for developing detailed site geotechnical characterization for the Grand Gulf ESP site. My work regarding the Grand Gulf ESP included developing Quality Assurance/Quality Control ("QA/QC") technical procedures and workplans to guide all field and laboratory activities, as well as directing field investigations consisting of geologic mapping, deep mud rotary borings, cone penetrometer test ("CPT") soundings, and borehole P-S velocity surveys. I also prepared Sections 2.5.4 to 2.5.6 for the Safety Analysis Report ("SAR"), responded to Nuclear Regulatory Commission ("NRC") Staff requests for additional information ("RAIs"), and presented the project to the Advisory Committee on Reactor Safeguards ("ACRS") in a formal meeting.

Q5. In an Order (Requesting Specific Summary Exhibits and Supplemental Briefs; Identifying Hearing Issues and Requesting Evidentiary Presentations on Specific Issues) of November 6, 2006, the Atomic Safety and Licensing Board ("Board") identified a series of hearing issues on which the Board has required testimony and presentations from the NRC Staff. The Staff submitted its pre-filed testimony on November 20, 2006. *See* NRC Staff Pre-Filed Testimony Concerning Hearing Issue D: "Slope and Foundation Stability" (Nov. 20, 2006). Have you reviewed the Staff's testimony on Hearing Issue D?

A5. (WRL, JLB) Yes.

Q6. During the October 31, 2006, pre-hearing conference, the Board expressly authorized the Applicant, as appropriate, to submit supplemental pre-filed testimony for the limited purpose of clarifying and/or providing additional factual information that may inform the Board's mandatory hearing review and decision-making process. *See* Transcript of October 31, 2006, Pre-hearing Conference at 8. Do you wish to provide any such supplemental testimony at this time?

A6. (WRL, JLB) Yes. We are offering supplemental testimony with respect to the following issues: river bluff stability, geologic nomenclature, foundation embedment depth, and shear wave velocity.

Q7. With respect to river bluff stability, please provide any additional information that you believe is necessary to address that issue.

A7. (JLB) In Hearing Issue D, Question Q.3 of the NRC Staff pre-filed testimony, the Board requested additional clarification regarding the geotechnical stability of the bearing strata and exterior earthern slopes (*i.e.*, bluff). The staff response discussed that the ESP setback ("stand-off") distance of 100 feet prevents potential failure surfaces through the bluff material from intersecting the plant cross-section. SERI Exhibits 3 and 5 provide a graphic representation of the relationships between the river bluff slope and ESP proposed plant reactor building envelope. This figure shows that the ESP setback distance provides a sufficient safety buffer against any reasonable potential failure surfaces from intersection of the proposed plant envelope. In order to reach the proposed plant envelope area, a failure plane extending from the river bluff would have an inclination significantly less than 15 degrees (above horizontal), which is far below typical estimated residual angles of internal friction (angle of repose) for the loess soil that forms the river bluff and typically stands vertically in excavated cuts.

Q8. With respect to geologic nomenclature, please provide any additional information that you believe is necessary to address that issue.

A8. (WRL) In Hearing Issue D, Question Q.4 of the NRC Staff pre-filed testimony, the Board requested additional clarification of the stratigraphic nomenclature used to describe the site geologic and hydrogeologic units. The Staff response provides clarification of the geologic stratigraphic nomenclature used in Section 2.5 of the SSAR, but does not provide clarification of the hydrogeologic nomenclature provided in Section 2.4 of the SSAR. The Staff's focus on the geologic unit nomenclature is appropriate, because Hearing Issue D relates to stability of the Mississippi River bluff, which is a geologic issue. However, to provide additional clarification, SERI Exhibit 4 provides a chart showing the correlation of geologic and hydrogeologic units used in the original site Updated Final Safety Analysis Report ("UFSAR") (in which some terms are now archaic), and those used in Section 2.4 (hydrogeologic units), and Section 2.5 (geologic units) of the ESP SSAR. The term "New Alluvium" cited in the Board question was not used in the ESP SSAR. It should be noted that the hydrogeologic nomenclature used in the original site UFSAR was adopted without change in the ESP. However, the geologic nomenclature used in the UFSAR was modified and updated in the ESP SSAR Section 2.5 to reflect more recent understanding of the geology in the Site Area.

Q9. With respect to plant foundation embedment depth and shear wave velocity, please provide any additional information that you believe is necessary to address that issue.

A9. (JLB) In Hearing Issue D, Questions Q.4, Q.5, Q.7, and Q.8 of the NRC Staff pre-filed testimony, the Staff discussed issues related to the depth of existing fill, plant foundation embedment depths, and minimum shear wave velocity requirements for plant foundation basemats. This response provides additional clarification regarding these issues.

Existing Fill

Existing fill underlying the ESP proposed reactor building envelope is localized and shallow (depth of fill above approximate elevation 100 feet; SERI Exhibit 3), and does not extend to the foundation depth ranges of planned power plants.

Foundation Depth

The Environmental Report plant parameters envelope (PPE; Table 3.0-1) lists the ESP bounding foundation embedment depth as 140 feet. This depth is the maximum depth of the bottom of the foundation basemat, as measured from the finished plant grade (assumed at approximately elevation 133 feet above mean sea level (MSL)) for any reactor design considered in the ESP Application. The relative location and elevation of this bounding depth with respect to the existing ground surface is shown on SSAR Figures 2.5-75 through 2.5-77 (*See* SERI Exhibit 3 for location of geologic cross sections A-A', B-B', and C-C'), and labeled as "likely maximum foundation depth range within Proposed PPBA" (Proposed Power Block Area). The corresponding elevation of this maximum bounding embedment depth is approximately elevation (-)7 feet MSL.

Other plant technologies considered in the ESP Application have basemat elevations that are shallower than the bounding embedment depth, typically within the range of about 30 to 70 feet below finished plant grade. The stability and foundation suitability of subsurface materials that occur between assumed finished plant grade and the bounding maximum foundation depth range (and below this depth range throughout the likely range of foundation influence) were specifically evaluated with respect to the varying technologies and possible embedment depths. This evaluation included compilation and review of about twenty existing borings from the Unit 1 UFSAR that are within and adjacent to the ESP reactor building envelope (See SERI Exhibit 3; SSAR Figure 2.5-69), drilling and sampling of three ESP borings, four ESP cone penetrometer soundings, seismic velocity surveys in the ESP borings, and laboratory static and dynamic testing of ESP borehole samples. On the basis of this evaluation, Section 2.5.4.6 of the SSAR recommends that the plant foundations be founded in Upland Complex alluvium at, or below, the bottom of loess deposits at approximately elevation 97 feet MSL (depth of 36 feet) or lower.

Responses provided by NRC Staff in pre-filed testimony reference foundation embedment depths of between 120 and 140 feet (average depth of 130 feet). This depth correlates to the PPE bounding embedment depth for ESP foundations, rather than a minimum or design depth that could be at shallower depths according to the ESP evaluation.

Shear Wave Velocity

Some plant designs considered in the ESP Application reference a minimum 1,000 feet-per-second ("fps") shear wave velocity ("Vs") requirement for soils below the safety-related plant foundation basemat. Shear wave measurements of site subsurface materials were obtained by borehole P-S suspension surveys in each of the three ESP borings distributed within the proposed reactor building envelope (SSAR Figure 2.5-80). Based on the results from the ESP velocity surveys, Section 2.5.4.6 of the SSAR states that the average Vs exceeds 1,000 fps (in Upland Complex Alluvium) at, and below, approximately elevation 97 feet MSL (depth of about 36 feet below assumed finished plant grade elevation 133 feet MSL). The minimum shear wave velocity exceeds 1,000 fps at, and below, approximately elevation -7 feet MSL (depth of about 140 feet below assumed finished plant grade). Plant basemat (foundation) elevations above this level would require overexcavation and replacement of soils down to material exhibiting a minimum shear wave velocity of 1,000 fps, or alternatively, in-situ ground improvement (*e.g.* grouting) and/or further engineering design analyses.

Q10. Does this conclude your testimony?

A10. (WRL, JLB) Yes.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	ASLBP No. 04-823-03-ESP

PRE-FILED TESTIMONY OF JOHN G. CESARE, GEORGE A. ZINKE, KYLE H. TURNER, AND MICHAEL D. BOURGEOIS ON BEHALF OF APPLICANT CONCERNING HEARING ISSUE E (ALTERNATIVE ANALYSES)

Q1. Please state your name, current position, and by whom you are employed.

A1. My name is John G. Cesare ("JGC"). I am employed as Lead Licensing Project Engineer for ENERCON Services, Inc.

A1. My name is George A. Zinke ("GAZ"). I am employed as the Project Manager, Business Development, for Entergy Nuclear, Inc.

A1. My name is Kyle H. Turner ("KHT"). I am employed as the Chief Executive Officer of McCallum-Turner, Inc.

A1. My name is Michael D. Bourgeois ("MDB"). I am employed as the Manager of Project Management for Entergy Nuclear, Inc.

Q2. On whose behalf are you testifying in this proceeding?

A2. (JGC, GAZ, KHT, MDB) We are providing testimony on behalf of the applicant in this early site permit ("ESP") proceeding, System Energy Resources, Inc. ("SERI" or the "Applicant").

Q3. Please describe your professional qualifications.

A3. (JGC) I hold a B.S. degree in Chemical Engineering and an M.S. degree in Nuclear Engineering from Mississippi State University. I have over 24 years of experience in the nuclear power industry, including experience in the areas of new reactor, operational and decommissioning licensing; special projects; organizational assessment; and management support. This includes ten years of supervisory and management experience at a boiling water reactor ("BWR") facility. A full statement of my professional qualifications is contained in SERI Exhibit 1.

A3. (GAZ) I hold a B.S. degree in Electrical Engineering from Wichita State University. I have 30 years of technical and management experience in the commercial nuclear power industry. Since 2001, as a Project Manager with Entergy Nuclear, Inc., I have focused principally on licensing matters involving the company's Grand Gulf Nuclear Station ("GGNS") ESP and combined operating license ("COL") Development projects, as well as the NuStart COL Development Project. Prior to that, I held various managerial and supervisory positions at the Maine Yankee, River Bend, and GGNS facilities, where I was responsible for overseeing various licensing, system engineering, quality assurance, worker concerns, emergency preparedness, and environmental programs related to facility construction, operation, and decommissioning. A full statement of my professional qualifications is contained in SERI Exhibit 1.

A3. (KHT) I hold a B.S. degree in Electrical Engineering for the Georgia Institute of Technology, as well as Ph. D. and M.S. degrees in Nuclear Engineering, also from the Georgia Institute of Technology. I have more than 30 years experience providing technical, business, and management consulting services to commercial industry and government. My management responsibilities have ranged in budget up to $16 million and 200 professional staff. I am Principal author for the industry ESP Siting Guide, ESP Model Program Plan and COL Model Program Plan for nuclear power plants, and am currently managing an Electric Power Research Institute ("EPRI") project to develop a model Program Plan for overall nuclear power plant development under Part 52 regulations. Since 2001, I have directed site selection studies for ten nuclear power plant sites for COL and ESP applications (Duke Power, Entergy Nuclear, Florida Power & Light, Progress Energy (2), NuStart, South Carolina Electric & Gas, and two confidential clients). A full statement of my professional qualifications is contained in SERI Exhibit 1.

A3. (MDB) I hold a B.S. degree in Nuclear Engineering Technology from Thomas Edison State College. I have over forty years of commercial and military nuclear experience. My experience includes project and outage management, nuclear reactor operation, and work control.

Q4. Please describe your professional responsibilities with regard to the Grand Gulf ESP application, including the basis for your familiarity with that application.

A4. (JGC) As part of a larger ENERCON team, I served as a consultant to SERI and supported the development of the ESP application that seeks to demonstrate site suitability for a new commercial nuclear power plant at the GGNS site. As the lead licensing project engineer, I coordinated and supported the development of the safety analyses, environmental report, and emergency planning assessment for the ESP application. I also participated in site safety and environmental visits, the development of applicant responses to Nuclear Regulatory Commission ("NRC") Staff requests for additional information ("RAIs"), and the Advisory Committee on Reactor Safeguards ("ACRS") review process. My work also involved active participation in the industry ESP task force and numerous licensing-related interactions with the NRC Staff.

A4. (GAZ) As the Project Manager, Business Development, for Entergy Nuclear, Inc., I have two different but complementary roles. Namely, I am both the NuStart Licensing Lead and the Entergy Nuclear New Plant Licensing Lead. In the former capacity, I am responsible for regulatory affairs associated with the NuStart COL Development Project. Entergy is a member of NuStart Energy Development, LLC, a consortium formed in 2004 that is seeking to facilitate the licensing, construction, and operation of new, advanced nuclear power plants in the United States. In the latter capacity, I am responsible for regulatory affairs and quality assurance associated with the Entergy COL Development Process. The acquisition of an ESP for the GGNS site is a preliminary and integral step in the Entergy COL Development Process. As such, I have overall responsibility for regulatory and engineering matters related to the Grand Gulf ESP application.

A4. (KHT) I was the Principal in charge of work performed by McCallum-Turner to support SERI in the site selection study for the Grand Gulf ESP. McCallum-Turner developed site evaluation criteria and worked with Entergy staff to evaluate the Entergy existing nuclear power plant sites in the Northeast and in the Southeast for potential location of a new nuclear power plant; this work involved performing and reviewing site evaluations, development of criterion weight factors and developing composite site suitability evaluations for use in comparing sites. McCallum-Turner applied the site selection criteria established in the EPRI siting guide to information gathered from existing data sources for the proposed sites. McCallum-Turner then facilitated overall ranking of the candidate sites to identify a preferred site (GGN) for the ESP.

A4. (MDB) As ESP Project Manager, I was the project lead for the GGNS ESP site selection process.

Q5. In an Order (Requesting Specific Summary Exhibits and Supplemental Briefs; Identifying Hearing Issues and Requesting Evidentiary Presentations on Specific Issues) of

November 6, 2006, the Atomic Safety and Licensing Board ("Board") identified a series of hearing issues on which the Board has required testimony and presentations from the NRC Staff. The Staff submitted its prefiled testimony on November 20, 2006. *See* NRC Staff Pre-Filed Testimony Concerning Hearing Issue E: "Alternative Analyses" (Nov. 20, 2006). Have you reviewed the Staff's testimony on Hearing Issue E?

A5. (JGC, GAZ, KHT, MDB) Yes.

Q6. During the October 31, 2006, pre-hearing conference, the Board expressly authorized the Applicant, as appropriate, to submit supplemental pre-filed testimony for the limited purpose of clarifying and/or providing additional factual information that may inform the Board's mandatory hearing review and decision-making process. *See* Transcript of October 31, 2006, Prehearing Conference at 8. Do you wish to provide any such supplemental testimony at this time?

A6. (MDB) Yes. I am offering supplemental testimony with respect to Answer 6 of the Staff's pre-filed testimony.

A6. (JGC, GAZ, KHT) No. We are prepared, however, to respond orally to any questions germane to Hearing Issue E that the Board may ask of us during the mandatory hearing.

Q7. Turning to Answer 6 of the Staff's pre-filed testimony, in narrowing the sites down to Grand Gulf, did Entergy Nuclear eliminate Fitzpatrick, River Bend, and Pilgrim from all future consideration for possible ESP purposes outside the scope of this proceeding?

A7. (MDB) No. By way of clarification, in conducting its alternative site screening process, Entergy Nuclear excluded those sites from further consideration as part of this ESP effort, but not from all possible future consideration for additional ESPs.

Q7. Does this conclude your prefiled testimony on Hearing Issue E?

A7. (MDB) Yes.

1-WA/2661774.2

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	ASLBP No. 04-823-03-ESP

PRE-FILED TESTIMONY OF JOHN CESARE, DAVID J. BEAN, AND MARVIN MORRIS ON BEHALF OF APPLICANT CONCERNING HEARING ISSUE F (EVALUATION OF CUMULATIVE SITE IMPACTS)

Q1. Please state your name, current position, and by whom you are employed.

A1. My name is John G. Cesare ("JGC"). I am employed as the Lead Licensing Project Engineer for ENERCON Services, Inc.

A1. My name is David J. Bean ("DJB"). I am employed as a Senior Environmental Scientist for ENERCON Services, Inc.

A1. My name is Marvin Morris ("MM"). I am employed as a consulting engineer and analyst for ENERCON Services, Inc.

Q2. On whose behalf are you testifying in this proceeding?

A2. (JGC, DJB, MM) We are providing testimony on behalf of the applicant in this early site permit ("ESP") proceeding, System Energy Resources, Inc. ("SERI" or the "Applicant").

Q3. Please describe your professional qualifications.

A3. (JGC) I hold a B.S. degree in Chemical Engineering and an M.S. degree in Nuclear Engineering from Mississippi State University. I have over 24 years of experience in the nuclear power industry, including experience in the areas of new reactor, operational and decommissioning licensing; special projects; organizational assessment; and management support. This includes ten years of supervisory and management experience at a boiling water reactor ("BWR") facility. A full statement of my professional qualifications is contained in SERI Exhibit 1.

A3. (DJB) I hold an M.S. degree in Zoology from the Ohio State University, and a B.A. degree in Biology from the State University of New York at Oswego. I have over 30 years of experience in the Environmental Industry, and am well-versed in environmental impact analysis/assessment, the National Environmental Policy Act ("NEPA"), and Strategic Environmental Management. I have extensive experience performing environmental safety and health ("ES&H") compliance strategy development, site evaluation and selection planning, risk assessment/analysis, and waste management. A full statement of my professional qualifications is contained in SERI Exhibit 1.

A3. (MM) I hold a B.S. degree in Mathematics from the University of Texas, Pan American, and an M.S. degree in Physics from Sam Houston State University. I have over 30 years of experience in the nuclear industry in areas of design, analysis, licensing, and operations support. A full statement of my professional qualifications is contained in SERI Exhibit 1.

Q4. Please describe your professional responsibilities with regard to the Grand Gulf ESP application, including the basis for your familiarity with that application.

A4. (JGC) As part of a larger ENERCON team, I served as a consultant to SERI and supported the development of the ESP application that seeks to demonstrate site suitability for a new commercial nuclear power plant at the Grand Gulf Nuclear Station ("GGNS") site. As the lead licensing project engineer, I coordinated and supported the development of the safety analyses, environmental report, and emergency planning assessment for the ESP application. I also participated in site safety and environmental visits, the development of applicant responses to Nuclear Regulatory Commission ("NRC") Staff requests for additional information ("RAIs"), and the Advisory Committee on Reactor Safeguards ("ACRS") review process. My work also involved active participation in the industry ESP task force and numerous licensing-related interactions with the NRC Staff.

A4. (DJB) As Senior Environmental Scientist, I coordinated the preparation of the environmental sections for the Grand Gulf ESP application. I was responsible for budget and schedule control, and technical review of sections of the Site Safety Analysis Report ("SSAR") and Environmental Report ("ER"). The evaluation included an assessment of the potential impacts on the terrestrial and aquatic environment of constructing and operating a new nuclear power generating facility at the proposed site.

A4. (MM) As part of a larger ENERCON team, I served as a consultant to SERI and supported the development of the ESP application that seeks to demonstrate site suitability for a new commercial nuclear power plant at the GGNS site. As a senior engineer, I was responsible for analyses supporting the application in the areas of offsite hazards, atmospheric dispersion, design basis accidents, and severe accidents. My responsibilities included Sections 2.3, 3.2, and 3.3 of the SSAR and Sections 2.7, 5.4, and 7.1 of the ER.

Q5. In an Order (Requesting Specific Summary Exhibits and Supplemental Briefs; Identifying Hearing Issues and Requesting Evidentiary Presentations on Specific Issues) of November 6, 2006, the Atomic Safety and Licensing Board ("Board") identified a series of hearing issues on which the Board has required testimony and presentations from the NRC Staff. The Staff submitted its prefiled testimony on November 20, 2006. *See* NRC Staff Pre-Filed

Testimony Concerning Hearing Issue F: "Evaluation Of Cumulative Site Impacts" (Nov. 20, 2006). Have you reviewed the Staff's testimony on Hearing Issue F?

A5. (JGC, DJB, MM) Yes.

Q6. During the October 31, 2006, pre-hearing conference, the Board expressly authorized the Applicant, as appropriate, to submit supplemental pre-filed testimony for the limited purpose of clarifying and/or providing additional factual information that may inform the Board's mandatory hearing review and decision-making process. *See* Transcript of October 31, 2006, Pre-hearing Conference at 8. Do you wish to provide any such supplemental testimony at this time?

A6. (JGC, MM) No. We are prepared, however, to respond orally to any questions germane to Hearing Issue F that the Board may ask of us during the evidentiary hearing.

A6. (DJB) Yes. I am offering supplemental testimony with respect to Exhibit 3 of the Staff's pre-filed testimony.

Q7. Turning to Exhibit 3 of the Staff's pre-filed testimony, please provide any additional information or clarification that you believe is necessary.

A8. (DJB) Staff Exhibit 3 is a table of resolved and unresolved safety and environmental issues identified by the Staff with respect to the GGNS ESP. For most resolved issues, the Staff provides clarifying assumptions and comments. SERI's Exhibit 2, which is attached to this testimony, includes additional clarifying comments to Staff Exhibit 3, with supporting references where appropriate. SERI's clarifying comments on Staff Exhibit 3 are noted in bold in SERI's Exhibit 2.

Q8. Does this conclude your testimony?

A8. (DJB) Yes.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	ASLBP No. 04-823-03-ESP

PRE-FILED TESTIMONY OF JOHN CESARE, AL SCHNEIDER, AND GEORGE ZINKE ON BEHALF OF APPLICANT CONCERNING HEARING ISSUE G (EVALUATION OF PLANT PARAMETER ENVELOPE)

Q1. Please state your name, current position, and by whom you are employed.

A1. My name is John G. Cesare ("JGC"). I am employed as Lead Licensing Project Engineer for ENERCON Services, Inc.

A1. My name is Al J. Schneider ("AJS"). I am employed as the Manager of Projects for the New Plant Services Division of ENERCON Services, Inc.

A1. My name is George A. Zinke ("GAZ"). I am employed as the Project Manager, Business Development, for Entergy Nuclear, Inc.

Q2. On whose behalf will you testify in this proceeding?

A2. (JGC, AJS, GAZ) We are providing testimony on behalf of the applicant in this early site permit ("ESP") proceeding, System Energy Resources, Inc. ("SERI" or the "Applicant").

Q3. Please describe your professional qualifications.

A3. (JGC) I hold a B.S. degree in Chemical Engineering and an M.S. degree in Nuclear Engineering from Mississippi State University. I have over 24 years of experience in the nuclear power industry, including experience in the areas of new reactor, operational and decommissioning licensing; special projects; organizational assessment; and management support. This includes ten years of supervisory and management experience at a Boiling Water Reactor ("BWR") facility. A full statement of my professional qualifications is contained in SERI Exhibit 1.

A3. (AJS) I hold B.S. and M.S. degrees in Mechanical Engineering from the University of Arkansas. I have over 33 years of technical and management experience in the commercial nuclear power industry. This experience encompasses numerous lead and supervisory assignments in engineering, projects, technical support, preoperational and start-up testing programs, procedure upgrade and development, licensing, and outage planning and scheduling. As noted above, I have provided project management and technical expertise to the Grand Gulf Nuclear Station ("GGNS") ESP project. I also have provided project management services in connection with NuStart's initiation of its combined operating license application ("COLA") preparation project, the ENERCON/NuStart Economic Simplified Boiling Water Reactor ("ESBWR") COLA preparation project, the design of BWR/6 Emergency Core Cooling System ("ECCS") Suction Strainers for three BWR/6 plants, Technical Specification Surveillance Test Procedure Upgrade Projects, system design criteria review and development, comprehensive in-service testing ("IST") program reviews, and a ten-year IST program update. A full statement of my professional qualifications is contained in SERI Exhibit 1

A3. (GAZ) I hold a B.S. degree in Electrical Engineering from Wichita State University. I have 30 years of technical and management experience in the commercial nuclear power industry. Since 2001, as a Project Manager with Entergy Nuclear, Inc., I have focused principally on licensing matters involving the company's Grand Gulf Nuclear Station ("GGNS")

ESP and combined operating license ("COL") Development projects, as well as the NuStart COL Development Project. Prior to that, I held various managerial and supervisory positions at the Maine Yankee, River Bend, and GGNS facilities, where I was responsible for overseeing various licensing, system engineering, quality assurance, worker concerns, emergency preparedness, and environmental programs related to facility construction, operation, and decommissioning. A full statement of my professional qualifications is contained in SERI Exhibit 1.

Q4. Please describe your professional responsibilities with regard to the Grand Gulf ESP application, including the basis for your familiarity with that application.

A4. (JGC) As part of a larger ENERCON team, I served as a consultant to SERI and supported the development of the ESP application that seeks to demonstrate site suitability for a new commercial nuclear power plant at the GGNS site. As the lead licensing project engineer, I coordinated and supported the development of the safety analyses, environmental report, and emergency planning assessment for the ESP application. I also participated in site safety and environmental visits, the development of applicant responses to Nuclear Regulatory Commission ("NRC") Staff requests for additional information ("RAIs"), and the Advisory Committee on Reactor Safeguards ("ACRS") review process. My work also involved active participation in the industry ESP task force and numerous licensing-related interactions with the NRC Staff.

A4. (AJS) As Project Manager for ENERCON for the Entergy Grand Gulf early site permit application development, I was responsible for overall management of all of ENERCON's work related to development of the ESP application, including budget, resources and schedule, and was responsible for implementation of the Quality Assurance program for the application development project. I was responsible for integrating the input from other contractors (*i.e.*, William Lettis & Associates, Inc.) into the safety analysis report for the application. I participated in the development and technical review of the environmental report and the safety analysis report parts of the application. I also participated in site safety and environmental visits to the site by the NRC, the development of applicant responses to Nuclear Regulatory Commission ("NRC") Staff requests for additional information ("RAIs") and DSER Open Items, and the Advisory Committee on Reactor Safeguards ("ACRS") review process.

A4. (GAZ) As the Project Manager, Business Development, for Entergy Nuclear, Inc., I have two different but complementary roles. Namely, I am both the NuStart Licensing Lead and the Entergy Nuclear New Plant Licensing Lead. In the former capacity, I am responsible for regulatory affairs associated with the NuStart COL Development Project. Entergy is a member of NuStart Energy Development, LLC, a consortium formed in 2004 that is seeking to facilitate the licensing, construction, and operation of new, advanced nuclear power plants in the United States. In the latter capacity, I am responsible for regulatory affairs and quality assurance associated with the Entergy COL Development Process. The acquisition of an ESP for the GGNS site is a preliminary and integral step in the Entergy COL Development Process. As such, I have overall responsibility for regulatory and engineering matters related to the Grand Gulf ESP application.

Q5. In its Order (Requesting Specific Summary Exhibits and Supplemental Briefs; Identifying Hearing Issues and Requesting Evidentiary Presentations on Specific Issues) of November 6, 2006, the Atomic Safety and Licensing Board ("Board") identified a series of hearing issues on which the Board has required testimony and presentations from the NRC Staff. The Staff submitted its pre-filed testimony on November 20, 2006. *See* NRC Staff Pre-Filed Testimony Concerning Hearing Issue G: Evaluation of Plant Parameter Envelope" (Nov. 20, 2006). Have you reviewed the Staff's testimony on Hearing Issue G?

A5. (JGC, AJS, GAZ) Yes.

Q6. During the October 31, 2006, pre-hearing conference, the Board expressly authorized the Applicant, as appropriate, to submit supplemental prefiled testimony for the limited purpose of clarifying and/or providing additional factual information that may inform the Board's mandatory hearing review and decision-making process. *See* Transcript of October 31, 2006, Pre-hearing Conference at 8. Do you wish to provide any such supplemental testimony at this time?

A6. (JGC, AJS, GAZ) No. We will be available, however, to respond orally to any questions germane to Hearing Issue G that the Board may pose to the Applicant during the forthcoming evidentiary hearing.

1-WA/2661430.2

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	ASLBP No. 04-823-03-ESP

PRE-FILED TESTIMONY OF GEORGE A. ZINKE, MARVIN MORRIS, JOHN G. CESARE, WILLIAM R. LETTIS, AND JEFFREY L. BACHHUBER ON BEHALF OF APPLICANT CONCERNING HEARING ISSUE H (CONTINUITY BETWEEN THE ESP STAGE AND COL STAGE)

Q1. Please state your name, current position, and by whom you are employed.

A1. My name is George A. Zinke ("GAZ"). I am employed as the Project Manager, Business Development, for Entergy Nuclear, Inc.

A1. My name is Marvin Morris ("MM"). I am employed as a consulting engineer and analyst for ENERCON Services, Inc.

A1. My name is John G. Cesare ("JGC"). I am employed as Lead Licensing Project Engineer for ENERCON Services, Inc.

A1. My name is William R. Lettis ("WRL"). I am employed as the President and Principal Geologist of William Lettis & Associates, Inc.

A1. My name is Jeffrey L. Bachhuber ("JLB"). I am employed as the Vice President, Senior Principal Engineering Geologist of William Lettis & Associates, Inc.

Q2. On whose behalf are you testifying in this proceeding?

A2. (GAZ, MM, JGC, WRL, JLB) We are providing testimony on behalf of the applicant in this early site permit ("ESP") proceeding, System Energy Resources, Inc. ("SERI" or the "Applicant").

Q3. Please describe your professional qualifications.

A3. (GAZ) I hold a B.S. degree in Electrical Engineering from Wichita State University. I have 30 years of technical and management experience in the commercial nuclear power industry. Since 2001, as a Project Manager with Entergy Nuclear, Inc., I have focused principally on licensing matters involving the company's Grand Gulf Nuclear Station ("GGNS") ESP and combined operating license ("COL") Development projects, as well as the NuStart COL Development Project. Prior to that, I held various managerial and supervisory positions at the Maine Yankee, River Bend, and GGNS facilities, where I was responsible for overseeing various licensing, system engineering, quality assurance, worker concerns, emergency preparedness, and environmental programs related to facility construction, operation, and decommissioning. A full statement of my professional qualifications is contained in SERI Exhibit 1.

A3. (MM) I hold a B.S. degree in Mathematics from the University of Texas, Pan American, and an M.S. degree in Physics from Sam Houston State University. I have over 30 years of experience in the nuclear industry in areas of design, analysis, licensing and operations support. A full statement of my professional qualifications is contained in SERI Exhibit 1.

A3. (JGC) I hold a B.S. degree in Chemical Engineering and an M.S. degree in Nuclear Engineering from Mississippi State University. I have over 24 years of experience in the nuclear power industry, including experience in the areas of new reactor, operational and decommissioning licensing; special projects; organizational assessment; and management support. This includes ten years of supervisory and management experience at a Boiling Water

Reactor ("BWR") facility. A full statement of my professional qualifications is contained in SERI Exhibit 1.

A3. (WRL) I hold a Ph.D. and an M.S degree in Geology from the University of California, Berkeley, and a B.S. degree in Geology and a B.S. degree in Forestry from Humboldt State University. I have over 20 of years experience performing regional and site investigations to assess geologic and seismic hazards for large engineered facilities, including bridges, dams, nuclear and fossil fuel plants, pipelines, and Liquid Natural Gas ("LNG") terminals. A full statement of my professional qualifications is contained in SERI Exhibit 1.

A3. (JLB) I hold an M.S. and B.A. degrees in Geology from San Jose State University. I am a Certified Engineering Geologist in California with over 20 years of professional experience performing geologic/geotechnical studies for nuclear and other critical facilities throughout the United States, Peru, Dominican Republic, Puerto Rico, Korea, Indonesia, Japan, and Turkey. I have performed detailed site investigations in a variety of geologic settings, in addition to regional hazard mapping and facility siting and routing studies. These projects involved assessment of earthquake hazard and sources, fault rupture and ground failure analysis, slope stability analysis and mitigation design, karst and void identification and treatment, foundation characterization with borings and geophysical techniques, laboratory testing, failure mode assessment, and development of foundation criteria for detailed static and dynamic stability and site response analyses (including soil-structure interaction) A full statement of my professional qualifications is contained in SERI Exhibit 1.

Q4. Please describe your professional responsibilities with regard to the Grand Gulf ESP application, including the basis for your familiarity with that application.

A4. (GAZ) As the Project Manager, Business Development, for Entergy Nuclear, Inc., I have two different but complementary roles. Namely, I am both the NuStart Licensing Lead and the Entergy Nuclear New Plant Licensing Lead. In the former capacity, I am responsible for regulatory affairs associated with the NuStart COL Development Project. Entergy is a member of NuStart Energy Development, LLC, a consortium formed in 2004 that is seeking to facilitate the licensing, construction, and operation of new, advanced nuclear power plants in the United States. In the latter capacity, I am responsible for regulatory affairs and quality assurance associated with the Entergy COL Development Process. The acquisition of an ESP for the GGNS site is a preliminary and integral step in the Entergy COL Development Process. As such, I have overall responsibility for regulatory and engineering matters related to the Grand Gulf ESP application.

A4. (MM) As part of a larger ENERCON team, I served as a consultant to SERI and supported the development of the ESP application that seeks to demonstrate site suitability for a new commercial nuclear power plant at the GGNS site. As a senior engineer, I was responsible for analyses supporting the application in the areas of offsite hazards, atmospheric dispersion, design basis accidents, and severe accidents. My responsibilities included Sections 2.3, 3.2, and 3.3 of the SSAR and Sections 2.7, 5.4, and 7.1 of the ER.

A4. (JGC) As part of a larger ENERCON team, I served as a consultant to SERI and supported the development of the ESP application that seeks to demonstrate site suitability for a new commercial nuclear power plant at the GGNS site. As the lead licensing project engineer, I coordinated and supported the development of the safety analyses, environmental report, and emergency planning assessment for the ESP application. I also participated in site safety and environmental visits, the development of applicant responses to Nuclear Regulatory Commission

("NRC") Staff requests for additional information ("RAIs"), and the Advisory Committee on Reactor Safeguards ("ACRS") review process. My work also involved active participation in the industry ESP task force and numerous licensing-related interactions with the NRC Staff.

A4. (WRL) As Project Manager for the seismic and geotechnical work in support of the Entergy Grand Gulf ESP, my responsibilities included preparation of Sections of 2.5.1 through 2.5.6 of the Site Safety Analysis Report ("SSAR"), including seismic source characterization and probabilistic seismic hazard analysis used to develop the Safe Shutdown Earthquake ("SSE") design ground motion in compliance with Regulatory Guide 1.165, and geotechnical characterization of the site in partial compliance with Regulatory Guides 1.138 and 1.132.

A4. (JLB) I was responsible for developing detailed site geotechnical characterization for the Grand Gulf ESP site. My work regarding the Grand Gulf ESP included developing Quality Assurance/Quality Control ("QA/QC") technical procedures and workplans to guide all field and laboratory activities, directing field investigations consisting of geologic mapping, deep mud rotary borings, Cone Penetrometer Test ("CPT") soundings, and borehole P-S velocity surveys. I also prepared Sections 2.5.4 to 2.5.6 for the SAR, responded to NRC RAIs, and presented the project to the ACRS in a formal meeting.

Q5. In an Order (Requesting Specific Summary Exhibits and Supplemental Briefs; Identifying Hearing Issues and Requesting Evidentiary Presentations on Specific Issues) of November 6, 2006, the Atomic Safety and Licensing Board ("Board") identified a series of hearing issues on which the Board has required testimony and presentations from the NRC Staff. The Staff submitted its pre-filed testimony on November 20, 2006. *See* NRC Staff Pre-Filed

Testimony Concerning Hearing Issue H: "Continuity Between The Esp Stage And Col Stage" (Nov. 20, 2006). Have you reviewed the Staff's testimony on Hearing Issue H?

A5. (GAZ, MM, JGC, WRL, JLB) Yes.

Q6. During the October 31, 2006, pre-hearing conference, the Board expressly authorized the Applicant, as appropriate, to submit supplemental pre-filed testimony for the limited purpose of clarifying and/or providing additional factual information that may inform the Board's mandatory hearing review and decision-making process. *See* Transcript of October 31, 2006, Pre-hearing Conference at 8. Do you wish to provide any such supplemental testimony at this time?

A6. (JGC) Yes. I am offering supplemental testimony with respect to Answer 4 and Exhibit 8 of the Staff's pre-filed testimony.

A6. (WRL, JLB) Yes. We are offering supplemental testimony with respect to Answer 5 of the Staff's pre-filed testimony.

A6. (GAZ, MM) No. We are prepared, however, to respond orally to any questions germane to Hearing Issue H that the Board may ask of us during the evidentiary hearing.

Q7. Turning to Answer 4 and Exhibit 8 of the Staff's pre-filed testimony, please provide any additional information that you believe is necessary.

A7. (JGC) In Answer 4 and Exhibit 8, the Staff states that COL Action Items "call for a set of design information to be provided by any future applicant referencing the ESP." By way of clarification, COL Action Items directly or indirectly deal with design-related issues and information. Some COL Action Items call for obtaining site characterization information at COL that would subsequently be used to confirm the adequacy of design or used in an analysis of a design related matter. For example, COL Action Item 2.3-2 requires the applicant to evaluate dispersion of airborne radioactive materials to the control room. Control room X/Q is a site characteristic, but is dependent on design information and site meteorological information (FSER 2.3.4.3 at 2-57). Moreover, these items constitute information requirements only and an applicant may depart from or omit COL Action Items, provided that the departure or omission is identified and justified in the FSAR. *See* FSER at A-4.

Q8. Turning to Answer 5 of the Staff's pre-filed testimony, please provide any additional information that you believe is necessary.

A8. (JLB, WRL) In Answer 5 of the Staff's pre-filed testimony, the Staff states that a reactor referencing the ESP would be about 140 ft. below grade (Elevation -5 feet), and that soil above Elevation -5 ft. needs to be removed to allow the construction of the foundation mat. This response provides additional clarification of this statement.

Foundation Depth

The Environmental Report plant parameters envelope (PPE; Table 3.0-1) lists the ESP bounding foundation embedment depth as 140 feet. This depth is the maximum depth of the bottom of the foundation basemat, as measured from the finished plant grade (assumed at approximately elevation 133 feet above mean sea level (MSL)) for any reactor design considered in the ESP Application. The relative location and elevation of this bounding depth with respect to the existing ground surface is shown on SSAR Figures 2.5-75 through 2.5-77 (geologic cross sections A-A', B-B', and C-C'), and labeled as "likely maximum foundation depth range within Proposed PPBA" (Proposed Power Block Area). The corresponding elevation of this maximum bounding embedment depth is approximately elevation (-)7 feet MSL.

Other plant technologies considered in the ESP Application have basemat elevations that are shallower than the bounding embedment depth, typically within the range of about 30 to 70 feet below finished plant grade. The stability and foundation suitability of subsurface materials that occur between assumed finished plant grade and the bounding maximum foundation depth range (and below this depth range throughout the likely range of foundation influence) were specifically evaluated with respect to the varying technologies and possible embedment depths. This evaluation included compilation and review of about twenty existing borings from the Unit 1 Updated Final Safety Analysis Report ("UFSAR") that are within and adjacent to the ESP reactor building envelope (*See* SERI Exhibit 3; SSAR Figure 2.5-69), drilling and sampling of three ESP borings, four ESP cone penetrometer soundings, seismic velocity surveys in the ESP borings, and laboratory static and dynamic testing of ESP borehole samples. On the basis of this evaluation, Section 2.5.4.6 of the SSAR recommends that the plant foundations be founded in Upland Complex alluvium at, or below, the bottom of loess deposits at approximately elevation 97 feet MSL (depth of 36 feet) or lower.

Responses provided by the NRC staff in pre-filed testimony on this hearing issue reference foundation embedment depths of between 120 and 140 feet (average depth of 130 feet). This depth correlates to the PPE bounding embedment depth for ESP foundations, rather than a minimum or design depth that could be at shallower depths according to the ESP evaluation.

Shear Wave Velocity

Some plant designs considered in the ESP Application reference a minimum 1,000 feet-per-second ("fps") shear wave velocity ("Vs") requirement for soils below the safety-related plant foundation basemat. Shear wave measurements of site subsurface materials were obtained by borehole P-S suspension surveys in each of the three ESP borings distributed within the proposed reactor building envelope (SSAR Figure 2.5-80). Based on the results from the ESP velocity surveys, Section 2.5.4.6 of the SSAR states that the average Vs exceeds 1,000 fps (in Upland Complex Alluvium) at, and below, approximately elevation 97 feet MSL (depth of about 36 feet below assumed finished plant grade elevation 133 feet MSL). Plant basemat (foundation) elevations above this level would require overexcavation and replacement of soils down to material exhibiting a minimum shear wave velocity of 1,000 fps, or alternatively, in-situ ground improvement (*e.g.* grouting) and/or further engineering design analyses.

Q.9 Does this conclude your testimony?

A.9 (JGC, WRL, JLB) Yes.

1-WA/2661778.2

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	ASLBP No. 04-823-03-ESP

PRE-FILED TESTIMONY OF MARVIN MORRIS AND JOHN CESARE ON BEHALF OF APPLICANT CONCERNING HEARING ISSUE I (RADIOLOGICAL REVIEWS AND CONFIRMATORY ANALYSES)

Q1. Please state your name, current position, and by whom you are employed.

A1. My name is Marvin Morris ("MM"). I am employed as a consulting engineer and analyst for ENERCON Services, Inc.

A.1 My name is John G. Cesare ("JGC"). I am employed as Lead Licensing Project Engineer for ENERCON Services, Inc.

Q2. On whose behalf are you testifying in this proceeding?

A2. (MM, JGC) We are providing testimony on behalf of the applicant in this early site permit ("ESP") proceeding, System Energy Resources, Inc. ("SERI" or the "Applicant").

Q3. Please describe your professional qualifications.

A3. (MM) I hold a B.S. degree in Mathematics from the University of Texas, Pan American, and an M.S. degree in Physics from Sam Houston State University. I have over 30 years of experience in the nuclear industry in areas of design, analysis, licensing and operations support. A full statement of my professional qualifications is contained in SERI Exhibit 1.

A3. (JGC) I hold a B.S. degree in Chemical Engineering and an M.S. degree in Nuclear Engineering from Mississippi State University. I have over 24 years of experience in the nuclear power industry, including experience in the areas of new reactor, operational and decommissioning licensing; special projects; organizational assessment; and management support. This includes ten years of supervisory and management experience at a Boiling Water Reactor ("BWR") facility. A full statement of my professional qualifications is contained in SERI Exhibit 1.

Q4. *Please describe your professional responsibilities with regard to the Grand Gulf Nuclear Station ("GGNS") ESP application, including the basis for your familiarity with that application.*

A4. (MM) As part of a larger ENERCON team, I served as a consultant to SERI and supported the development of the ESP application that seeks to demonstrate site suitability for a new commercial nuclear power plant at the GGNS site. As a senior engineer, I was responsible for analyses supporting the application in the areas of offsite hazards, atmospheric dispersion, design basis accidents, and severe accidents. My responsibilities included Sections 2.3, 3.2, and 3.3 of the SSAR and Sections 2.7, 5.4, and 7.1 of the ER.

A4. (JGC) As part of a larger ENERCON team, I served as a consultant to SERI and supported the development of the ESP application that seeks to demonstrate site suitability for a new commercial nuclear power plant at the GGNS site. As the lead licensing project engineer, I coordinated and supported the development of the safety analyses, environmental report ("ER"), and emergency planning assessment for the ESP application. I also participated in site safety and environmental visits, the development of applicant responses to Nuclear Regulatory Commission ("NRC") Staff requests for additional information ("RAIs"), and the Advisory Committee on

Reactor Safeguards ("ACRS") review process. My work also involved active participation in the industry ESP task force and numerous licensing-related interactions with the NRC Staff.

Q5. In its Order (Requesting Specific Summary Exhibits and Supplemental Briefs; Identifying Hearing Issues and Requesting Evidentiary Presentations on Specific Issues) of November 6, 2006, the Atomic Safety and Licensing Board ("Board") identified a series of hearing issues on which the Board has required testimony and presentations from the NRC Staff. The Staff submitted its pre-filed testimony on November 20, 2006. *See* NRC Staff Pre-Filed Testimony Concerning Hearing Issue I: "Radiological Reviews And Confirmatory Analyses" (Nov. 20, 2006). Have you reviewed the Staff's testimony on Hearing Issue I?

A5. (MM, JGC) Yes.

Q6. During the October 31, 2006, pre-hearing conference, the Board expressly authorized the Applicant, as appropriate, to submit supplemental pre-filed testimony for the limited purpose of clarifying and/or providing additional factual information that may inform the Board's mandatory hearing review and decision-making process. *See* Transcript of October 31, 2006, Pre-hearing Conference at 8. Do you wish to provide any such supplemental testimony at this time?

A6. (MM, JGC) Yes. We are offering supplemental testimony with respect to Answer 3 of the Staff's pre-filed testimony. Specifically, we have augmented the discussion of the Applicant's and the Staff's radiological analyses of normal gaseous and liquid effluent releases.

Q7. Please describe the Applicant's and the Staff's analyses with respect to gaseous radiological effluent releases.

A7. (MM, JGC) For the gaseous release pathway, SERI and the Staff calculated annual radiation exposures for the population within a 80-km (50-mi) radius of the site and for hypothetical individuals of various ages, by using the GASPAR II code and assuming the following pathways:

- direct radiation from immersion in the gaseous effluent cloud and from particulates deposited on the ground;
- inhalation of gases and particulates;
- ingestion of milk contaminated through the grass-cow-milk pathway;
- ingestion of vegetables contaminated by particulates; and
- ingestion of meat from animals grazing on contaminated pasture.

The methodology contained in the GASPAR II program, which is described in NUREG/CR-4653, "GASPAR II – Technical Reference and User Guide" (Mar. 1987), was used to determine the gaseous pathway doses. This program implements the radiological exposure models described in Regulatory Guide 1.109, Revision 1, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 C.F.R. Part 50, Appendix I" (Oct. 1977) for radioactivity releases in gaseous effluents.

Three types of doses were calculated by the Staff and compared with SERI's calculations. Those doses include:

- doses to an individual located at the exclusion area boundary of 0.93 km (0.58 mi) north of the site as a result of gamma air dose, beta air dose, total body dose and skin dose;
- doses to hypothetical individuals (maximally exposed individual) of various ages that are exposed to gaseous radioactive effluents via the pathways listed above; and
- doses to the population residing within an 80-km (50-mi) radius of the site.

The input data for the dose analysis are summarized in the table below.

Input Description	Location of Data (SSAR)	Data Source
Source Term	Table 1.3-2	Composite release
Population Data	Section 2.1	Projected population at the end of plant life – i.e., 2070
Meteorological Data	Section 2.3	GGNS site data
Consumption Factors	Table 3.2-2	Regulatory Guide 1.109, Table E-5.
Milk Production within 5 miles	Table 3.2-6	Land use survey
Meat Production within 5 miles	Table 3.2-7	Land use survey
Vegetable Production within 5 miles	Table 3.2-8	Land use survey

For parameters that are not site-specific, the Applicant used default values from Regulatory Guide 1.109

The results of the Applicant's dose analysis are provided in Site Safety Analysis Report ("SSAR") Table 3.2-3A, "ANNUAL DOSE TO A MAXIMALLY EXPOSED INDIVIDUAL FROM GASEOUS EFFLUENTS (Per Unit)", and SSAR Table 3.2-4, "ANNUAL POPULATION DOSES - GASEOUS PATHWAY." These results are within the regulatory design objectives. The Staff concluded that there would be no observable health impacts due to normal gaseous releases from a new nuclear plant and, therefore, that the health impacts would be SMALL. *See* FEIS at 5-58.

Q8. Please describe the Applicant's and the Staff's evaluations with respect to liquid radiological effluent releases.

A8. The release of small amounts of radioactive liquid effluents currently is permitted at GGNS, and would be expected to be permitted for the new facility at the GGNS ESP Site, as long as releases comply with the requirements specified in 10 C.F.R. Part 20. The important exposure pathways include:

- internal exposure from ingestion of water or contaminated food chain components;
- external exposure from the surface of contaminated water or from shoreline sediment; and
- external exposure from immersion in contaminated water.

The LADTAP II computer program, as described in NUREG/CR-4013, "LADTAP II—Technical Reference and User Guide" (Apr. 1986), and the liquid pathway parameters presented in ER Table 5.4-1, were used by the Staff and SERI to calculate the maximally exposed individual dose from this pathway. The LADTAP II program implements the radiological exposure models described in Regulatory Guide 1.109, Revision 1, for radioactivity releases in liquid effluents. The input parameters used are listed below:

LIQUID PATHWAY PARAMETERS[4]

Description	**Parameter**
Effluent Discharge [1]	12,800 gpm
Source Term [2]	Isotope Maximum Composite Release
Commercial Fish Catch [3]	446,467 kg
Invertebrate Harvest [3]	3,511 kg

NOTES:
1. ER Table 3.0-1.
2. ER Table 3.0-8.
3. GGNS Unit 1 FER.
4. ER Table 5.4-1.

Consumption Factors were obtained from NRC Regulatory Guide 1.109, Table E-5.

The results of this analysis are given in ER Table 5.4-8, "Liquid Pathway Comparison of Maximum Individual Dose to 10 Cfr 50, Appendix I Criteria" and ER Table 5.4-10, "Estimated Population Dose from Liquid Effluents via the Aquatic Food Pathway." These results are within the regulatory design objectives. The Staff concluded that there would be no observable health impacts due to normal liquid releases from a new nuclear plant and therefore the health impacts would be SMALL. *See* FEIS at 5-58.

Q9. Does this conclude your prefiled testimony on Hearing Issue I?

A9. (MM, JGC) Yes.

1-WA/2661933.1

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the matter of	)	Docket No. 52-009-ESP
	)	
SYSTEM ENERGY RESOURCES, INC.	)	ASLBP No. 04-823-03-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	November 28, 2006

AFFIDAVIT OF JEFFREY L. BACHHUBER

I, Jeffrey L. Bachhuber, do hereby state as follows:

1. I am employed as the Vice President, Senior Principal Engineering Geologist of William Lettis & Associates, Inc.

2. I hold M.S. and B.A. degrees in Geology from San Jose State University. I am a Certified Engineering Geologist in California with over 20 years of professional experience performing geologic/geotechnical studies for nuclear and other critical facilities throughout the United States, Peru, Dominican Republic, Puerto Rico, Korea, Indonesia, Japan, and Turkey. I have performed detailed site investigations in a variety of geologic settings, in addition to regional hazard mapping and facility siting and routing studies. These projects involved assessment of earthquake hazard and sources, fault rupture and ground failure analysis, slope stability analysis and mitigation design, karst and void identification and treatment, foundation characterization with borings and geophysical techniques, laboratory testing, failure mode assessment, and development of foundation criteria for detailed static and dynamic stability and site response analyses (including soil-structure interaction). A full statement of my professional qualifications is contained in SERI Exhibit 1.

3. I was responsible for developing detailed site geotechnical characterization for the Grand Gulf ESP site. My work regarding the Grand Gulf ESP included developing quality assurance/quality control ("QA/QC") technical procedures and workplans to guide all field and laboratory activities, directing field investigations consisting of geologic mapping, deep mud rotary borings, cone penetrometer soundings and borehole P-S velocity surveys. I also prepared Sections 2.5.4 to 2.5.6 for the site safety analysis report ("SSAR"), responded to Nuclear Regulatory Commission ("NRC") requests for additional information ("RAIs"), and presented the project to the Advisory Committee on Reactor Safeguards ("ACRS") in a formal meeting.
4. I have primary technical responsibility for those portions of the Applicant's Prefiled Direct Testimony on Hearing Issues A, C, D, and H marked with my initials ("JLB").
5. I attest to the accuracy of these statements, support them as my own, and endorse their introduction into the record of the above-captioned proceeding. In accordance with 28 U.S.C. §1746, I declare under penalty of perjury that those statements, and my statements in this affidavit, are true and correct to the best of my knowledge, information, and belief.

Jeffrey L. Bachhuber

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

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	)	
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	)	
(Early Site Permit for Grand Gulf ESP Site)	)	November 28, 2006

AFFIDAVIT OF DAVID J. BEAN

I, David J. Bean, do hereby state as follows:

1. I am employed as a Senior Environmental Scientist for ENERCON Services, Inc.
2. I hold an M.S. degree in Zoology from the Ohio State University, and a B.A. degree in Biology from the State University of New York at Oswego. I have over 30 years of experience in the Environmental Industry, and am well-versed in environmental impact analysis/assessment, the National Environmental Policy Act ("NEPA"), and Strategic Environmental Management. I have extensive experience performing environmental safety and health ("ES&H") compliance strategy development, site evaluation and selection planning, risk assessment/analysis, and waste management. A full statement of my professional qualifications is contained in SERI Exhibit 1.
3. I have primary technical responsibility for those portions of the Applicant's Prefiled Direct Testimony on Hearing Issue F marked with my initials ("DJB").
4. I attest to the accuracy of these statements, support them as my own, and endorse their introduction into the record of the above-captioned proceeding. In accordance with 28 U.S.C. §1746, I declare under penalty of perjury that those statements, and my

statements in this affidavit, are true and correct to the best of my knowledge, information, and belief.

David J. Bean

UNITED STATES OF AMERICA
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	)	
(Early Site Permit for Grand Gulf ESP Site)	)	November 28, 2006

AFFIDAVIT OF MICHAEL D. BOURGEOIS

I, Michael D. Bourgeois, do hereby state as follows:

1. I am employed as the Manager of Project Management for Entergy Nuclear, Inc.
2. I hold a B.S. degree in Nuclear Engineering Technology from Thomas Edison State College. I have over 37 years of commercial and military nuclear experience. My experience includes project and outage management, nuclear reactor operation, and work control. A full statement of my professional qualifications is contained in SERI Exhibit 1.
3. I have primary technical responsibility for those portions of the Applicant's Prefiled Direct Testimony on Hearing Issues E and G marked with my initials ("MDB").
4. I attest to the accuracy of these statements, support them as my own, and endorse their introduction into the record of the above-captioned proceeding. In accordance with 28 U.S.C. §1746, I declare under penalty of perjury that those statements, and my statements in this affidavit, are true and correct to the best of my knowledge, information, and belief.

Michael D. Bourgeois

UNITED STATES OF AMERICA
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	)	
(Early Site Permit for Grand Gulf ESP Site)	)	November 28, 2006

AFFIDAVIT OF JOHN G. CESARE

I, John G. Cesare, do hereby state as follows:

1. I am employed as Senior Licensing Consultant for ENERCON Services, Inc.
2. I hold a B.S. degree in Chemical Engineering and an M.S. and B.S. degree in Nuclear Engineering from Mississippi State University. I have over 24 years of experience in the nuclear power industry, including experience in the areas of new reactor, operational and decommissioning licensing; special projects; organizational assessment; and management support. This includes ten years of supervisory and management experience at a boiling water reactor ("BWR") facility. A full statement of my professional qualifications is contained in SERI Exhibit 1.
3. As part of a larger ENERCON team, I served as a consultant to SERI and supported the development of the ESP application that seeks to demonstrate site suitability for a new commercial nuclear power plant at the GGNS site. As the Lead Licensing Project Engineer, I coordinated and supported the development of the safety analyses, environmental report, and emergency planning assessment for the ESP application. I also participated in site safety and environmental visits, the development of applicant responses to Nuclear Regulatory Commission ("NRC") Staff requests for additional information ("RAIs"), and the Advisory Committee on Reactor Safeguards ("ACRS") review process.

My work also involved active participation in the industry ESP task force and numerous licensing-related interactions with the NRC Staff.

4. I have primary technical responsibility for those portions of the Applicant's Prefiled Direct Testimony on Hearing Issues E, F, G, H, and I, that are marked with my initials ("JGC").

5. I attest to the accuracy of these statements, support them as my own, and endorse their introduction into the record of the above-captioned proceeding. In accordance with 28 U.S.C. §1746, I declare under penalty of perjury that those statements, and my statements in this affidavit, are true and correct to the best of my knowledge, information, and belief.

John G. Cesare

UNITED STATES OF AMERICA
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AFFIDAVIT OF LORI M. EVANS

I, Lori M. Evans, do hereby state as follows:

1. I am employed as Senior Project Manager for ENERCON Services, Inc. I hold a B.S. degree in Geology from Tennessee Technological University. I have over 14 years of experience that includes project management, a varied technical background, and environmental risk analysis. I have acted as task leader for hydrologic analyses for a proposed expansion of an existing nuclear power plant, have assisted in development of new bank environmental policy guidance documents, and have been responsible for managing multiple-site Phase I environmental site assessment projects. A full statement of my professional qualifications is contained in SERI Exhibit 1.
2. I am task leader for the hydrologic analysis sections of the Grand Gulf ESP application. As task leader, I was responsible for assessing the potential impacts on the surface water and groundwater of constructing and operating a nuclear power generating facility at the Grand Gulf site.
3. I have primary technical responsibility for those portions of the Applicant's Prefiled Direct Testimony on Hearing Issues A and B marked with my initials ("LME").
4. I attest to the accuracy of these statements, support them as my own, and endorse their introduction into the record of the above-captioned proceeding. In accordance with

28 U.S.C. §1746, I declare under penalty of perjury that those statements, and my statements in this affidavit, are true and correct to the best of my knowledge, information, and belief.

Lori M. Evans

UNITED STATES OF AMERICA
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	)	
(Early Site Permit for Grand Gulf ESP Site)	)	November 28, 2006

AFFIDAVIT OF WILLIAM LETTIS

I, William R. Lettis, do hereby state as follows:

1. I hold a Ph.D. and an M.S degree in Geology from the University of California, Berkeley, and a B.S. degree in Geology and a B.S. degree in Forestry from Humboldt State University. I have over 20 years experience performing regional and site investigations to assess geologic and seismic hazards for large engineered facilities, including bridges, dams, nuclear and fossil fuel plants, pipelines, and liquid natural gas ("LNG") terminals. A full statement of my professional qualifications is contained in SERI Exhibit 1.
2. I am Project Manager for the seismic and geotechnical work in support of the Entergy Grand Gulf Nuclear Station ("GGNS") ESP. My responsibilities included preparation of Sections of 2.5.1 through 2.5.6 of the SSAR, including seismic source characterization and probabilistic seismic hazard analysis to develop the safe shutdown earthquake ("SSE") design ground motion in compliance with Regulatory Guide 1.165, and, geotechnical characterization of the site in partial compliance with Regulatory Guides 1.138 and 1.132..
3. I have primary technical responsibility for those portions of the Applicant's Prefiled Direct Testimony on Hearing Issues A, B, and H marked with my initials ("WRL").

4. I attest to the accuracy of these statements, support them as my own, and endorse their introduction into the record of the above-captioned proceeding. In accordance with 28 U.S.C. §1746, I declare under penalty of perjury that those statements, and my statements in this affidavit, are true and correct to the best of my knowledge, information, and belief.

William R. Lettis

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AFFIDAVIT OF MARVIN MORRIS

I, Marvin Morris, do hereby state as follows:

1. I am employed as a consulting engineer and analyst for ENERCON Services, Inc.
2. I hold a B.S. degree in Mathematics from the University of Texas, Pan American, and an M.S. degree in Physics from Sam Houston State University. I have over 30 years of experience in the nuclear industry in areas of design, analysis, licensing and operations support. A full statement of my professional qualifications is contained in SERI Exhibit 1.
3. As part of a larger ENERCON team, I served as a consultant to SERI and supported the development of the ESP application that seeks to demonstrate site suitability for a new commercial nuclear power plant at the GGNS site. I was responsible for analyses supporting the application in the areas of offsite hazards, atmospheric dispersion, design basis accidents, and severe accidents. My responsibilities included Sections 2.3, 3.2, and 3.3 of the SSAR and Sections 2.7, 5.4, and 7.1 of the Environmental Report ("ER").
4. I have primary technical responsibility for those portions of the Applicant's Prefiled Direct Testimony on Hearing Issues B, F, H, and I, that are marked with my initials ("MM").

5. I attest to the accuracy of these statements, support them as my own, and endorse their introduction into the record of the above-captioned proceeding. In accordance with 28 U.S.C. §1746, I declare under penalty of perjury that those statements, and my statements in this affidavit, are true and correct to the best of my knowledge, information, and belief.

Marvin Morris

Marvin Morris

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AFFIDAVIT OF AL J. SCHNEIDER

I, Alcuin J. Schneider, do hereby state as follows:

1. I am employed as the Manager of Projects for the New Plant Services Division of ENERCON Services, Inc.
2. I hold B.S. and M.S. degrees in Mechanical Engineering from the University of Arkansas. I have over 33 years of technical and management experience in the commercial nuclear power industry. This experience encompasses numerous lead and supervisory assignments in engineering, projects, technical support, preoperational and start-up testing programs, procedure upgrade and development, licensing, and outage planning and scheduling. I have provided project management and technical expertise to the Grand Gulf Nuclear Station ("GGNS") ESP project. I also have provided project management services in connection with NuStart's combined license application ("COLA") preparation project, and the NuStart Economic Simplified Boiling Water Reactor ("ESBWR") COLA preparation project. A full statement of my professional qualifications is contained in SERI Exhibit 1
3. I have primary technical responsibility for those portions of the Applicant's Prefiled Direct Testimony on Hearing Issue G marked with my initials ("AJS").

4. I attest to the accuracy of these statements, support them as my own, and endorse their introduction into the record of the above-captioned proceeding. In accordance with 28 U.S.C. §1746, I declare under penalty of perjury that those statements, and my statements in this affidavit, are true and correct to the best of my knowledge, information, and belief.

Alcuin J. Schneider

UNITED STATES OF AMERICA
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	)	
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AFFIDAVIT OF KYLE H. TURNER

I, Kyle H. Turner, do hereby state as follows:

1. I am employed as the Chief Executive Officer of McCallum-Turner, Inc.
2. I hold a B.S. degree in Electrical Engineering for the Georgia Institute of Technology, as well as Ph. D. and M.S. degrees in Nuclear Engineering, also from the Georgia Institute of Technology. I have more than 30 years experience providing technical, business, and management consulting services to commercial industry and government. My management responsibilities have ranged in budget up to $16 million and 200 professional staff. I am Principal author for the industry ESP Siting Guide, ESP Model Program Plan and COL Model Program Plan for nuclear power plants ,and am currently managing an Electric Power Research Institute ("EPRI") project to develop a model Program Plan for overall nuclear power plant development under Part 52 regulations. Since 2001, I have directed site selection studies for ten nuclear power plant sites for COL and ESP applications (Duke Power, Entergy Nuclear, Florida Power & Light, Progress Energy (2), NuStart, South Carolina Electric & Gas, and two confidential clients). A full statement of my professional qualifications is contained in SERI Exhibit 1.
3. I have primary technical responsibility for those portions of the Applicant's Prefiled Direct Testimony on Hearing Issue E marked with my initials ("KHT").

4. I attest to the accuracy of these statements, support them as my own, and endorse their introduction into the record of the above-captioned proceeding. In accordance with 28 U.S.C. §1746, I declare under penalty of perjury that those statements, and my statements in this affidavit, are true and correct to the best of my knowledge, information, and belief.

Kyle H. Turner

UNITED STATES OF AMERICA
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AFFIDAVIT OF GEORGE A. ZINKE

I, George A. Zinke, do hereby state as follows:

1. I am employed as Project Manager, Business Development, for Entergy Nuclear, Inc.
2. I hold a B.S. degree in Electrical Engineering from Wichita State University. I have 30 years of technical and management experience in the commercial nuclear power industry. Since 2001; as a Project Manager with Entergy Nuclear, Inc., I have focused principally on licensing matters involving the company's Grand Gulf Nuclear Station ("GGNS") Early Site Permit and Combined Operating License ("COL") Development projects, as well as the NuStart COL Development Project. Prior to that, I held various managerial and supervisory positions at the Maine Yankee, River Bend, and GGNS facilities, where I was responsible for overseeing various licensing, system engineering, quality assurance, worker concerns, emergency preparedness, and environmental programs related to facility construction, operation, and decommissioning. A full statement of my professional qualifications is contained in SERI Exhibit 1.
3. As Project Manager, Business Development, for Entergy Nuclear, Inc., I have two different but complementary roles. Namely, I am both the NuStart Licensing Lead and the Entergy Nuclear New Plant Licensing Lead. In the former capacity, I am responsible for regulatory affairs associated with the NuStart COL Development Project. Entergy is

a member of NuStart Energy Development, LLC, a consortium formed in 2004 that is seeking to facilitate the licensing, construction, and operation of new, advanced nuclear power plants in the United States. In the latter capacity, I am responsible for regulatory affairs and quality assurance associated with the Entergy COL and ESP Development Processes. The acquisition of an ESP for the GGNS site is a preliminary and integral step in the Entergy COL Development Process. As such, I have overall responsibility for regulatory and engineering matters related to the Grand Gulf ESP application.

4. I have primary technical responsibility for those portions of the Applicant's Prefiled Direct Testimony on Hearing Issues E, G, and H, which are marked with my initials ("GAZ").

5. I attest to the accuracy of these statements, support them as my own, and endorse their introduction into the record of the above-captioned proceeding. In accordance with 28 U.S.C. §1746, I declare under penalty of perjury that those statements, and my statements in this affidavit, are true and correct to the best of my knowledge, information, and belief.

George A. Zinke

the same thing at this point in time. I would admit those into evidence. If during the course of the proceeding the staff has an objection they can raise the objection at that time and if the objection were upheld we would then withdraw it from evidence. But for the purposes right now they are received, they are part of the record subsequent to a further order by the Board.

(Whereupon, the documents marked as SERI Exhibit Nos. 1-30 for identification were admitted into evidence.)

MS. SUTTON: Yes, Your Honor.

JUDGE MCDADE: Thank you. Okay, we are ready to proceed with Hearing Issue A. A question: do we need to take a short recess prior to that for you to just handle the administrative matters, and if so how long would you suggest? If it's only going to be a couple of minutes we might as well just stay here in place and be ready.

MS. HODGDON: Ten minutes?

JUDGE MCDADE: From the staff. Is that sufficient?

MS. SUTTON: Ten minutes would be

sufficient.

JUDGE MCDADE: Judge Trikouros, before we do that, do you have anything further?

JUDGE TRIKOUROS: Yes, just a point of clarification. You were going to submit that ESP form into the record. When would that happen? Sooner would be better than later.

MS. HODGDON: Mr. Weisman said within the next couple of days, before the hearing is over. He didn't give you an exact time.

JUDGE TRIKOUROS: All right. Well, the sooner the better. It'd be helpful to me to have it.

MS. HODGDON: Well, we don't know - the answer is we don't know exactly. As soon as we know, we will tell you.

JUDGE MCDADE: Okay. Rather than just sort of everybody sit here and stare at each other for 10 minutes, why don't we take a 10-minute recess. It is now, at least according to my watch, quarter of 10:00. We'll come back at five minutes of 10:00. Thank you. We are in recess.

(Whereupon, the foregoing matter went off the record at 9:47 a.m. and went back on the record at 10:04 a.m.)

JUDGE MCDADE: The hearing will come to order. Let me just note for the record that we had a recess. The recess was originally scheduled to go until 9:55. We were advised that they would need an additional five minutes so we extended it to 10:00. We're now advised that we're going to be needing an additional 10 minutes to sort of get the paperwork together. I just wanted to note for the people who are here that we are going to go back into recess and will come back in at 10 minutes past 10:00 so that if anybody has any other business to take care of we're going to be in recess until 10 minutes past 10:00. If you believe that you are going to need any additional time, just tell Ms. Wolf so that we can extend the recess. But hopefully we can get started promptly at 10 past 10:00. We are in recess.

(Whereupon, the foregoing matter went off the record at 10:05 a.m. and went back on the record at 10:17 a.m.)

JUDGE MCDADE: The hearing will come to order. The first order of business at this point would be beginning with Hearing Issue A. We had advised in our preliminary hearings that prior to the presentation of the testimony if the staff wished to make a brief opening statement what they would be presenting they would be allowed to do so, and then the applicant would have an opportunity to do so as well either directly after the staff or at the conclusion. Do you wish to make an opening with regard to Hearing Issue A?

MR. RUND: We have no opening statement, but we'd like to introduce who's up there. I believe the applicant's witnesses on Hearing Issue A are also sitting with us. So after I introduce our witnesses I'd like to hand it over to the applicant.

JUDGE MCDADE: That's fine.

MR. RUND: The staff's panel for Hearing Issue A which deals with site characterization consists of Lance Vail, Goutam Bagchi and Thomas Cheng. Also with us is Carl Constantino who assisted Dr. Cheng in preparing his testimony.

JUDGE MCDADE: Okay, thank you. From the standpoint of SERI, do you have any opening statement to make?

MS. SUTTON: Your Honor, we have called as witnesses by way of background Lori Evans, William Lettis and Jeffrey Bachhuber. We don't - I just have some preliminary administrative matters if you would like to run through to introduce them as witnesses, but no, we have no opening statement on this.

JUDGE MCDADE: Why don't you go ahead and do that at this point.

MS. SUTTON: All right. Would you just briefly introduce yourselves to the Board?

WITNESS EVANS: My name is Lori Evans. I work for Enercon Services and I'm here on behalf of SERI.

WITNESS LETTIS: I'm William Lettis. I work with William Lettis & Associates, principal geologist and I'm here on behalf of SERI.

WITNESS BACHHUBER: I'm Jeff Bachhuber with William Lettis & Associates, principal engineering geologist, representing SERI.

JUDGE MCDADE: Okay. We have received the pre-filed testimony of each of these individuals. We have also received curriculum vitae with regard to each of these individuals. There being no objection from either side we will recognize and accept them as experts in the field for which they are offered and will accept opinion testimony from them as experts. There's no objection from the staff?

MR. RUND: No. I would like to point

out though, all of our statements of professional qualifications are in one document labeled Staff 13. Dr. Constantino's statement of professional qualifications is separately in Staff 14. Also, since we - it slipped my mind, I think we'd like to have all of our witnesses introduce ourselves for the court reporter.

JUDGE MCDADE: Well, we would also ask not only to introduce yourself initially for the court reporter, but when you do make a statement, assuming that you're familiar with your name, you've used it a long time, the court reporter may not be, even though you've introduced yourself. So if you could, just preface your statement by giving your name to make sure that the statement you give is attributed to you. You may want to do that because you may disagree with the statement of one of your colleagues and not want to have it attributed to you. So please, when you do make a statement, just preface it by your name and then go ahead. But gentlemen representing the staff, if you could identify yourselves?

WITNESS CONSTANTINO: I'm Carl Constantino, a professor at City University of New York and consultant to Brook Haven National

Laboratory.

WITNESS CHENG: My name is Thomas Cheng, senior structural engineer in the Geosciences Center in civil engineering branch.

WITNESS BAGCHI: My name is Goutam Bagchi. I'm a senior level advisor in Division of Engineering and I was responsible for the review in the hydrology area.

WITNESS VAIL: My name is Lance Vail. I'm a senior research engineer at Pacific Northwest National Laboratory in the hydrology group.

JUDGE MCDADE: Okay, thank you. At this point, could all seven of you please stand to be sworn? And we will do this just once for all seven of you and basically what I'm going to be asking you is do you state under penalty of perjury that the testimony you give will be true and correct?

WHEREUPON,

LANCE VAIL
CARL CONSTANTINO
GOUTAM BAGCHI
LORI EVANS
WILLIAM LETTIS
JEFF BACHHUBER

were duly sworn and assumed the witness stand.

JUDGE MCDADE: Okay, please be seated, you are under oath. Is the staff ready to proceed?

MR. RUND: Yes, we are.

JUDGE MCDADE: Judge Wardwell is going to be beginning with the questioning of the Board on Hearing Issue A.

JUDGE WARDWELL: I have a number of things and I thought the best way to focus it was to create hypothetical hypotheses that I think need to be refuted in order to comfort myself in regards to some concerns I have in regards to the site characterization. I will present those to you when the time's appropriate so that you can tailor any response that you have in accordance with those hypotheses under each section that we're dealing with, but I thought it might be useful to start off with, to just have anyone who wishes to to start off by just describing the various geologic strata that exist between the Mississippi River and the power block area extending all the way to the existing plant for that matter, naming the various layers, referencing whatever exhibit is best for us to follow along with and hopefully we'll be able to pull it up or you can pull it up on your computer also if you want to hook that up. And just step us through what's there, what depths they're at, how does that relate to the PPE for any foundation exploration or foundation depth, just any background information to get everyone oriented to some of the site characteristics in the geologic end.

WITNESS CHENG: Your Honor, may I ask my consultant Dr. Constantino to respond to this question?

JUDGE WARDWELL: Make sure you - I can hear you, but I want to make sure everyone else can hear you, so pull that mic real close and talk into it in good shape, so.

JUDGE MCDADE: And also again, let me reiterate, when you are making a statement to state your name first. That statement was made by Dr. Cheng and he is now referring the matter to his colleague. Sir?

WITNESS CONSTANTINO: I'm Carl Constantino. The issue of description of the site is provided in the various engineering reports. Basically there's a surficial layer if I recall of loess, followed by a series of alluvium layers, followed by a very much stiffer Catahoula formation. The extent of the site to hard rock conditions is - I should say hard rock conditions are very deep so you have this generic site which extends to thousands of feet.

JUDGE WARDWELL: Is there a good cross-section we should be looking at that would assist us in this description?

WITNESS CONSTANTINO: Yes. I think if you look at Figure 25.

JUDGE WARDWELL: And it'd be best if you could -

WITNESS CONSTANTINO: 2576 and -7 have generic profiles that were generated from the ESP.

MR. RUND: Just for clarification, 25-75 is labeled as Staff Exhibit 40. 2.5-76 is Staff 41.

JUDGE MCDADE: Thank you.

WITNESS CONSTANTINO: Following these cross-sections that were provided, these cross-sections were built up from the ESP borings that were - and cone penetrometers that were generated at the site together with a significant amount of data from the previous explorations that were done for the existing plant. As you can see from those figures, the upper surface elevation is at approximately Elevation 130, 135. And that loess material which is shown on 2.5-76 in yellow extends down to Elevation 60 or so, and then followed by a series of alluvium layers of various characterizations. Some are fine grain, some are fine grain intermixed with gravels.

JUDGE MCDADE: Actually, sorry, if I could interrupt you for just a second, just an administrative question I have. We received an electronic copy of it that we can look at electronically here. We can't send it out to the well. We've also got paper copies. I know you all, you know, were going to bring laptops. If it is possible for you to flip that up so that the people present could see these figures as well and do it relatively easily. I don't want to interrupt the testimony or delay the testimony, but if it's readily available that you can hook it in so that it's available to the people in the audience I would appreciate it. As I've said, we've got it up here but we can't send it out to the audience.

MR. RUND: We have a laptop with that electronically. I think it'll just take a minute if we - are you suggesting we plug it in?

JUDGE MCDADE: Yes. Why don't we keep going with the testimony and just if you could be plugging it in and that way, you know, at the earliest possibility without delaying things, you know, the people in the back who are here, it's an awful lot easier to follow the testimony if you're also looking at the exhibit as well. So as I said, we can proceed because the members of the Board and you all have copies of it, but if we can send it out to the audience as well conveniently.

MR. RUND: We'll start on that.

JUDGE MCDADE: I'm sorry for the interruption.

WITNESS CONSTANTINO: Should I continue? Okay.

JUDGE MCDADE: If it's not going to disturb you to have them fiddling with the computer.

WITNESS CONSTANTINO: Very little disturbs me.

JUDGE MCDADE: Okay.

WITNESS CONSTANTINO: In any case, the interesting part of this figure is not only the description of the site profiles in the upper echelon of the - the soil layering in the upper echelons of the site profile, which is, this is only the top several hundred feet of profile which extends, as I said, to thousands of feet to hard rock. The interesting part of the figure is the sketch of an intended depth of the foundation for any new plant, approximate depth of the foundation of any new plant that would be sited. And it's indicated that any new plant would be sited well below the loess material.

Of the generic three profiles we have, the loess, the alluvium and the Catahoula, the loess is the most problematic from a design perspective since it tends to be the softest, the finest material and one which would have difficulty in providing adequate foundation capacity to any plant situated basically on the loess. When you get to alluvium strengths tend to be higher and the Catahoula has much higher strength. So the only additional material at the site which is indicated on this figure are the fill materials, which are indicated to be in the upper echelons, the upper parts of the site. Those were placed in - based on the SERI descriptions in an uncontrolled manner. Their properties are not well known, but they would have - judged to have little impact on any foundation designs since they're so high in the profile.

JUDGE WARDWELL: On that cross-section which I assume will have a profile I guess it is, there are various numbers listed there as opposed to the actual formation and they refer to descriptions down below.

WITNESS CONSTANTINO: Right.

JUDGE WARDWELL: Could you go through which numbers relate to what and what it's called now and what it will be called in the future?

WITNESS CONSTANTINO: I'll try as best I could. Zone Material 1 is this uncontrolled fill material which is at near-surface in the profile. Zone Number 2 is the loess material which extends to depth or elevations of about Elevation 70 which approximately then with the surface at 130, approximately 60 or 70 feet of loess material, which is just Aeolian material, windblown, relatively uniform across the site. The Material 3 is the colluvium or alluvium deposits which are located across the site. The additional layers shown on this Figure 2b and 2c are off to the side of the site and would not have a direct impact on any plant location since they are under the Mississippi River. And Zone 4 is the old alluvium, the Upland Complex, very stiff material. You could tell that from the measured blow counts, SPT blow counts as well as velocity measurements. And below that is the Catahoula formation which is very stiff. And

Catahoula is in fact not shown on Figure 76.

JUDGE WARDWELL: At about what elevation and ranges do - is the Catahoula encountered?

WITNESS CONSTANTINO: The Catahoula, there was only one location encountered from the ESP borings that I recall, and the Catahoula is of the order of 140 feet below grade I think is the number. And that was, as I say, encountered in only one boring taken for the ESP profile. There was one SPT sample if I recall that encountered the Catahoula and it was very high blow count. Catahoula is generally characterized as a silt stone/clay stone material, very stiff, very dense.

JUDGE WARDWELL: So at 140 feet below the grade, the existing grade that the boring was made was anywhere between what, 130 to 140?

WITNESS CONSTANTINO: One hundred thirty to 140 was the deepest investigation.

JUDGE WARDWELL: I'm trying to get how - what's the elevation of that level.

WITNESS CONSTANTINO: Well, if the grade is at 135 and I go down 140, it's somewhere of the order of zero if my arithmetic works.

WITNESS LETTIS: Excuse me.

JUDGE WARDWELL: Zero to -5 or -10.

WITNESS LETTIS: This is William Lettis. If I could add a point of -

JUDGE WARDWELL: Could you also add that you are with the applicant when you do that? And I don't mind, at least in regards to my questions in this particular area. There may be some times I'll want the staff to only answer, but I think in this introductory thing I appreciate any -

WITNESS LETTIS: I'm sorry.

JUDGE WARDWELL: - amplification that you do make on it. So please feel free to do that but make sure you identify yourself as with the applicant.

WITNESS LETTIS: Okay. I'm William Lettis with the applicant and I apologize for interjecting here, but just a point of clarification. On Staff Exhibit 41 I believe which they have entered shows the Catahoula at depth. It would have been Figure 2.5-77. And it is located in the boring that encountered the Catahoula at an elevation of approximately -70 feet or so, -70 elevation.

JUDGE WARDWELL: And to be clear that's Number 5 on your profile sheet. That's Numeral 5 is the Catahoula. Correct?

WITNESS LETTIS: Yes, and it's identified as Number 5. And so it's at approximately a depth of 200 to 225 feet below the site from the ground surface to the site. So it's a bit deeper than what Dr. Constantino is mentioning.

WITNESS CONSTANTINO: Yes, I agree with that. I have those figures in front of me.

JUDGE WARDWELL: Yes, go ahead if you have more to say.

WITNESS CONSTANTINO: So again, from a siting perspective all of these layers are of interest, but the primary layers of concern from a foundation perspective would be the alluvium, the Upland alluvium, the old alluvium or the new alluvium, whatever term you want to associate with it.

JUDGE WARDWELL: That's one of the things we need to resolve now. We have to define which - what are these alluviums we're talking about because in various documents we have Upland Complex, we have Upland alluvium, we have new alluvium, we have young alluvium, we have old alluvium, we have clay/silt alluvium, sand/gravel alluvium, fill and the Catahoula formation.

WITNESS CONSTANTINO: Yes.

JUDGE WARDWELL: And depending upon where you are those are intermixed and I'd like to clarify are all of those separate ones, or is there some duplication and renaming of some of those? And how does it interrelate to what we've got for a strata here?

WITNESS CONSTANTINO: Yes. My interpretation of what we have, names have changed over the course of time by various people. The issues, the alluvium layers are really relatively thin layers of various characteristics so it's difficult to say what an alluvium is. In the characterization the primary interest is the engineering properties of those layers and they vary with fineness of the material and as you go down the profile, the fineness, grain size distribution changes from small layer to small layer to small layer, from fine grain to fine grain with some gravel interspersed to coarse grain material back to fine grain. In the profile, I think the engineering properties are relatively consistent from sublayer to sublayer to sublayer. That is, we know the velocities are relatively consistent with depth. The grain size may change, but the strength parameters don't seem to change that much. If we encounter more gravel than fines, then basically we would expect that to be a better foundation material than the fine grain. But I think the alluvium, colluvium, Upland Complex all refer to the series of layers.

JUDGE WARDWELL: Okay, let me - I'm sorry if I do interrupt, and I will interrupt occasionally if I feel we're getting more depth than we really need just for brevity. It's not to be rude or anything, but I do want to continue to move this along and when I feel we've gotten sufficient here, or if the question that's being asked is not really clear and being responded to appropriately I'll rephrase the question. The 3, Number 3 on Staff Exhibit 41 is labeled on this sheet Upland Complex alluvium, if I interpret it correctly. And again, either of you can respond to that. Is that going to be the best nomenclature to move forward to the COL stage in regards to that upper layer of alluvium that exists beneath the loess?

WITNESS LETTIS: This is William Lettis with the applicant. I might offer a point of clarification that might help move forward with the nomenclature issue. If I could refer to SERI Exhibit 4. SERI Exhibit 4 is a correlation chart that we put together to illustrate sort of the evolution of geologic terms used to describe the materials at the site. We can begin with the existing UFSAR. They established a site nomenclature at the site at the time of their license process. They described units both for geotechnical purposes and for hydrologic purposes. The hydrological, the geohydrological or hydrogeological terminology is different than the geotechnical terminology. Or there's greater definition of subunits within the hydrogeologic nomenclature. And so what this chart shows is what was used in the original UFSAR classification, what terms are now archaic, if you will, or no longer going to be used especially in the geotechnical area, and how the terms are now being defined for the ESP classification. And this is the terminology that we intend to move forward with to the COL process.

The geotechnical classification, we have the artificial fill as Dr. Constantino described. There's the Mississippi River alluvium that is located out on the Mississippi River flood plain and does not underlie the site itself. There's the loess deposits which are the highest or youngest unit underlying the site itself is the loess. Then there's the Upland Complex which has been divided into two units, the alluvium and the old alluvium. The term "young alluvium" is also used for this Upland Complex alluvium just to differentiate from old alluvium, the underlying. The term "new alluvium" as far as we can search through the documents we did not use in any of the materials, so the term "new" has sort of been introduced to this process inadvertently. But I tried to capture all the different terms in this correlation chart.

JUDGE WARDWELL: I assume the same with "young." "Young" was also encountered at one point.

WITNESS LETTIS: Yes, "young alluvium" would refer to the upper alluvium in the Upland Complex. And then the Upland Complex alluvial deposits, the young and the old, are underlain by the Catahoula formation at a depth of about 200 - 225 feet beneath the site. And then we can describe other terms.

JUDGE WARDWELL: And what's that elevation-wise again?

WITNESS LETTIS: It would be about -70 elevation. Once again, the surface of the Catahoula we believe has been eroded by the - during deposition of the alluvium above it, so it has an erosional relief on it. So the exact depth of the Catahoula will vary, but it's approximately a -70 elevation beneath the site. And for the hydrology units, because we're attempting to correlate hydrologic data from the ESP site with the existing information from the site, we've retained the same nomenclature from the UFSAR to the ESP. So we did not revise the nomenclature for the hydrogeologic units.

JUDGE MCDADE: If I could just interject something here to make sure that I'm following it and I have very limited geologic background. I took a rocks for jocks class back in the 1960s so bear with me here. Am I following it correctly that basically we've got three kinds of strata here. We've got the loess, we've got the alluvium and then we've got the old Catahoula. And that each of those - what did I say wrong?

JUDGE WARDWELL: You just added another. You said the old - just the Catahoulas, not the old Catahoula.

JUDGE MCDADE: Okay. Well, I don't know it's the old Mississippi so it's the old Catahoula. That each of those have certain strength parameters, but the alluvium basically, whatever we call it, there are variances in it, but for the purposes of an engineering structure on it they have basically similar strength parameters and that as long as the foundations of the facility are done below the loess and in the alluvium that it is going to have basically similar strength parameters regardless of which alluvium it is. Am I correct in that?

WITNESS CONSTANTINO: With one clarification I would suggest. Basically you're right, there are basically three zones of material we're interested in. The alluvium properties actually vary with depth, so the deeper you go, the better that you are. One of the issues is how deep you really have to go to get to the minimum characteristics you would accept, and that's an issue that has to be defined here.

JUDGE MCDADE: Okay, and how will that be defined and when?

WITNESS CONSTANTINO: I presume it'll be defined at COL stage by a number of borings which penetrate to depths of interest. Because you want - the primary characteristic we're interested in is the minimum sheer wave velocity of 1,000 feet a second so you want to get down to depths which consistently give you numbers like that. The alluvium seems to indicate velocities based on the data we have already less than 1,000 feet a second higher up in the alluvium.

JUDGE WARDWELL: And I think the better way to address that question is what did the applicant commit to in the ESP stage in regards to following forward in the COL stage based on the staff's review.

WITNESS CONSTANTINO: Well, the table - you want to answer that?

WITNESS CHENG: This is Tom Cheng. In the SSAR Section 2.5.6 the zone criteria, the applicant committed to use the - to satisfy the 1,000 feet per second of sheer wave velocity for the foundation level.

JUDGE WARDWELL: So it's not committing to - it's not relying on - to achieve that particular commitment, is that based on new information that they will take at the COL stage prior to any construction? Is it a commitment based on information they'll take during actual construction? Is it based on the data that's available now defining whatever information there is in regards to sheer wave velocity or is it a combination of all of those or some of those?

WITNESS CHENG: During our review of the SSAR we issued RAI to question the minimum sheer wave velocity and the staff position is 1,000 feet per second minimum. So in response to the staff's RAI that's how the applicant made that commitment.

JUDGE WARDWELL: But there is information available now, albeit maybe not extensive enough, that shows the difference in sheer velocities with depth. Would the staff be satisfied at the COL stage if in fact the applicant comes in and says I can put the foundation as shallow as 40 feet below the ground because see, here's some borings I took that showed 1,000 feet per second. Would that be adequate for the staff in regards to meeting the ESP requirements?

WITNESS CHENG: As shown in Exhibit 40 through 42, which is the SSAR Figure 2.5-75 through 77, indicate the sheer wave velocity in the old alluvium region or zone has the sheer wave velocity higher than - equal or higher than 1,000 feet per second. And that this is - it's possible foundation of the power block will be located in that elevation which is elevation based on my scale from the figure, the elevation -5 feet, which is about 130 -

140 feet under - the under-grade, below grade.

JUDGE WARDWELL: Let me try to rephrase my question. Is it acceptable at the COL stage for an applicant to base their foundation grade on the information that exists at this present time and only on that information and no other?

WITNESS CHENG: May I ask my consultant to address your question?

WITNESS CONSTANTINO: I think the answer is no. They only have three pieces of information.

JUDGE WARDWELL: Can I just quickly interrupt? I just - I want to get a clarification then. When your contractor speaks, he's speaking on - in representing the staff, correct? I want to just clarify that.

MR. RUND: That's correct.

JUDGE WARDWELL: There were times in the documents where it seemed to kind of say that, well, contractor said this and in actuality whenever either in the documentation or in this hearing if your contractor is saying it, staff does agree that it represents staff's position, is that correct?

MR. RUND: Yes, that's correct.

JUDGE WARDWELL: Good. Sorry to interrupt you.

WITNESS CONSTANTINO: Okay. My recommendation carries no weight. I would recommend to the staff that the answer would be no.

JUDGE WARDWELL: But see, we've just gotten - we've gotten carte blanche approval for you to knock your socks off. You've got, oh boy, here's your time to - maybe you can get a raise out of this. Just ask for - say you will have a raise.

WITNESS CONSTANTINO: The issue is the minimum velocity. We have only three borings, three cone penetrometers with three velocity measurements which show variability in the velocity through those kind of depths. We need many more. "Many" is subjective, but certainly you need a greater site investigation program to make assessments of the minimum velocity and at depths, if you wish to go to that minimum velocity of 1,000 feet a second that's one option. If you wish to locate higher, you then must address the minimum and its variability impact on the design. So I think the program must define the minimum. Anything which goes beyond that has to come at COL stage. So I think the answer to the first question is the data available now is not sufficient to make those definitions.

JUDGE WARDWELL: Okay, but in your

response you've raised a couple of other questions. It seems that you just said that if in fact it's less than that, they could then do an analysis that showed that based on the variability that you could in fact place part of the, I don't know the appropriate word, foundation for the plant on material less than 1,000 feet per second?

WITNESS CONSTANTINO: Well, you have various options. One is yes, you could do that and try to assess the impact on the plant. The other is you could remove the material and replace it with something. What something is is open to question. And go through a verification program for what you replace it with to show that that replacement meets 1,000 feet a second. So there are various options available for any applicant to place anything.

JUDGE WARDWELL: I'd just like to clarify something, probably from Dr. Cheng, is that correct? In the staff's review, in my review of the documentation I never saw any suggestion that the power block would be placed on anything less than 1,000 feet per second of existing sheer velocity, or the material would be enhanced as you suggest to get it up to the equivalence of that. And that there was no suggestion that in fact if there were parts of the plant that were less than that, an analysis could be done to show that it's still adequate support. Which is the - if it's different, I think we should know that as we move forward. You could speak right into the mic if you want. Unless you want to caucus to make sure. Okay.

JUDGE MCDADE: But just as an aside, I mean if a question comes up that you want to discuss among yourselves before you make an answer, you want to check with your colleague because you're not certain of it because remember, you are testifying under oath and an answer 'I don't know' is often the only truthful answer. So if you want to discuss it with a colleague beforehand just do so.

JUDGE WARDWELL: And trust us, we recognize that with various individuals, especially if some may be contractors, that people will provide engineering solutions that are perfectly adequate but not necessarily in the documentation. So I'll just be asking clarifications for that, and it's nothing against anyone's particular opinion of how you could actually achieve a certain design. I just want to make sure we're clear on what it is that the applicant is proposing in the ESP and then what's going to be moved forward and at least as we stand now in the COL stage knowing that of course it can change at the COL stage with the right appropriate recommendations and design details. Go ahead.

WITNESS CHENG: This is Tom Cheng. To answer your question, the staff did not make any recommendation or suggestion in the SER to meet the 1,000 feet per second requirement. They just repeated based on the staff position used for the review of the design certification for advanced reactors. And indeed this deposition will be incorporated in the future revision of the SRP.

May I just - I was talking about the improvement of the site condition. Would you please allow me to read one paragraph I quoted from the SSAR?

JUDGE TRIKOUROS: You're reading from the Grand Gulf UFSAR?

WITNESS CHENG: Yes. Not UFSAR, it's the ESP SSAR.

JUDGE TRIKOUROS: Okay, I just wanted to make that clear.

WITNESS CHENG: In Section 2.5.4.6 design criteria, at end of the paragraph it states that the soil underlying the elevation of the selected plant foundation that are found to have a sheer wave velocity below the design requirement, which is 1,000 feet per second, will require removal or recompaction with or without additive and/or in situ improvement using method such as cellular deep soil mixing or consolidation grouting to achieve the required sheer wave velocity. That's a commitment made by the applicants.

JUDGE WARDWELL: Okay. And that says to me that in fact no portion of the foundation grade can have a sheer wave velocity less than 1,000 unless it has been improved by some fashion like you just described.

WITNESS CHENG: That's correct.

JUDGE WARDWELL: Or a similar alternative.

WITNESS CHENG: For the safety-related structure, yes.

JUDGE WARDWELL: And do you agree with that as the applicant's commitment?

WITNESS LETTIS: This is William Lettis with the applicant. With one additional caveat that depending on which vendor is selected for the site, the vendor may choose to do additional engineering analysis to confirm that their design meets a lower velocity and/or they may make design improvements, strengthen their foundation or whatever might be required to meet a lower minimum threshold velocity. Well, a higher threshold velocity.

JUDGE MCDADE: But if that were the case, under this Early Site Permit you would have to ask for a variance, correct? Under this site permit it has to be 1,000 feet per second sheer wave.

WITNESS LETTIS: Yes, that would be correct.

JUDGE TRIKOUROS: Where does that show up? If I look at the plant parameter envelope I see a foundation embedment of 140 feet, but I don't see, and it may be elsewhere that I'm not seeing, a sheer wave velocity design requirement of 1,000 feet per second.

WITNESS CHENG: If you look at the SSAR Figure 2.5-36 -

JUDGE WARDWELL: Is that an exhibit?

WITNESS CHENG: 36.

JUDGE WARDWELL: Is that an exhibit?

JUDGE TRIKOUROS: I understand that it's in the SSAR. What I'm saying is, is it in either the site characteristic table or the plant parameter envelope which identifies site and reactor design requirements?

WITNESS CHENG: No, in the SER, Section 2.5.5 there's a table to list as a site characteristic requirement. In the final SER.

JUDGE WARDWELL: And the 140-foot depth in the PPE was strictly the maximum that was evaluated, is that correct? That's the deepest anticipated?

WITNESS CHENG: I think that this - I would suggest to ask the applicant to address this because based on my interpretation of the figure 2.5-75 through 77 that's the lowest they will go.

JUDGE TRIKOUROS: And it is identified as maximum in Exhibit 46 or 43.

WITNESS LETTIS: This is William Lettis with the applicant. Yes, that's correct, that's the maximum possible embedment depth for a reactor considering all reactor technologies that we were considering at the time that we would put the base mount of the reactor. Other technologies have shallower embedment depth requirements so we would consider shallower embedment depths.

JUDGE MCDADE: And within the proposal, within the application, what we would need are two things. One, it's going to be 140 feet or less and it's going to be 1,000 feet per second sheer wave velocity. It has to meet both of those requirements. If it doesn't, then a variance would be requested. Is that correct?

WITNESS LETTIS: This is William Lettis. Yes, that's correct, unless as stated in the documents we may over-excavate and backfill or improve the ground to achieve the minimum 1,000 feet per second. So it may not be the native soil that gives us the 1,000 feet per second, but we may improve the ground to achieve 1,000 feet per second.

JUDGE MCDADE: I understand. Thank you.

JUDGE TRIKOUROS: And we will be exploring the issue of what is, again, what is in your Early Site Permit. Is it arbitrary, is it to say anything that's in the SSAR is considered a design requirement in the Early Site Permit, or is it specifically going to be listed as a plant parameter envelope item, or a site characteristic item, or both, which in some cases site characteristics are part of the plant parameter envelope.

WITNESS BAGCHI: Your Honor, this is Goutam Bagchi of the staff. I'm covering hydrology area, but I just respectfully want to point out the site characteristic has the minimum sheer wave velocity stability of subsurface to geo-foundations. It is a site characteristic.

JUDGE TRIKOUROS: Right. So this currently is a site characteristic and the only thing in the PPE is a foundation embedment of 140 feet. So what Judge McDade indicated is then correct. You have two criteria.

WITNESS BAGCHI: As I understand it the Early Site Permit would incorporate the site characteristics in the permit itself. Therefore, it will be binding. That's my belief.

JUDGE TRIKOUROS: Right. But what you have not established is whether it will include the entire plant parameter envelope, at least not as of this conversation this morning.

JUDGE WARDWELL: But even if it did and it included this 140, that 140 is just the maximum depth. It could be anywhere less than 140, correct? As long as it meets the 1,000 sheer wave velocity.

WITNESS CHENG: Yes, it could be less than 140. However, if the soil sheer wave velocity is less than 1,000, they'll either remove and refill or improve the site.

JUDGE WARDWELL: How is that 1,000 feet per second of sheer velocity going to be verified at the COL stage? And based on your review, how do you anticipate that being done by the applicant, any applicant that would come in under this?

WITNESS CHENG: In the SER - this is Tom Cheng again. In the SER the staff asked the applicant to perform additional boring to collect more data. And during that time the staff had a chance to review the information profiled by the applicant and to make the final decision.

JUDGE WARDWELL: Wouldn't you - go ahead. Someone else.

WITNESS LETTIS: This is William Lettis with the applicant. If I could just amplify on that. There's very good and very clear guidance provided by Regulatory Guide 1.132 and Regulatory Guide 1.138 which governed the level of investigation required for siting a nuclear power plant once you've selected your design or your vendor and the footprint and that requires borings spaced at approximately every 100 feet. It provides guidance on the depth of those borings. It would be related to the embedment depth of the reactor, obviously. The deeper the reactor, the deeper your borings would go. It has recommendations for types of data that will be collected, including sheer wave velocity, other static and dynamic property data. So there's very clear guidance on what will be performed during a COL phase. There is a COL action item attached to this ESP, Action Item 2.5.3 or -3.

MS. SUTTON: 2.5-3.

WITNESS LETTIS: And that requires us to perform those additional investigations at the COL phase and it will be based on those data that we will ultimately design the final foundation depth and a final footprint location and other design features such as that.

JUDGE WARDWELL: Would you anticipate any confirmation testing during actual construction of those velocities or is that pretty much impossible to do once you've reached a grade that's desired?

WITNESS CONSTANTINO: I'm Carl Constantino again. The decision on the depth really has to come before you get down to construction stage. So there's a geophysical testing program, relatively extensive, various methods used for confirmation, which indicate what that depth is going to be for the design stage. Then once construction starts there are programs you could put in place. That is, after excavation you could do some geophysical testing locally to ensure. That's not part of the requirement.

WITNESS LETTIS: This is William Lettis with the applicant. During construction there is a permit condition on the ESP that we will perform logging of all the excavations and cut slopes during construction to confirm that we're meeting the anticipated foundation conditions. There's no requirement -

JUDGE WARDWELL: That's just a visual observation?

WITNESS LETTIS: That's visual observations. There's no requirement for performing additional subsurface investigation either through borings or geophysical techniques during construction. During construction and also post-construction there's an instrumentation phase where we will be putting in monuments to monitor for settlements or stress relief issues. So there's an instrumentation phase of work and then there's also the logging of existing exposures, visual examination of existing exposures. We may also take, during that process take samples of the exposed soil for further lab testing. That's not required but it may be part of the due diligence or the normal standard of practice for engineering. But we do not at this time plan to do any additional subsurface investigations during construction.

JUDGE WARDWELL: Back, Mr. Lettis, to your geologic unit correlation table, your Exhibit 4 I believe. Did I get that right? Yes.

WITNESS LETTIS: Yes.

JUDGE WARDWELL: SERI Exhibit 4. Under the hydrologic sections, looking at the alluvium beneath the Mississippi River we have several descriptions of alluvium. Are those separate layers and zones, or are those other names for the same deposit?

WITNESS EVANS: This is Lori Evans for the applicant. The first three terms, Mississippi River alluvium, Holocene alluvium and flood plain alluvium are essentially all the same, can be used pretty much interchangeably. The clay/silt alluvium and sand/gravel alluvium are subdivisions within that. You have thicker deposits near the base.

JUDGE WARDWELL: And where do you find the clay/silt alluvium and the sand/gravel alluvium in the profile section? Can you define it spatially in regards to certain depths that you generally have as far as a range of values?

WITNESS EVANS: There was a lot of variability as is typical with flood plain deposits. I can't give you an exact depth at this time.

JUDGE WARDWELL: But they are - those zones are spatially defined, we can't put the exact number on it because of the variability -

WITNESS EVANS: Correct.

JUDGE WARDWELL: - but they are spatially defined in a vertical sense. They're not scattered in lenses or are they both in regards to how - well, how is it used during the hydrologic ESP classification? Why did you break those two out and how were they incorporated into whatever you did that made you want to divide those up into those zones?

WITNESS EVANS: This relates more directly to the radial wells that are used for the water supply, the service water supply for Unit 1. And we did sort of a cursory evaluation of whether that could also potentially be used for any potential new units at the site.

JUDGE WARDWELL: And is the clay/silt above the sand/gravel generally, or is it?

WITNESS EVANS: Generally, yes.

JUDGE WARDWELL: Okay. That's what I'm

interested in. I should have asked my question much better and we could have saved three or four minutes there.

WITNESS EVANS: Okay.

JUDGE WARDWELL: Back to Staff Exhibit 41. And I think I'll stay with the applicant for awhile because they prepared this profile. One, Zone 1 is fill. I was - well, let me just ask the question. Did you really mean to have that upper layer that's the higher elevation area where the power block will be to mean that that was fill material? I didn't realize that was fill material that now exists out on the site as you go up that bank. I thought that bank was a cut slope and not a fill slope, and you're saying here as I interpret this profile that that's a fill slope and not a cut slope, if in fact 1 represents fill material. That shaded zone that you now are saying is going to be a potential cut area for the ESP plant, are you saying material was brought in to bring that elevation up?

WITNESS LETTIS: On Staff Exhibit 41 that you're referring to ... .

WITNESS BACHHUBER: This is Jeff Bachhuber with SERI. On Staff Exhibit 41 the area of fill is shown ingratiating with the Number 1 designation. It occurs in two locations on that exhibit cross-section. One of them is within the zone that is shaded or hatched as a potential excavation area. The current plant grade is shown by the top line on the cross-section. And there is about a 25-foot cut slope between what we call the lower pad and the upper pad that is spanned by the proposed plant envelope. The upper portion -

JUDGE WARDWELL: You've answered my question. Thank you very much.

WITNESS BACHHUBER: Okay.

JUDGE WARDWELL: The 1 refers only to the little valley that's filled in there. I didn't have a colored sheet. Now I understand what it was.

WITNESS BACHHUBER: That's good. Jeff Bachhuber -

JUDGE WARDWELL: I thought it was referring to that whole flat path before. But now I see that dashed line and the difference in grading.

WITNESS BACHHUBER: Jeff Bachhuber, applicant. One more point of clarification. The SERI Exhibit 3 shows the extent of former swales that existed at the site before any development occurred. And the fill that is defined occurs within those swales. And so it's part of the plant preparation for the existing power plant and which extends over our proposed ESP area, they in-filled those swales to create a level grade.

JUDGE WARDWELL: And that fill is to be removed as far as your proposal is that the staff reviewed?

WITNESS BACHHUBER: Jeff Bachhuber, applicant. The fill will be removed from below the footprint areas of safety-related facilities. It is possible that non-safety facilities, parking areas, warehouses, could potentially be constructed over some remaining fill. In the ESP SSAR, it's defined that the fill will be further evaluated for suitability for that use. But for safety-related facilities it will be completely removed from the footprint zones.

JUDGE WARDWELL: That's exactly what I meant by my question. Thank you. Staying with that exhibit, you show a zone called 2A. Could either the staff for the applicant - and let's stay with the applicant. It's their cross-section, their profile. Could you elaborate more on what that zone is?

WITNESS BACHHUBER: Jeff Bachhuber with the applicant. Zone 2A is colluvium and/or old landslide deposits. The colluvium is a soil that has accumulated on the existing Mississippi River bluff and it has accumulated by long-term erosion and soil creep. It's typically on the order of several feet to perhaps 10 feet thick and it's comprised of loess soils but they have been transported and now are sitting on the surface of this slope. In the case of ancient landslide deposits, we identified a couple potential landslide areas during the ESP investigation. And these are shown on SERI Exhibit 3 and they're labeled QLSO with a question mark. And that designation indicates a possible shallow soil slump. These features were identified on the basis of examining existing topographic maps and brief site reconnaissance. These features, it actually turns out with further studies, post-ESP studies that they indeed are not ancient landslides, but rather are related to either surficial erosion or poor control in the topography. We have since obtained a higher quality topographic map that does not show one of the features that's shown on this ESP figure, Exhibit 3.

JUDGE WARDWELL: Your Exhibit 3 doesn't cover the entire bank surrounding the power block area, correct? Or does it?

WITNESS BACHHUBER: Jeff Bachhuber, applicant. Exhibit 3 shows a portion of the river bluff where it encroaches closest to the ESP. The areas where the river bluff is shown on this Exhibit 3 occur in the lower left-hand area near WLA CPT-3 and then also on the upper part of the figure near B-19. It's a boring designation. Now, that upper slope, you could see by the contours, there are closely spaced topographic lines indicating a slope in that area. And that actually is a slope related to a tributary creek that drains into the Mississippi River. And so that slope shown on the north side of Exhibit 3 is the slope going down into a tributary drainage.

JUDGE WARDWELL: Was that drainage Basin A, do you remember?

WITNESS BACHHUBER: Yes, that's correct. The slope shown in the lower left-hand area is the actual Mississippi River bluff, and it extends further to the northwest off the map and further to the south off the map.

JUDGE WARDWELL: And do you have mapping of that that shows those other - or were there any other areas in that portion of the bluff that's not shown on this figure?

WITNESS BACHHUBER: There are other figures in the SSAR that show a more general geologic maps that extend well beyond the ESP area. And those do include the area of the Mississippi River slope. Similar features that are shown on Exhibit 3 as the ancient slumps, the QLSO question mark, are not shown on those figures because of the scale of the mapping.

JUDGE WARDWELL: Okay. On Figures 2.4-36 and 37 of the SSAR which are Staff Exhibits what? Do you know?

JUDGE MCDADE: 2.4-36 is Staff Exhibit 32. What was the other one?

JUDGE WARDWELL: 37 it should be. I hope 33.

JUDGE MCDADE: 33 is Staff Exhibit 34.

MR. RUND: Did you mean 2.5-36 and 37?

JUDGE WARDWELL: Probably could be, probably.

JUDGE MCDADE: Okay, 2.5-36, Staff Exhibit 38. 2.5-37 is Staff Exhibit 39. Am I correct?

MR. RUND: That's correct.

JUDGE WARDWELL: On those exhibits,

which are similar profiles if my memory serves me correctly, not taking the time to pull those up right here at this moment, that show the same thing that's shown on Staff Exhibit 41, but it uses different nomenclature including the term "terrace deposit" or "terrace" I guess it's just called. Is that correct?

WITNESS LETTIS: Could you please clarify where it says terrace deposit?

JUDGE WARDWELL: Well it may not. I'm trying to refresh my memory and I haven't pulled it out in front of me. Because of the late submittal of it I don't have that nicely organized so that I can grab that.

JUDGE MCDADE: Which one, Staff Exhibit?

JUDGE WARDWELL: 38 and 39. 2.5-36 and 37 aren't the ones that I am interested in. I'm interested in the SSAR Figures 2.4-36 and 37.

WITNESS LETTIS: This is William Lettis with the applicant. I believe you're correct. You're referring back to cross-sections Figure 2.4-37 as opposed to Figure 2.5.

JUDGE WARDWELL: Right. And that's the one I'm interested in. Right.

WITNESS LETTIS: And the Figures 2.4-37,

36 and 37 are taken from the UFSAR for the existing site. And they use the old archaic nomenclature of terrace deposits. On our figures we're using the more current nomenclature of the Upland Complex to describe the alluvium. The terrace deposits are basically the alluvial units.

JUDGE WARDWELL: That's what I wanted confirmation of. Thank you.

MR. RUND: Just for clarification, those are Staff Exhibits -

JUDGE WARDWELL: 24 is the one we're looking at. That's the one that has the terrace deposits listed on there and I wanted to confirm that in fact. And let me ask this. Those terrace deposits are in fact - the best way to interpret those terrace deposits would be if you were using current nomenclature, one of the two zones of the Upland Complex, either the Upland Complex alluvium and the old Upland Complex alluvium together.

WITNESS LETTIS: That's correct. It's the terrace deposits referred to in the UFSAR primarily are the Upland Complex younger alluvium, the upper alluvium. The older alluvium extends part way into what they defined as the Catahoula formation. The uppermost part of the Catahoula formation is a gravel, or an alluvium as opposed to a stiff clay, as described in the UFSAR. We have interpreted those gravels in the upper part of the old Catahoula description as the Upland Complex older alluvium. So we've redefined the UFSAR's stratigraphy and the terms to more accurately reflect the true depositional environments of these units. The Catahoula is strictly confined to the stiff clay under the site. The alluvium, river-deposited alluvium, has been defined as the Upland Complex, both the younger alluvium and the older alluvium. And then we have the overlying windblown loess.

JUDGE WARDWELL: I just wanted to note that the record will reflect that I wasn't the only person to use the term "old Catahoula." Revenge is sweet.

On Page 7 of the pre-filed testimony -- oh, let me interrupt quickly before I go to that question. Staff, in your review, is there anything that's been said by the applicant that you would contradict or amplify, wish to amplify in regards to the last dialogue that we've had on that cross-section? Is everything consistent with what you interpreted during your review?

WITNESS CHENG: Staff don't have any - yes.

JUDGE MCDADE: Okay, and that was Dr. Cheng who made that statement. Just so the record reflects who's responding.

WITNESS CHENG: Tom Cheng. The answer is no.

JUDGE WARDWELL: That's young Dr. Cheng.

JUDGE MCDADE: You are back on Page 7?

JUDGE WARDWELL: Page 7 of the pre-filed testimony under Answer 4, second to the last line it said the plant grade will be located at a depth of about 132.5 mean sea level. I don't - could you clarify that?

WITNESS BAGCHI: Well perhaps - this is Goutam Bagchi of the staff. Perhaps the word "depth" is a little bit misleading. We have a site parameter of planned grade to 132.5 feet mean sea level. That's what we mean here.

JUDGE WARDWELL: So that was meant to convey the top elevation of the plant, not the foundation grade whatsoever?

WITNESS BAGCHI: Yes, Your Honor.

JUDGE WARDWELL: Okay. Which finally moves us into my first, what I call fake hypotheses.

To my first question, my fake hypotheses, ones that I don't necessarily believe in, but I want to make sure that we have enough information to refute them. And so I think it helps focus the discussion. And we've already answered many of the questions I had on this. Here's where the next line of questionings will be geared towards and in fact we've already answered the question, as I said, on some of the points that I wanted to raise in this hypothesis to be able to refute it.

But the hypothesis someone could take is that the site is inherently unsuitable for the placement of another plant due to several basic factors, including but not limited to excessive differential settlements caused by residual fills, the inability to assure a sheer wave velocity of 1,000 feet per second, extensive Karst formation and blast-induced liquefaction from a river barge accident or premeditated activity. That's the hypothesis that we want to now talk about to make sure we got enough information to say no, that can't happen. I think we've already discussed the fills so we don't need to spend any more time on that. I'm satisfied that we do have that information. Same thing with the sheer wave velocity. I think we've covered that in depth. Could you elaborate more on the Karst formation and the potential for that at the site and what will take place to address that particular issue at the site?

JUDGE MCDADE: Actually, before you do, think about it for a second. I just want to raise one administrative matter. We would anticipate going through and breaking at the first reasonable breaking point after 12:00 for lunch. With that in mind, does anybody need a break before that, or is everybody good to keep going through until a little bit after 12:00, about another 40 minutes or so?

MS. SUTTON: We would like to proceed. We need no break.

MR. RUND: Staff is fine, we're ready to proceed.

JUDGE MCDADE: Okay. The witnesses feel the same? You're the more important people. Okay, because as I said, if we took a break now then we'd go longer before lunch, but we'll probably look for a breaking point after 12:00, somewhere between 12:00 and 12:15. So if everybody thinks they can go through, let's get started answering the straw man hypothetical posed by my colleague.

JUDGE WARDWELL: That's an excellent

description. I'm going to use that from now on in regards to my hypotheses. A straw man hypotheses. SMH.

WITNESS CONSTANTINO: This is Carl Constantino again. The issue of Karst formation came up in reviewing the SSAR words. And that issue is a generic issue that I think shows up anytime you see in the site profile words like limestone or carbonate materials, things which are essentially susceptible to solutioning processes.

JUDGE WARDWELL: Could you make sure - you probably were going to, but for the benefit of the panel, just describe that potential problem as it exists in the country?

JUDGE MCDADE: And when he says for the benefit of the panel, he means me. Because he already knows, but he assumes I don't, with some basis.

WITNESS CONSTANTINO: At many sites that I'm involved with, for example Savannah River site or the Oak Ridge site or, well, Hanford site, all those sites do have voids that have been encountered over the years of exploration. And those voids, the collapse of those voids lead to serious concern with the design process of the facilities placed on the top. So anything which potentially impacts the creation of voids below the power block has a potential impact on the design of the power block, a serious impact. So for example, the Oak Ridge site, many of the rocks encountered at the Oak Ridge site are very similar to the ones encountered here, except these are very much deeper than they are further north. But the potential for solutioning is the issue. There's no indication of anything I've read that in fact sinkholes or soft zones are existing under the site. I have not seen that. But the process going forward into the COL stage would have to be to make sure that the exploration program is detailed enough to be able to make an assessment of what that potential is. And if there is a potential, then how that potential would be incorporated into the design. I think that's the whole issue of our question, or my question. And it really came from the descriptions that were provided in the SSAR of the materials that you would expect to be encountered.

JUDGE WARDWELL: Are those materials only in the Catahoula, or are they in the alluvium also? Are they mostly Catahoula or deeper rock zones?

WITNESS CONSTANTINO: They're certainly deeper than the Catahoula. I don't recall any concern with materials in the alluvium or the Upland Complex, although there may be some carbonate materials described in that description higher up in the profile. The deeper the potential for such soft zones, the less the potential impact on the design. No matter how deep, I think the issue of voids or holes below a power block is of interest in the design.

JUDGE WARDWELL: How are these - how is this determined? It hasn't been defined at the ESP stage correctly.

WITNESS CONSTANTINO: No. No. There's not enough information presented at the ESP stage to make any determination one way or the other.

JUDGE WARDWELL: Couldn't someone take the position that in fact it's a basic site characteristic that ought to be discovered now because it could preclude the site from moving forward with a plant design?

WITNESS CONSTANTINO: My response to that I think is there is nothing that has been presented which indicates in fact that's a problem. There is an existing plant there which did go through a detailed evaluation, so I don't think that's a serious issue at this site, but I think that's one that has to be addressed, usually not by borings or deep sampling, but just by investigation, investigations and studies that are available from the geologic communities over the years. And those kind of assessments I think are relatively easy to address. It's a matter of going back and looking through the technical literature that's available and talking to people in the area. I don't think that's a showstopper at the current time.

JUDGE WARDWELL: Any of the other witnesses in their review, did - were there any other things that led you to be comforted that more than likely Karst formation is not a critical issue at this site? Yes, we still need to look at it as we move forward at the COL stage, but at this point you have sufficient observations that lead you to believe that it's not a problem. What are those items that other people might have, other witnesses might have used to comfort themselves that it's not anything that needs to be addressed at this point? Any further than what already is.

WITNESS CHENG: Tom Cheng. Based on my understanding of the site, because the limestone kind of formation would be several feet below the grade which is very far from the foundation, potential foundation level I believe the fact that, because of the sinkhole and the soft zone has any significant impact on the construction.

JUDGE WARDWELL: If the site was - on sites where this is a problem, what would you likely - would you see anything necessarily on sites where this might be a problem which would certainly raise a flag and say, gee, we ought to cover it at the ESP stage?

WITNESS CONSTANTINO: Yes, at sites where this is known to be a problem the investigation programs are very extensive. And trying to locate a sinkhole requires an extensive boring, cone penetrometer, any type of penetration program. And they're difficult to find and they're even more difficult to incorporate within the design to ensure that the facilities could bridge over it. So I think where those - at the sites I'm familiar with where that has been a problem, the programs are very extensive to address those issues.

WITNESS LETTIS: This is William Lettis with the applicant. I'd like to add some additional comments regarding Karst. The first comment is that the shallowest carbonate horizon beneath the site is at approximately a depth of 400 feet. So it's well below the - any proposed embedment depth of the foundation. In response to an RAI from the staff, RAI 2.5.4-9, we performed a fairly extensive investigation as Dr. Constantino mentioned to search for evidence and more importantly negative evidence showing that Karst is not present in the site area.

We did a threefold investigation. One was to look in the 5-mile radius area around the site through aerial photography, available maps, looking for any potential evidence that Karst-type phenomena might have occurred, any evidence of sinkhole, deformation of the ground surface, circular features on the ground surface and there are none. We also looked in areas throughout the State of Mississippi where this unit beneath the site called the Glendon limestone comes to the ground surface to see if there's Karst associated with this unit where it's exposed or in the shallow subsurface. And we looked all through the State of Mississippi and throughout the central and western parts of Mississippi there are no known Karst features associated with the Glendon limestone, or more importantly the Vicksburg group, which is a more extensive body of carbonate rock including the Glendon limestone.

So we looked throughout Mississippi. We also contacted local researchers in Mississippi, in particular Professor Millroy from Mississippi State who is - he's a cave specialist I believe. Karst commonly will form caves, so there's the National Spelunking Society which we also contacted about where there are caves in Mississippi. There is nothing associated with the Glendon limestone throughout central and eastern Mississippi - or western Mississippi. The limestone in this area appears to be too dirty. As you progressively go east into eastern-most Mississippi and on into Alabama and on into Florida the limestone becomes pure and pure limestone is more susceptible to dissolution and Karst formation than what you might call dirty limestone or limestone that contains a lot of terregenous material like clays and silts and things. And so that's the second part.

Third part we looked at the foundation depth relative to the location of where this material is in the subsurface at 400 feet or more and even if we had dissolution cavities, which would still be of concern as Carl mentions, but it would have little influence on the foundation at a depth of somewhere between 100 and 140 feet in terms of the foundation bulb of influence at that depth.

Lastly, I'll mention for the existing UFSAR we reviewed the site data. They had several boreholes that penetrated the Glendon limestone. There was no evidence in those boreholes of any dissolution phenomena at all. They also performed for the existing site seismic refraction surveys, and none of those seismic refraction surveys show any type of collapse features or anything in the shallower subsurface that might reflect deeper Karst formation. So through reviewing the existing site information that gives us information on the Glendon limestone, looking in the site area for evidence of Karst, of which there is none, looking at areas where the Glendon limestone reaches the ground surface for evidence of Karst, of which there is none, contacting researchers in the State of Mississippi for Karst phenomena associated with the Glendon limestone or Vicksburg group in this part of Mississippi and there is none, and then looking at the site information there is no evidence of Karst. So that was all contained in a response to a staff RAI and we spent a considerable amount of time responding to that RAI and doing this research.

JUDGE WARDWELL: On Page 8 of the pre-filed testimony by the staff in regards to Hearing Issue A, the last - starting four lines up with the sentence, 'As a common engineering practice for determining the potential for Karst formation, the applicant should search and investigate the available database for information for the known site materials and determine the opinions of recognized geologic experts versed in this area and provide that to the staff.' Based on your discussion in your pre-filed testimony from - you being SERI - you feel you have done that as you just described to us in response to that RAI, is that correct?

WITNESS LETTIS: Yes, Your Honor, that RAI described more or less that scope of work that the staff suggests should be done.

JUDGE WARDWELL: Is there anything else that needs to be done at the COL stage beyond what you've done, considering this is what the staff says should be done at the COL stage then?

WITNESS LETTIS: What we have agreed to do is in response to a COL action item is to do a deeper borehole into the Glendon limestone in response to a COL Action Item 2.5-8 which will search for evidence of dissolution in the Glendon limestone. We will sample the Glendon limestone and look to see the purity of the carbonate, whether it's susceptible to dissolution or not, but other than that we don't plan to do any additional work on Karst at the site.

JUDGE MCDADE: When you say you don't plan to, that's what in response to RAI 2.5.4-3 you're committing to do, correct? I mean, you've made a commitment to do that, what you've just said, and that's going to be a COL action item.

WITNESS LETTIS: Yes.

JUDGE MCDADE: Okay.

JUDGE WARDWELL: Staff, do you agree with their interpretation in fact they have accomplished lots of what you had suggested in the bottom of Page 8 has already been performed, and that only a boring is needed, or would you still stand by your writeup in your pre-filed testimony at the bottom of Page 8 and the top of Page 9?

WITNESS CONSTANTINO: Carl Constantino again. In response to what Dr. Lettis said, I only have one problem. The potential dissolutioning extends from depths on the order of 400 feet or more. If the plant power block is located at a depth of 130 feet, that leaves of the order of 200-some odd feet to this zone of potential carbonates. The typical advanced reactor systems that we've looked at have power blocks which are dimensioned as much as 400 feet. So if there are materials down there in this carbonate material which could be subjected to dissolution, they would impact the design. So the program not only of the looking at samples of limestone, but looking at samples of these carbonates and see how susceptible they are to any dissolutioning would be something that you would do during COL stage, I would suggest.

JUDGE WARDWELL: And is that what you're talking about on the top of Page 9 where you stated that the staff would also perform a chemical evaluation of available soil samples to support any of the conclusions -

WITNESS CONSTANTINO: Yes, that's -

JUDGE WARDWELL: - drawn from.

WITNESS CONSTANTINO: I think that's what -

JUDGE WARDWELL: But you agree that the applicant has studied the database?

WITNESS CONSTANTINO: Yes.

JUDGE WARDWELL: In regards to their response and refreshing your memory in regards to what was in the RAI response?

WITNESS CONSTANTINO: Yes. No, I think searching the database I think was fine. I think the commitment to take samples through these potential materials and as part of the testing program, incorporate that into the testing program. They're very simple tests.

JUDGE WARDWELL: But what you're referring to here on the top of Page 9 is really taking available soil samples prior to the boring program I believe, isn't it? As I interpret it?

WITNESS CONSTANTINO: No. As part of boring program you will be taking samples to depths which extend into these carbonate materials because -

JUDGE WARDWELL: I understand that, but the sentence at the top of Page 9 says, "The staff would also perform a chemical evaluation of available soil samples to support any conclusions drawn from the applicant's study of the database. These evaluations should be performed prior to planning any deep boring program." So I assume what you're referring to here is you're going to test the existing soil samples that are available, and I assume still kept, so that you could help guide the boring program into those areas for the best location is what I interpreted that to mean.

WITNESS CONSTANTINO: I'm not sure that sentence captures your description. The intent was as part of the boring program to be done, which extends to those depths. There are really not many samples available now.

JUDGE WARDWELL: That's where I was going with this question.

WITNESS CONSTANTINO: Okay. So I think -

JUDGE WARDWELL: So really, the sentence, the third line down, these evaluations should be performed prior to the deep boring program should really be ahead of the previous sentence and then we'd all be pretty much copacetic, is that fair?

WITNESS CONSTANTINO: That's fair.

JUDGE WARDWELL: Fine. Any comments on what's been said by the staff from the applicant? Dr. Lettis?

JUDGE MCDADE: Well actually, beforehand if I could just ask a question by way of clarification with regard to the testimony. There was a request for additional information. As a result of that request for additional information there was a commitment made by the staff. That commitment, or a commitment has been documented in the Safety Evaluation Report as COL Action Item Number 2.5-3. And one thing I want to clarify is, is there anything in addition to what is specified in that COL action item that you believe is necessary prior to moving forward. Is there anything that should be added to that commitment at this point in time?

JUDGE WARDWELL: What's that number again?

JUDGE MCDADE: I believe it's Action Item Number 2.5-3. It's on Page - Appendix A-7. Is that? Dr. Lettis, that is the commitment that you were referring to?

JUDGE WARDWELL: No, it was 2.5-8.

WITNESS LETTIS: This is Dr. Lettis. COL Action Item 2.5-8 requires us to perform a deep boring to investigate the Glendon limestone.

JUDGE MCDADE: Okay, and that's the commitment you were referring to?

WITNESS LETTIS: Yes.

JUDGE WARDWELL: Any other comments on what the staff said in regards to any discrepancies that you feel you'd like to clarify or amplify non-discrepancies?

WITNESS LETTIS: No Your Honor, that's fine.

JUDGE WARDWELL: Okay.

JUDGE MCDADE: And again, I'm not sure that - if I got an answer, it went over my head. Is there anything in addition to that COL action item that you feel should be added in order to determine the suitability here?

WITNESS CONSTANTINO: I'd like to just look at that.

JUDGE MCDADE: Please. And I misstated, it's actually on Page A-8, not A-7.

WITNESS CONSTANTINO: I don't think we - Carl Constantino again. I don't think there's any disagreement with that statement as it sits. That statement does not imply to me that the investigation would only be restricted to the limestone.

JUDGE MCDADE: Okay, well here's my point. It will extend to whatever we say it has to extend to, and I'm just asking you in your expert opinion are there additional conditions that we should require here, additional things that we should require them to do.

JUDGE WARDWELL: Related to Karst formation.

JUDGE MCDADE: Yes.

WITNESS CONSTANTINO: I'm interpreting this response to say that part of this is to evaluate the soil samples taken below the power block from the deep borings and evaluate their potential for dissolution, not only the limestone. That's what I'm interpreting this statement to say.

JUDGE WARDWELL: I think that's a logical interpretation. However, reading Page 9 tells me that you're going to be doing that. That's what - that was my next round of questions. The staff would also perform a chemical evaluation of the available soil samples to support any conclusions drawn from the applicant's. Is that correct?

WITNESS CHENG: This is Tom Cheng. Sometimes the staff likes to perform the confirmatory evaluation to support its staff conclusion. That's why the statement is made there.

JUDGE WARDWELL: So would you anticipate

the applicant to also be performing these same similar analyses on the soil samples? That you'd split the samples and they would perform some?

WITNESS CHENG: Yes.

MS. STEPHENS: Is that your understanding as the applicant that you would be performing these types of chemical evaluations on any samples? Forget what's written on Page 9. Do you agree as the applicant that you would perform chemical evaluations of any samples, I guess we shouldn't really call them soil samples, retrieved from your Karst deep boring that you're going to perform as part of the COL action item?

WITNESS LETTIS: This is Dr. Lettis. The intent of the deep boring is to look for any potential calcareous units at depth. If we identify any calcareous units we will sample them and perform chemical analyses to look and see what their carbonate content is, what their potential for dissolution might be. Also, as we go into the carbonate-rich zone such as the Glendon limestone, we'll look for evidence has there been any dissolution that has occurred just physically in the core sample itself. As I mentioned, the several borings that have gone through the Glendon limestone at the site have shown no evidence of any dissolution in the Glendon limestone. And the boring work performed to date do not show any other shallow or calcareous units at the site.

Obviously as we move forward through the boring program for the COL phase we'll be looking for calcareous units shallower than the Glendon limestone. I don't expect to encounter any based on what we know about the site, but that's part of just the due diligence of performing a geotechnical site investigation is to look for those types of phenomena.

JUDGE WARDWELL: Based on the responses I've heard to these questions, I think there's agreement between the staff and the applicant. Does the staff agree with that? Is there any misunderstandings in regards to that?

WITNESS CHENG: This is Tom Cheng. The staff agrees with it.

JUDGE WARDWELL: I guess that's all. Well, let me just summarize. As far as a Karst formation is concerned that in fact many of the things that would be desirable to be done to try to do the research of existing databases, see what's there, talk to some people has been done. A good faith effort has been accomplished in regards to defining that, whether or not that's a potential significant problem. There's a commitment to do additional work and to further define the potential for this formation, and that the applicant and the staff are in agreement of what that work's going to be, and the straw man disappears. Fair to say?

JUDGE MCDADE: Just so when we get the transcript of it there will be something on the record other than a nod, would somebody speak out so that the court reporter can write it down? Say yes?

WITNESS CHENG: Tom Cheng, yes.

WITNESS LETTIS: Dr. Lettis, yes.

JUDGE MCDADE: Thank you.

JUDGE TRIKOUROS: I have a question regarding pre-filed testimony on Page 3. The - I'll read the preamble to it. It says, 'The staff was unable to determine that either the specific isotopes chosen by SERI or the distribution coefficients of the chosen isotopes were appropriate. Information on both the chemistry of the radwaste system and the aquifer itself did not preclude the possibility that the radionuclides' mobility might be significantly increased through chemical matriculation.' It says, 'Permit Condition

Number 2 which precludes the release from the radwaste system eliminated the necessity for further characterization information.' I'd like to get a further explanation -

JUDGE WARDWELL: Can we wait on that? I've got quite a few questions that deals with this later on.

JUDGE TRIKOUROS: I do, I have a number of additional questions regarding Permit Condition 2.

JUDGE WARDWELL: Yes, well I do too, but can?

JUDGE TRIKOUROS: On this particular subject?

JUDGE WARDWELL: Yes. I'd like to stay with this subject and get through my first straw man hypotheses if we could before we get to that because we've got a lot - we had to spend quite a bit of time on this.

JUDGE TRIKOUROS: That's okay, I'll wait till you're ready.

JUDGE WARDWELL: We'll never get it done before noon if we jump to this.

JUDGE TRIKOUROS: I know that.

JUDGE WARDWELL: In fact that's what I

was going - I was just pausing and that's what allowed you the opportunity to leap into this. And the reason I was pausing is because whether or not we want to break now or get into the next smaller subject area which I think will take about 20 - 30 minutes. Seems like it's break.

JUDGE MCDADE: Well, we have one vote for break. I don't really care one way or the other.

JUDGE WARDWELL: I think it's a good time.

JUDGE MCDADE: So why don't we take a break at this point in time. It's now about five minutes of 12:00. Just so we have a nice round figure to shoot at do you want to come back at 1 o'clock? Is that going to be enough time or does anybody need additional time?

MS. SUTTON: That will be sufficient.

MR. RUND: That's fine with the staff.

JUDGE WARDWELL: And it's 12:02 by the computer. Not that there's anything wrong with his watch, but there is.

JUDGE MCDADE: But one other thing that I would - one of the things we had asked before is that you have people available for Hearing Issue 2 while Hearing Issue 1 was here. I think we're going to be going awhile on Hearing Issue A so you may want to be able to tell the people for B that they don't necessarily have to be readily available at 1 o'clock. If they, you know, wander back within your control by 2:00 or 2:30 that is probably going to be adequate. Do you think I'm safe in that assumption?

JUDGE WARDWELL: Yes.

JUDGE MCDADE: Okay. That said, we will be in recess until 1 o'clock. Thank you.

(Whereupon, the foregoing matter went off the record at 11:58 a.m. and went back on the record at 1:05 p.m.)

JUDGE MCDADE: Before we get started back with the testimony I just wanted to take care of a couple of administrative matters. The first administrative matter is how late we're going to run through till tonight. What we proposed to do is to break sometime between 5:00 and 6:00, not to break under any circumstances before 5:00. That we would break sometime between 5:00 and 6:00 at a reasonable break time, you know, given the questioning. Does that pose a problem for any of the parties, or do you anticipate for any of your witnesses? From the staff?

MR. RUND: We're okay with that.

MS. SUTTON: No problem.

JUDGE MCDADE: Okay. We'll probably take at least one break probably for 15 minutes in about an hour and a half, again depending on what looks like a good time to break here this afternoon. With regard to tomorrow we would anticipate or propose to start at about 9 o'clock and let me rephrase that, not about 9 o'clock, at 9 o'clock tomorrow. Does that pose a problem for the staff or your witnesses?

MR. RUND: That's fine.

MS. SUTTON: That's fine.

JUDGE MCDADE: Okay. And specifically if you think there are going to be administrative matters that you are going to need some more time to take care of in the morning let us know because there's no point of getting everybody here ready to go at 9 o'clock if it's then going to be delayed while certain administrative matters get taken care of. So when we break today I'll ask the question again and absent some statement from one of the parties we'll just set it for 9 o'clock tomorrow morning.

Anything that we should take up before

we get started again with the witnesses? From the staff?

MR. RUND: The staff has two points we'd like to make now. The first regards a question which I think is coming regarding the barge accident. Our witness is not available today but will be here tomorrow. So I'd like to request that we could put that off until tomorrow.

JUDGE MCDADE: And again, we're talking here a hypothetical barge accident.

MR. RUND: Absolutely.

JUDGE MCDADE: Okay. You're not actually going to blow one.

MR. RUND: I hope not.

JUDGE MCDADE: Okay.

MR. RUND: And secondly the Board seemed to have interest in radiological releases. There seemed to be some questions that might be going down that direction, so we brought up our experiment on that, Steve Klementowicz. He's currently on the panel and if the Board would like to swear him in now just in case some of those questions come down the pike. I think that might be a good idea.

JUDGE MCDADE: Okay, do we already have pre-filed testimony from him?

MR. RUND: Yes, we do. We also have his qualification.

JUDGE WARDWELL: Were you motivated by one of the questions we had near the end of the morning session that led you to believe we may start in on that?

MR. RUND: It seemed like that so I thought the efficient thing would be to go ahead and just get him sworn in.

JUDGE WARDWELL: I think we're going to try to reserve that till we get into Issue B which I anticipate we should be able to do today, this afternoon. So I think we can get through into that, but it's fine he's here, I just wanted to know your motivation. Thanks.

JUDGE MCDADE: And since we might bounce around and it may come up, sir, could you please rise?

MS. SUTTON: Your Honor, we also have our radiological expert available who also has filed pre-filed testimony who we would like to also introduce at this time. Mr. Marvin Morris.

JUDGE MCDADE: And do we have his CV?

MS. SUTTON: Yes, you do.

JUDGE MCDADE: Okay.

MS. SUTTON: It's in SERI Exhibit 1, Your Honor.

JUDGE WARDWELL: Did both these witnesses provide pre-filed testimony in regards to Issue B?

MS. SUTTON: Yes, Your Honor.

MR. RUND: Yes, Your Honor.

JUDGE WARDWELL: Okay, that's what I thought.

JUDGE MCDADE: And from the staff's standpoint you have no objection to the qualification of the applicant's witness as an expert?

MR. RUND: We do not.

JUDGE MCDADE: And you have no objections to the staff's expert as a witness?

MS. SUTTON: Your Honor, we would also like to have Mr. George Zinke sworn at this time. He also is knowledgeable about Permit Condition 2 that you questioned previously and have him available for purposes of expediency. And we have no objections to the qualifications of the staff's witness.

JUDGE MCDADE: Okay. And again, we already have his CV?

MS. SUTTON: Correct, in SERI Exhibit 1 and his pre-filed testimony as well.

JUDGE MCDADE: Okay. Would you also stand? I thought we were going to do a two-fer and now we're going to do a three-fer as far as the swearing. Will you state under penalty of perjury that any testimony you give here will be true and correct?

WHEREUPON,

STEVE KLEMENTOWICZ
MARVIN MORRIS
GEORGE ZINKE

were duly sworn and assumed the witness stand.

JUDGE MCDADE: Okay, you are under oath. Please be seated and let's get started.

JUDGE WARDWELL: To refresh everyone's memory where we were, we were dealing with the first straw man hypothesis saying that the site is inherently unsuitable, and we were dealing with the first issue that I raised with that being excessive differential settlements caused by any number of four different topics. We've covered residual fills, sheer velocity, the Karst formation and then the last one was blast-induced liquefaction and hearing that the potential for a barge accident would not be till later I think we'll just go ahead and defer all of that discussion till later. While I hear some murmurings over on the staff's corner, I'll explain where we're going with that. I'd like to hear what the liquefaction potential of the soils are at the site and I'll lead you through a series of questions with that, and then talk about whether or not there is a potential for enough of a driving force to cause that liquefaction if in fact the liquefaction potential is not well-defined or there is some indication that it could be, and then relate that to would a blast from the river provide enough force to cause that problem. I think we might as well do that all together once your other witness is available. And you said that he or she would be available when?

MR. RUND: Tomorrow morning.

JUDGE WARDWELL: Okay. Shall we just delay that till then, that part of it?

JUDGE MCDADE: Let me just posit a question here. You got a general overview of the questions that Judge Wardwell wants to ask in that particular area. If we have the individuals here now who are going to be responsible for answering most of those questions, but they would not otherwise be back here tomorrow morning, rather than require them to be here the rest of this afternoon and then be here again tomorrow, do you think it would be helpful, and you may want to consult with your witnesses on this, but do you think it would be helpful to have these individuals answer questions on that, or would you prefer to defer until tomorrow?

MR. RUND: I believe everybody is going to be here. I see Mr. Bagchi raising his hand. Is that fine to wait until tomorrow?

WITNESS BAGCHI: I would have liked to propose respectfully that liquefaction issue is related to geotechnical and Dr. Constantino is the expert on this and I believe that vibratory motion is necessary for liquefaction that could lead to a safety-related structural concern. So I think even without the characterization of the blast load from a postulated barge accident, potential for liquefaction can be discussed and disassociate that from the amplitude of the load.

JUDGE WARDWELL: Okay, and that's fair, so we will move forward because what I hear you saying, Mr. Bagchi, if that's correct, Dr. Bagchi, that -

WITNESS BAGCHI: I'm a simple mister, sir. My CV is there.

JUDGE WARDWELL: That's not simple. That's with experience as good as any, so. You've just been conveyed an honorary doctor by this panel. What I heard you say is that you might have the potential to eliminate liquefaction as a potential from happening regardless of what the driving force is such that we may even not necessitate any testimony from the blast person, although I think I still would like to hear about that anyhow, but we'll decide that after we go through with the line of questioning.

WITNESS BAGCHI: Forgive me Judge. I wanted to say vibratory motion is necessary of the kind that comes from an earthquake.

JUDGE WARDWELL: Well, we'll talk about that in my line of questioning. So let's proceed with the panel here to talk strictly about the liquefaction potential at the site now.

MS. SUTTON: Your Honor? Our panel that is currently empaneled can address that issue. Our expert on the blast zone is here as well if you would like him to be sworn, but he is currently not sworn. He will also be here tomorrow.

JUDGE WARDWELL: We will wait tomorrow on that if and when we do cover the blast portion. As I read the pre-filed testimony and the SER, it seemed to me that the small liquefaction potential to a certain degree was based on the over-consolidated nature of the loess, the alluvium and the Catahoula formation. Would one of the members of the panel describe what your knowledge base is on the over-consolidated nature of these soils? Or strata?

WITNESS CONSTANTINO: Carl Constantino again. Based on information provided in the SSAR, over-consolidation ratios that were encountered in the UFSAR are of the order of 1 and a half, 2, which is reasonably high. The issue of liquefaction potential is a function of two things. Not only is it a function of the characteristics so the soil, the strength of the soil, as well as the demand. So both sides - if I talk about liquefaction, I have to look at two sides. If I talk about over-consolidation I'm only looking at one piece of that. So I think the indication that over-consolidation ratios are relatively high for these soils goes to speaking to the fact that those materials would probably be expected to have high strength against liquefaction.

On the other side, the demands for this site, or seismic demands for this site are very low. So the demands you would expect for the magnitude of the seismic-induced sheer strains would lead to small demands. We would expect for materials at depth which have significant over-consolidation ratios, their characteristic strength would be very high so we would - the implication is safety factors against potential liquefaction over broad areas which would impact the power block, the safety factors would be very large. So liquefaction in general from a vibratory demand would be expected to be not an issue, not a serious issue.

On top of that, if the power block is situated low, the foundation of the power block is situated low in the soil profile, there are essentially no indications under any kind of seismic load of liquefaction-induced failures for depths below 50 feet. That is, 50 feet is a normally considered cutoff. Below that depth the general subjective assumption is nothing's going to happen. And that's really confirmed when we do site response analysis to look at the demand and we look at laboratory testing to look at the capacity. So liquefaction from vibratory effects are expected to be not an issue.

Liquefaction from potential blast effects are also expected to not be an issue because of several reasons. Blast loadings tend to be single cycle loadings and to get liquefaction-induced development of pore pressures you need many cycles. The classic is 15 cycles for a large magnitude event. And the smaller the number of cycles induced by the, whatever the causative event is, seismic or blast, the smaller the number of cycles, the lower the potential for liquefaction. In addition, blast tends to give you - if liquefaction does occur on the blast, it would be a very restricted zone because of the rate of change of the induced stresses are very heavily dependent on distance from the blast point which are very close by. So there are great changes in the induced stresses. Those stresses tend to be not sheer kind of stresses, but hydrostatic kind of stresses. So they are not inducing high pore pressures which would lead to liquefaction. So on both those terms then, liquefaction due to vibratory and liquefaction due to blast, both of those potential effects are in my opinion negligent.

JUDGE WARDWELL: But in hearing your testimony then you do agree that there's a potential for excess pore water pressures to develop under a blast loading?

WITNESS CONSTANTINO: Yes, and they would be very restricted and close to the blast. Yes.

JUDGE WARDWELL: And that would have a potential of creating excessive uplift for anything buried beneath the water table of those particular strata that this occurs.

WITNESS CONSTANTINO: Locally, if the blast is big enough and close enough to the point of the blast you could say that's a potential issue for plants of this size. I would say again that that's not a problem.

JUDGE WARDWELL: The over-consolidation ratio that you've quoted, that you indicated that you reviewed, did you review the laboratory data from that, or did you just review that that statement that that is the over-consolidation ratio? Did you confirm that over-consolidation ratio?

WITNESS CONSTANTINO: No. Well, no. The only thing I personally did was review the statements. There was no, as far as I recall, no consolidation laboratory test performed as part of this cycle of testing.

JUDGE WARDWELL: Do you know what their basis was for making that statement?

WITNESS CONSTANTINO: Yes, the primary basis I recall was the information provided from the UFSAR. That in those consolidation tests, the over-consolidation ratios were physically measured primarily in the loess material which are most susceptible, but down below they also indicate there's some information about over-consolidation ratios. I personally did not review the laboratory data to confirm this.

JUDGE WARDWELL: Would SERI like to comment?

WITNESS BACHHUBER: Jeff Bachhuber for SERI and I'd like to add to Carl's information here. For the ESP we looked at several data sets to evaluate over-consolidation ratio and one of the data sets we looked at was the UFSAR where they had reported calculated over-consolidation ratios or OCR based on consolidation tests in the Catahoula formation, which is the bearing formation for the existing plant, Unit 1.

In addition to that we performed a

couple of analyses for the ESP. One was based on the cone penetrometer test. We performed four cone penetrometer soundings throughout the ESP site and we used correlations that compare the CPT results with estimates of over-consolidation. And based on that assessment we were predicting over-consolidation ratios of about 1.5 to 5 and that was consistent with what was reported in the UFSAR.

In addition to that, we evaluated the results from the dynamic testing that we performed on samples obtained from the ESP borings. And those included resonant column and torsional sheer tests performed by the University of Texas at Austin. And based on the behavior of those soils, they show that they are significantly over-consolidated, likely in the range again of about 2 to 5. And so we had several independent data sets that we looked at.

As for the geologic setting, the Upland Complex alluvium, which are the bearing strata for the foundation, whether we look at shallow levels or deeper levels all the way to the 140-foot depth, those materials show a history of geologic past higher loading. And we know that from the profile, the way the strata currently occur at the site. The different layers within the Upland Complex, they have substantial relief. And so separate layers within that Upland Complex alluvium have undergone past significant erosion, indicating that there were thicker deposits overlying those sediments previous.

The entire region shows evidence of substantial incision of rivers which has left a number of terraces on the landscape. And it looks like that river incision has removed tens to perhaps hundreds of feet of sediment that previously existed. And that caused a consolidation or compression of the deposits and now those soils have been removed, leaving the soils in an over-consolidated state.

JUDGE WARDWELL: What data did you have - did they have in the UFSAR relating to the loess formation?

WITNESS BACHHUBER: I don't recall for the loess. For the Catahoula formation I think they had on the order of 10 or 15 consolidation tests. So they had a fairly significant amount of lab testing. For the loess I don't recall any testing on those materials. But the foundations for the plants will be below any loess soils and so over-consolidation of the loess does not really have a connection with liquefaction at the foundation levels.

JUDGE WARDWELL: But it would have in regards to the pure development of excess pore water pressures that could lead to uplift. It's not necessarily a sheer strength problem, but an excess pore water pressure problem. Isn't that fair to say as a straw man hypothesis?

WITNESS BACHHUBER: Yes, that's something you would want to look at and consider.

JUDGE WARDWELL: And the lowest blow counts, in fact the only material that I saw that had any degree of low blow counts were the loess materials. Is that a fair assessment?

WITNESS BACHHUBER: Within the power block area, the loess soils are the lowest density, lowest strength materials that did exhibit the lowest blow counts. The loess, however though it does exhibit a substantial cohesion and you don't really pick that up in the standard penetration test blow counts. It typically stands vertically in cut slopes which shows that it does have a substantial cohesion that would help reduce any development of vibration-induced strength loss.

JUDGE WARDWELL: How much would you relate that cohesion to partially saturated conditions as opposed to a true cohesion? Does this material have any degree of plasticity, and if so how did it achieve that?

WITNESS BACHHUBER: Yes, Jeff Bachhuber again. It does have some cohesion. The clay content in the loess varies, typically between perhaps 5 and 15 percent.

JUDGE WARDWELL: Based on grain size only?

WITNESS BACHHUBER: That's based on grain size tests that we performed.

JUDGE WARDWELL: So it's clay-sized particles, not necessarily clay. Is that a fair assessment?

WITNESS BACHHUBER: That's correct, clay-sized particles. Many of the cuts or the vertical exposures I mentioned in the loess occur well above the groundwater table in deposits that appear to be drained and dry. And so that supports that we do have cementation not just related to partial saturation or water tension-induced, but truly from a cementation.

JUDGE WARDWELL: Before I move on to explore that last statement, out of the corner of my eye I thought I saw some motion over here. Would staff like to comment?

WITNESS CONSTANTINO: Yes, I think - this is Carl Constantino again. I think the issue of the development of excess pore pressure in the loess as opposed to the development of uplift on any base mat, if the base mat is located in the alluvium, any excess pore pressure developed in the loess would be very localized. So the chance of inducing excess pore pressure from that excess pore pressure development would be I think not a real issue. So impacting uplift response of the power block structure, I don't think that's a serious issue.

JUDGE WARDWELL: In regards to that, would - who would like to comment on the knowledge base of the water levels in the loess and the relationship to any type of aquifer or zone that exists in there that would create an avenue to have fully saturated and potentially excess pressures under a blast-induced loading? I'll start with the staff. Who wants to talk about the hydrology of the loess?

WITNESS CONSTANTINO: I'll pass that on.

JUDGE WARDWELL: No, we'll start with the staff. We have a volunteer I think that's eager to talk.

WITNESS BAGCHI: This is Goutam Bagchi. I'll venture an opinion. The blast pressure will be dissipated very quickly, so for it to get into a location where even lenses of aquifers might be located, are very farfetched, very unlikely. And based on the borings that have been done, they have not located any lenses of aquifers that would have to be dealt with. When more detailed site investigations are done under the COL application required by currently existing regulatory guides. 1.032 and 1.038 were mentioned earlier on this morning.

JUDGE WARDWELL: Thank you.

WITNESS BACHHUBER: Jeff Bachhuber. I'd like to add one more point regarding uplift resistance. The plant foundations will be embedded to some extent into the older alluvial deposits below the loess. And the frictional resistance against the side walls of the plant will help reduce any potential uplift. They should provide a high factor of safety against potential uplift induced by pore water pressure in the loess.

JUDGE WARDWELL: Did you do any rough calculations to indicate what that magnitude of safety would exist for an uplift?

WITNESS BACHHUBER: No, we did not perform calculations. Those we are waiting until a plant design has been selected and the depth of the foundation is known. Our comparisons are a qualitative basis.

JUDGE WARDWELL: Unless there's anything else anyone would like to add, that's the questions I have on that. I don't feel there's a strong need to continue to pursue this if you don't want to bring your witness in tomorrow for the blast aspects, unless there's some other panel member who wants to talk about.

MR. RUND: That's fine. We'll tell him he doesn't need to come for that. Thank you.

JUDGE WARDWELL: That covers potential differential settlements including vertical settlements. I don't know what those were, but the way you shoehorned liquefaction in there also, blast-induced. But the other issue in regards to why someone could hypothesize that the site is unsuitable is that there isn't - that the control of groundwater as it relates to the need for active foundation underdraining and the inability to assure adequate capacity and contingencies with the potential safety factor for underdraining, and then the development of excessive movement in the existing plant from any aquifer drawdown if in fact there is active underdraining taking place, makes this an unsuitable site for the ESP. Based on that, would someone from the staff like to start off and kind of summarize the existing hydrogeologic studies and the knowledge base of what we know about any potential water levels that exist in the ground at the power plant, the power block area?

WITNESS BAGCHI: This is Goutam Bagchi of the staff. I may need to have Mr. Vail add to my observations, and if so then I will request him to do that. Starting off, please note that in the hydrology area, the site characteristic for high groundwater elevation is 62.5 feet MSL and the plant grade is 132.5. Uplift is not really an issue at all in this case. And standard designs are designed to groundwater elevations within one feet of the grade.

JUDGE WARDWELL: What data do you have to support that position that I understand you're saying, if I can paraphrase what you're saying, is that the loess is always only has perched water zones in it and it will never become saturated with its own water level at the surface. What is your - what data supports - if what I just said is a fair interpretation of what you're saying, what is your information base that allows you to say that the loess will never become saturated at some point?

WITNESS BAGCHI: Lance, would you like to address that now or can he have some time to look at the information that we have.

JUDGE WARDWELL: Yes, sure.

WITNESS BAGCHI: We had characterized that in our pre-filed testimony, a summary of all the hydrologic characteristics, characterization, in response to Question Number - this would be Staff Exhibit - is it a staff exhibit? Pre-filed testimony? This is Issue A, site characterization. It's in response to Question Number 3 on Page 4. There's a summary of subsurface characterization of the ESP site.

MR. RUND: As a point of clarification, all those tables and figures that are listed in that testimony have now been made exhibits.

JUDGE WARDWELL: Well, I see a list of things that you reference, and again we still - we didn't get those as pre-filed testimony, nor is there a narrative that really helps support what your position is in regards - not only support, but define what your position is in regards to the water levels in the various zones and what the database is that allowed you to reach those conclusions in your review of the applicant's submittals.

WITNESS BAGCHI: I referred to - this is Goutam Bagchi and I referred to Page 4, Item Number 6 in which we discuss. But to summarize really it's based on observation well data.

JUDGE WARDWELL: And you're referring to two pesometers in alluvium five and terrace deposits - and again, I assume those terrace deposits are alluvium - and eight in the Catahoula?

WITNESS BAGCHI: Yes, sir.

JUDGE WARDWELL: And where does that lead you to indicate any information in regards to the loess? And then also, if you did have data on that, you know, how did that relate to your setting of levels in those other zones also?

WITNESS BAGCHI: Our primary interest was to set the level in the area of the power block so that the site characteristic would be set and any calculations at the COL stage and consideration of the groundwater level would be set on the basis of the site characteristic. Maybe we'll take a couple of minutes.

JUDGE WARDWELL: Well, it would be helpful if I could help guide you. If you could take each strata and say, okay, here's what the data shows in regards to water levels in that strata, here's what we know about the aquifer characteristics in that strata and then this is how it relates to our potential need for both construction, but operational foundation underdraining. And then this is how the applicant evaluated that and any potential backup system should that fail during operations, if in fact it is needed to have operational de-watering. That was difficult for me to dig out for myself, that type of narrative that provided that clear picture that it's been evaluated by the applicant sufficiently to say that this hypothesis can be rejected.

WITNESS BAGCHI: We can again refer back to Figure 2.5-76. This was discussed. Exhibit 41 of the staff. There is an indication of the groundwater level. The particular layer is saturated. The well has been dug through that layer and you'd have to indicate the behavior of the layer. Maybe I'm not quite getting the thrust.

JUDGE WARDWELL: Well, I guess I'll go

lower then. Again, can someone provide a narrative of the water levels that are in each zone and how it affects the design and step us through that? Or shall I just ask individual questions to try to achieve the same thing? We can go either way, I don't care. I just thought someone might be able to just provide a narrative. We have a loess formation. We anticipate water levels ranging from this to this, if there are any, and this is the data that supported that position. And therefore this is the relationship to the design aspects of that. The Upland Complex alluvium water levels are such and such. Here the aquifer characteristics are such and such in regards to transmissivity and saturated thickness. And here's how it would relate to the proposed foundation design. And then do the same thing with the old alluvium. Very similar to the geologic description that was done this morning for the strata, similar narrative for the hydrogeologic conditions that are there.

WITNESS BAGCHI: We don't have that type of detailed well observation, well information through every type of geologic stratum at the site. The important point was the water, groundwater elevation in the area where the power block is going to be located, because that directly applies to pressure of the side walls, uplift of the power block and those kinds of structural calculations. So we relied on the data that was available in the power block area from the wells. The groundwater elevation there was 62.5. That's where we set it.

JUDGE WARDWELL: Is that a confined aquifer or an unconfined aquifer in the alluvium, do you know?

WITNESS BAGCHI: This is an unconfined aquifer.

JUDGE WARDWELL: Do you know if the applicant has committed to or sees a need for or has even evaluated the potential for operational underdraining of the power block area?

WITNESS BAGCHI: I think operational underdraining or de-watering has been proposed for construction, probably would be necessary.

JUDGE WARDWELL: My question was in regards to operations. I'm aware that construction would have de-watering, yes, but what about operations? Would there be a long-term underdraining of that building foundation, the power block foundation for operations?

WITNESS BAGCHI: Well, this is a COL

activity. It's going to be reviewed at that time and determined whether or not a permanent underdrain system will be necessary.

JUDGE WARDWELL: So there's no commitment one way or another as far as you remember or understand?

WITNESS BAGCHI: No.

JUDGE WARDWELL: Would the applicant like to comment on that?

WITNESS EVANS: Lori Evans for the applicant. Without knowing the exact reactor type and the exact footprint of the structures it would be difficult at this point to say whether or not a permanent drain system would be necessary. At the ESP stage. At COL when the reactor design and the exact location are known, then you can make those determinations.

JUDGE WARDWELL: Wouldn't the bounding range that you have provide you enough information to take a rough cut at whether or not an underdrain system is needed and to what degree and what flow rate you might have to deal with? I mean, you could hypothesize a site that would be so difficult to maintain the drawdown that an underdrain system would be impossible to maintain and certainly assure that it would never fail and have a backup system to counteract any failure if in fact you needed that for design. That would preclude the site from being a suitable one for a power plant to be built, wouldn't it?

WITNESS BAGCHI: Your Honor, Goutam Bagchi for the staff. Existing power plants have permanent de-watering systems. I don't believe the Unit 1 has any permanent de-watering system, does it?

WITNESS EVANS: Lori Evans for the applicant. They have an intermittent de-watering.

WITNESS BACHHUBER: Jeff Bachhuber for the applicant. During construction they handled groundwater inflows through the alluvial deposits, or as they called the terrace deposits, by using sumps. And so they did not have very high flow rates. They were able to control it easily during the construction period. With deep excavations that extended to the Catahoula formation.

JUDGE WARDWELL: And now how did you apply that to your ESP analysis in regards to the potential need for underdraining?

WITNESS BACHHUBER: With respects to drainage requirements during construction we evaluated what was done for the existing plant, compared that to the material properties that we encountered in the ESP borings, compared those materials to similar deposits at the existing plant site and made a determination that a similar approach could be used. So integrating sumps, perhaps drainage points that weren't used for the existing plant, but that was an extra measure that, you know, we would be able to apply for a plant at the ESP site. But in any case the inflow rates shown through precedent excavations for the existing plant demonstrated that we would be able to handle inflows using conventional-type techniques.

JUDGE WARDWELL: And that's for construction, correct?

WITNESS BACHHUBER: Correct.

JUDGE WARDWELL: How would you extrapolate that same information to the needs for operations?

WITNESS EVANS: Again, we looked at similarities or assumed similarities between the existing plant and the new plant. And very limited de-watering is required for Unit 1. In the proposed power block area for the ESP plant groundwater levels to a certain extent are controlled by the surface elevation of the Catahoula formation which in fact is lower under the ESP power block area. So we would anticipate actually slightly lower groundwater levels in the ESP power block area.

JUDGE MCDADE: Just so the record is clear, that was Lori Evans who made that statement.

WITNESS EVANS: Lori Evans for the applicant.

WITNESS CONSTANTINO: Can I - this is Carl Constantino, can I?

JUDGE WARDWELL: Based on that statement, what would you conclude as an expert in this field in regards to the feasibility of underdraining the existing power block area at this site? Is it feasible, really feasible? Is it a little shaky pizza, or boy it's going to be hard to underdrain that if we need to?

WITNESS EVANS: Lori Evans for the applicant. I believe it is feasible.

JUDGE WARDWELL: Thank you. Now, sorry.

WITNESS CONSTANTINO: Yes, I just wanted to make a comment. Carl Constantino again. There are two issues associated, and we're not talking about the construction period, we're talking about operational. There are really two issues associated with underdraining. The first really has to do with the impact on the design of the facility. Based on the suspension log data, the groundwater elevations are indicated on Figure 2.5-76 and they were inferred, really not measured. And they show the groundwater elevation down - elevation of the order of 60. The design of the plants are really, all that I'm aware of are based on an assumed groundwater elevation at plant grade. So there's a huge safety factor from that design operation. Underdrain systems are typically only required when I have now a poorly constructed plant where lots of material is flowing into the facility. I presume that's not going to happen here. In New York we have great experience with underdrain systems. Water is permanently coming into every facility in New York. So underdrain systems are easily feasible. They're not things you like because they're expensive to maintain. From a design perspective they're, the groundwater location at this site is most likely not an issue, just based on the data that's available now.

JUDGE WARDWELL: And with that same experience base, do you find it difficult to provide backup systems or procedures or any need for if the primary underdrain system does not operate?

WITNESS CONSTANTINO: Yes, they're difficult to install after the fact. So we try to design systems which don't require underdrain systems. And again, that's an operational kind of consideration which you'll find later on, but for structures that we typically encounter at nuclear power plants, issues of groundwater inflow into the structure are not a major issue.

JUDGE WARDWELL: You mentioned that the water levels shown on Exhibit 41 were inferred and not measured. Is that based on just the question marks being along that line, or is that just a standard copout that's used by the hydrogeologic professor?

WITNESS CONSTANTINO: Well, standard copout I guess, but from the suspension log you tend to measure both MS. SUTTON: -wave and P-wave velocities. And there's a big change in P-wave velocity when you get down to that depth which is essentially the velocity through the saturated. So, and that, in my experience that's always been relatively consistent with what we find from the borings. These borings were, if I recall were drilled in the wet so then you couldn't get any major good information from - on groundwater from those borings, but the SPTs or the CPTs or the suspension logging data shows relatively consistent results. So anything above, any water encountered above that would tend to be perched and not be a major issue from any design perspective.

JUDGE WARDWELL: Any statements made by the staff that the applicant would like to amplify or modify in any aspect?

WITNESS LETTIS: This is William Lettis for the applicant. Just to - we agree with the staff's comments. Just to amplify or for another exhibit, SERI Exhibit 14 is a - graphically depicts the results of the velocity profiles that Carl Constantino was just referring to for all three of the borings that we drilled in the site area, and it shows the sheer wave velocity and the P-wave velocity profiles. Where the P-wave velocity profile jumps up or kicks up is generally related to saturated or groundwater conditions. And so this shows - and you can also see we've put on the figure the geologic contact between the loess and the alluvium, the Upland Complex alluvium, and you can see the groundwater table which is shown by the black triangle for B-1, B-2 and B-3 over on the right-hand side of the figure, the groundwater table is generally below the loess and in the Upland Complex alluvium, but it's pretty clearly demarcated by the velocity data, the P-wave velocity data. It's not precise. As Carl says, did you use the word "inferred"?

WITNESS CONSTANTINO: Guess.

WITNESS LETTIS: But we have pretty good constraint on the level of groundwater and the absence of groundwater in the loess above in terms of saturation.

JUDGE WARDWELL: What information -

JUDGE MCDADE: Can I just interrupt for a second. "Inferred" sounds a lot more scientific than "guess." How reliable is this guess in your view?

WITNESS CONSTANTINO: Carl Constantino again. The guess is good, it's the location of the guess that's difficult. So if I want to say the groundwater elevation is 62.3, and it may be 70, within that range I would say it's acceptable.

JUDGE MCDADE: But as far as being able to state that it's in the alluvium as opposed to the loess.

WITNESS CONSTANTINO: Oh yes, no, I

think that's - you can make that jump. That's not an issue.

JUDGE MCDADE: That's a strong inference?

WITNESS CONSTANTINO: That's a strong inference and not a guess. It's just trying to label a particular elevation that's a little more difficult. The drill string on a suspension logger is 10 meters. So trying to interpolate between those measurement points is where the smearing of the data occurs.

JUDGE MCDADE: Okay, and the difference, you know, the reasonable range within which it's going to fall, am I correct that from your standpoint, from an engineering standpoint would not pose a major problem?

WITNESS CONSTANTINO: No. Not at all. Because the design condition for each of the advanced reactor systems that I've reviewed, groundwater is assumed to be up at the ground surface. So if it's down below, there's no impact on the design.

JUDGE MCDADE: And whether it's down below by 90 feet or 92 feet isn't going to make a material.

JUDGE WARDWELL: And so you're saying that as far as any analysis that was performed at the ESP stage, that the loess was assumed to be saturated at groundwater table up through the loess.

WITNESS CONSTANTINO: That's right.

JUDGE WARDWELL: Is that correct from the applicant's standpoint also?

WITNESS EVANS: Lori Evans for the applicant. Yes, that is correct.

JUDGE WARDWELL: Thank you. Just out of curiosity, because now that last question made this question moot, but I thought I'll ask it anyhow. What - do you have any data or information in regards to whether or not there is a potential that the loess does in fact get saturated during the right climatic and river level conditions? And no is an acceptable answer, I was just wondering whether you had any information.

WITNESS EVANS: Lori Evans for the applicant. We don't have any definitive information at this point. We have some preliminary investigation from the COL investigations, but nothing definitive yet.

JUDGE WARDWELL: I'm sorry, from the what investigations?

WITNESS EVANS: The COL investigations.

JUDGE WARDWELL: Okay, thank you.

WITNESS BACHHUBER: Jeff Bachhuber, SERI. I'd like to add that we did look for evidence of seepages on the slopes around the site. And we did not find any seeps or evidence of substantial past seeps down to the elevation of the existing plant grade or the proposed plant grade of about 133 feet. And there is a 25-foot high cut slope in loess on the site, and so we can evaluate the upper 25 feet of loess, and again did not find evidence of seeps in that material.

JUDGE WARDWELL: And you were looking for the seeps in regards to the drainage - in drainage basins A and B and in the front face that's directed towards the river, the west face bluff?

WITNESS BACHHUBER: Yes, that would be from observations of the cut slope, the trends in the north-south direction across the site and also in the basin A or the tributary slope and the river bluff slope to the west of the site.

JUDGE WARDWELL: Thank you. I guess - I don't know whether this is the best place to ask, but I think I will because we're talking about groundwater, but certainly for the EIS and the SER it was recognized that there isn't a lot of information in regards to aquifer properties which were part of the reasons I was trying to - my line of questioning was going on. And to the point that the water quantity and quality under the EIS was deemed to be unresolved, an unresolved issue for the EIS. Given that same situation for hydrologic alterations to the groundwater, wouldn't they also be unresolved? I don't know if anyone here can comment on that. We may have to wait for another panel, but.

WITNESS VAIL: This is Lance Vail and I was responsible for the environmental review related to hydrology. In the aspects of hydrologic alteration that we were looking at, there would be a change potentially in the water table and in the flow pass, in the subsurface that I think you're alluding to. And that uncertainty would, you know, result in some uncertainty about the impact. But the staff didn't determine that there was anything that would result in an impact of the hydrologic alteration that wasn't already covered in the unresolved aspect of it in the water use and water quality issue. So we made an effort not to essentially double count impacts that there would be some uncertainty, but we did not see a hydrologic alteration impact that would reach the level of moderate or large.

JUDGE WARDWELL: And that's because you don't expect much alterations in the hydrologic conditions with the building and the operations of the power block area?

WITNESS VAIL: Well, we certainly expect it locally, but hydrologic alterations that are going to affect the environment in a general sense, we didn't think that that was sufficient to reach a level of moderate or large.

JUDGE WARDWELL: And what is - if you don't know the aquifer characteristics, what is the basis for your conclusion of that? That's what I'm having a hard time grasping.

WITNESS VAIL: The impacts associated with this are expected to be localized with the exception of the potential impact of the drawdown, particularly in the Catahoula which could go offsite which we did say that that was unresolved under the water use side.

JUDGE WARDWELL: Okay, thank you. Anything applicant would like to add to that?

WITNESS EVANS: Lori Evans for the

applicant. I have nothing to add.

JUDGE WARDWELL: Everyone happy here? Okay.

JUDGE MCDADE: The answer is yes. Ecstatic.

JUDGE WARDWELL: That handles straw man hypothesis - straw person hypothesis number one. We're getting close to the end of A. We just have two more hypotheses to deal with. The second one is that one could argue that the sediments dredged up for any construction in the river for any structure that might be intake, outtake, whatever is being built out on the river would end up being categorized as hazardous waste and that the economic difficulties in handling, storing and disposal of those dredge wastes would make construction in the river unfeasible and therefore there is no, as presently proposed, mechanism for water management at the site and would make it an unsuitable site. I haven't even asked any questions yet, I drew out the hypothesis. That's good. And again, keep in mind, these are not my hypotheses, these are ones I think we need to be sure we can refute.

Isn't this a safety issue if in fact the sediments preclude construction of the structures for makeup water, not as I think was referred to as we were trying to describe this in our previous orders, an environmental issue. It's an environmental issue also. It's certainly an EIS issue, but I'm coming at it from the safety side, that because these would have to be handled, the economics of doing it would preclude the use of that. Therefore, you don't have that river as a makeup water source. Would you like to comment on that? It's obvious you would like to comment on that, so please do.

WITNESS BAGCHI: No, no, first of all though Your Honor I didn't quite understand what you meant by sediment and dredging. Would you kindly describe that one more time, your hypothesis?

JUDGE WARDWELL: Sure. I assume that in order to build the intake and outfall structures in the river -

WITNESS BAGCHI: Outfall structures.

JUDGE WARDWELL: Well, either one, I don't know which. I don't know the details of it. You will relay that to me if in fact I misconceived it, but I assume that for both any intake structures and outfall structures that sediments would have to be dredged from the river. The soil in the bottom of the river, I call them sediments. That dredging I assume, and I don't know whether I assume it or whether I read it, that the characterization of those sediments has been deferred to the COL stage as a design detail. This hypothesis says wait a minute, shouldn't that have been looked at at the ESP stage to assure that in fact there's not a fatal flaw with doing that activity. And the fatal flaw that someone could hypothesize would be you go in there at the COL stage and all of a sudden you realize that there are excess radionuclides from the previous outfall, or there are just heavy metals or whatever. We don't know what's in those sediments. Now you find out that they are, and they characterize as a hazardous waste by EPA standards. Now you have to handle any dredging that takes place as - the sediments from it as a hazardous waste, and that's a whole another level of issues that someone could hypothesize would make it economically infeasible to use that option. Therefore, you can't build whatever structure you wanted to build that required the dredging and therefore this ain't a good site. That's the hypothesis.

WITNESS BAGCHI: Okay. Maybe I will be missing one or two of your questions. If I do, please remind me. This is Goutam Bagchi of the staff. Let me address the safety aspect of it first. Intake, if there is one, there will be one, is not safety-related. It is for normal plant heat sink. It can be withdrawn from the river based on its depth of the channel and constant flow. It's eminently feasible.

JUDGE WARDWELL: Without dredging?

WITNESS BAGCHI: Without any kind of dredging. There is a large channel, a very deep channel and constant flow of millions of cubic feet of water per second flowing through. If we need to develop intake from the river, I think it's entirely feasible. We answered that in our pre-filed testimony in response.

JUDGE WARDWELL: You will construct this intake structure without any dredging of the river bottom?

WITNESS BAGCHI: Well, that's not safety-related, it's not a concern at this point for the staff. It's just normal heat sink withdrawal and however the applicant does it, that's their responsibility. And we did not feel for a large river like that it is infeasible. I certainly did not think that.

JUDGE WARDWELL: If in fact you couldn't use the river because of the - well, let me back up a bit. You testified that that intake structure can be built without any dredging. Not to get capacity, just to physically get that into the river and protect it from any future activities that takes place in the river, you can do that without dredging any sediments?

WITNESS BAGCHI: Whatever is necessary to construct a pipeline to lay it out into the river channel to ensure that it is permanently below the level of water where there will be a constant flow of water available or in other words below the low water elevation of the river, substantially below that, depending on the pumps used and so on. Laying out a pipe and then withdrawing from that does not in my mind require a dredging.

WITNESS VAIL: This is Lance Vail. And again, I worked on the environmental review. And there was going to be a dredging in the embayment area. The construction of a surface diffuser and stuff would not necessarily require dredging activities, although potentially may move out, depends I think on the time of year when they would actually be able to do the construction on the level of the river and stuff. So there would be some dredging potential and stuff that would go on in there. But in the environmental review, we specifically did not consider the cost-benefit of these activities and our determination was that it was technically feasible. Whether it's economically feasible was not considered. And so we did not address that issue. So the fact is that this becomes hazardous waste and it results in significant costs to the applicant to dispose of that waste, that was not considered as part of our analysis.

JUDGE WARDWELL: Under the environmental order, I understand that.

WITNESS VAIL: Under the environmental.

WITNESS BAGCHI: And under safety - this is Goutam Bagchi again. Under safety, it is not a safety-related structure. We don't worry about that.

JUDGE WARDWELL: If for whatever reason you couldn't take water out of the river or put water back into the river, how would you do that at this site? Those activities? How would you provide the water for the heat sink makeup?

WITNESS BAGCHI: Do we need water?

There are proposed plants where the plant is dry cooling.

JUDGE WARDWELL: And is that what would have to take place at this site if in fact you couldn't use the river?

WITNESS BAGCHI: We don't need to speculate at this point. They have not explored that issue. We don't need to speculate how they're going to cool the normal population of the plant.

JUDGE WARDWELL: Well, we do under this hypothesis have to explore that, and that's what I'm trying to get a better feeling. While the makeup water is not a direct safety-related, isn't it tied to it such that you would be - that it would make it as a decision being that it isn't an effective site to be permitted?

WITNESS BAGCHI: I think they discussed the potential for using an underground basin for the ultimate heat sink source, and any makeup would really be the makeup for the evaporation loss. Very minor loss. So that can be made up from wells and some other kinds of sources. There is nothing that I considered intrinsically at fault with the site that would not allow the location - siting a plant there.

JUDGE WARDWELL: But isn't it true that we haven't characterized the aquifers enough to determine the capacity associated with those?

WITNESS BAGCHI: That is true sir, but at this point, at Early Site Permit stage we are not even sure what kind of a reactor design they would employ that would require water-cooled ultimate heat sink. And we did not feel that this is the appropriate point at which we try to characterize all of the aquifers which then become disrupted by construction activities and our conclusions at this stage need to be revised later on. So I think it's wise and best to leave it for the COL application stage. We just need to determine whether or not a reactor could be safely sited at this site.

JUDGE WARDWELL: Any amplification or -

MS. SUTTON: And Your Honor -

JUDGE WARDWELL: - that the applicant -

MS. SUTTON: As a matter of law before they answer, I just would like to remark that this is calling for vast amounts of speculation in terms of the inability to withdraw or return water to the river. So they can answer but it is purely hypothetical and speculative.

JUDGE WARDWELL: It is a hypothesis that

the sediments have not been characterized whatsoever. We have no knowledge of what those sediments are like in the river, is that correct? Let me ask that.

WITNESS EVANS: Lori Evans for the applicant. It is correct that we did not characterize the sediments during the ESP stage. I also would like to address just generally the idea of the feasibility of using water from the Mississippi River. There are in fact a number of users of water from the Mississippi River both for industrial purposes and for public water supplies, both upstream and downstream of the plant.

JUDGE WARDWELL: And what I'm trying to get on the record is testimony that allows us to move forward without that characterization of the sediments. And not even, is this correct that not only have the sediments not been characterized, there is no information whatsoever on any of the chemical characteristics of the sediments? There hasn't been any sampling done of the sediments, is that correct or not?

WITNESS EVANS: Lori Evans for the applicant. Sediment sampling is done as part of Unit 1's routine radiological monitoring program.

And then there is additional limited data done by other agencies of the Mississippi River that was presented in the application.

JUDGE WARDWELL: And were those sediment quality parameters reviewed to assure yourself that it wouldn't be a problem in regards to handling sediments if needed during the construction of either the intake or the outfall structures?

WITNESS EVANS: We did not do that analysis.

JUDGE TRIKOUROS: Let me ask a question to maybe help this thing along a little bit. Is it possible for a plant, an existing plant that meets 10 C.F.R. § 20 requirements, all the normal release requirements, to result in sediment and in a river that it discharges to to be characterized as radwaste? Is that a physical possibility? The releases are monitored, the site - the environment external to the site is monitored. Is the postulation possible, that you would have a sedimentation in the river that would be characterized as radwaste from a nuclear power plant operating that meets all of its requirements for normal release? I think if the answer to that question is no, then I think it goes a long way towards answering Judge Wardwell's concern.

JUDGE MCDADE: Perhaps this isn't the panel that's going to be able to offer expert testimony in response to that. But sir, can you?

WITNESS KLEMENTOWICZ: Yes, my name is Steven Klementowicz. I'm a senior health physicist within NRR. And part of my significant experience is with the radiological environmental monitoring programs. Each operating nuclear power plant is required to have a REMP. As part of the REMP they are required to sample their discharge canal, the sediment. So during the environmental review that will be discussed later I believe in Issue I, we will present as part of our testimony that we did look at several years worth of REMP data. I do not have the information with me, but that is a part of an operating power plant to sample and analyze the sediment for plant-produced radionuclides. It does not do chemical analysis, but we are looking for licensed radioactive material being discharged.

JUDGE MCDADE: Okay. And just so, to make sure I understand at least the import of the testimony that you gave and going back to the previous witnesses, that first of all it is your testimony that you believe that you would be able to construct the necessary - any necessary intake and outflow structure without any significant dredging; that secondly, even if that were not possible and you were not able to withdraw water from the Mississippi that you did not believe that that would be a limiting factor making this an unsuitable site, that you would be able to get sufficient water from the aquifer without adversely affecting the aquifer. And using - designing the plant accordingly so that that would occur within the plant parameter envelope of this application. Is that a correct summary of what you were testifying to, or did I misunderstand?

WITNESS BAGCHI: Goutam Bagchi. I'm not implying that all of the water would have to come from the aquifers. Distribution of different cooling requirements can be designed. It's technically entirely feasible. The site does not in my opinion have any intrinsic fault that would allow siting of a plant here infeasible. I'm sorry, my English wasn't all that great. What I meant to say is that the site does not have any intrinsic impediment for siting a nuclear power plant.

JUDGE MCDADE: Okay, but Judge Wardwell's hypothesis, again he described this as a straw man hypothesis, was that you would not be able to withdraw water from the Mississippi River for the operation of the facility for whatever reason. Would that render this an inappropriate site for the plant, or within the plant parameter envelope of this application would you be able to proceed anyway to construct and operate the facility?

WITNESS BAGCHI: I think the permit-holder could proceed irrespective of the hypothesis made by Judge Wardwell.

JUDGE MCDADE: But nevertheless you believe that the hypothesis raised is unlikely, that based on your experience that you see no impediment to being - no realistic impediment to being able to use the water from the Mississippi?

WITNESS BAGCHI: I fully agree with that, Your Honor.

JUDGE WARDWELL: Let me just add one more, then we'll get to you. I'll complete the thought on this. I think I asked it before, but let me make sure I hear this. And you also testified that you could install the intake and outfall structures without any dredging if needed? In your opinion?

WITNESS BAGCHI: That is my personal opinion, yes sir.

JUDGE WARDWELL: How about your professional opinion?

WITNESS BAGCHI: Yes, professional opinion.

JUDGE WARDWELL: Thank you.

JUDGE MCDADE: Sir?

WITNESS ZINKE: George Zinke with the applicant. With regard to your hypothesis with regard to safety and the need for water for safety, our application proposed that if we pick a design, and the only designs that we're trying to bound with the application, if we pick a design that needs a source of safety-related water, then we would design a facility to have that water. Meaning that similar, and we said similar to with the Unit 1. What that means is that what we've done for Unit 1 is we designed and built a facility which holds the water. It has basins and it has the water, so that we do not - with our application we are not trying to permit using the Mississippi as a source for any safety-related water need.

JUDGE WARDWELL: Or any other water besides what's stored in your tank.

WITNESS ZINKE: Or any other water - yes. Or any other water other than what would be in a designed storage tank facility structure. And so therefore, at least that's how I understand the hypothesis and how our application is presented.

JUDGE WARDWELL: I think that's another nice nugget to have refuting this hypothesis. And let me just make sure I understand this correctly because this is the side that I don't gather. They call me the olo-ologist. I'm not a radioactive person. I know the ology side, not the other side. What needs do you have, or what facilities do you have, or what is required by the NRC to supplement the water that is in that storage tank that you now use as your ultimate heat sink that doesn't require any river water or groundwater for that matter.

WITNESS ZINKE: Okay, for the - and each design that we would look at and pick would have different requirements, so let me give as an example for our current Unit 1, the design requirements include things like it has to have a 30-day supply of water. And so then calculating the usage of the water for its safety-related needs, you know, following an accident, that 30 days would, you know, the water is there. That allows then post-30 days, depending upon the needs of that design, that we have a variety of ways of bringing in water, whether it would be trucked in, but it would, you know, we have a variety of ways of replenishing after the 30 days. So taking that as an example, what we would do with our Early Site Permit, if we pick a design, then we would design the structure with the regulatory guidance associated with the design we picked of how much water is needed, you know how long it's good for, what happens after water, the safety-related water needs, after that point in time. What are the ways of replenishing so that all of that then matches. And then all of that design factoring how much water you need, for what period of time, what happens after, that all gets put into the COL application with the design that's referenced, and then all that gets reviewed and reviewed against the staff's acceptance criteria at the COL.

JUDGE WARDWELL: Are the existing radial wells safety items?

WITNESS ZINKE: No, they are not.

JUDGE WARDWELL: Thank you. I think that helps clarify stuff. Anyone else like to add any more comments on this?

WITNESS KLEMENTOWICZ: Excuse me?

JUDGE WARDWELL: Yes.

WITNESS KLEMENTOWICZ: This is Steve Klementowicz again. I would like to add that there are nuclear power plants that do not discharge radioactive effluents into any body of water. And they operate, you know, very successfully. So that's just another piece, that they do not have to discharge their liquid radioactive effluents into a body of water. There are other methods to process that water and to dispose of it.

JUDGE WARDWELL: Thank you. The last one is one that I think was addressed fairly well, but I want to make sure we get it on the record and talk about it a bit. And that is that the desired withdrawal rate that was proposed by the applicant, something in the neighborhood I think of 3,700 gallons per minute from the Catahoula and the drawdown effects from the deeper zones during this process would have an adverse impact on the water quality in the upper zones of the Catahoula. And I'd just like to explore for a minute on why that wouldn't necessarily preclude this from being a viable site, the fact that it's unresolved in regards to what is the capacity of that Catahoula and then in turn what is the effects on the water quality in the upper zones caused by the upper gradients from the lower zones. And would someone from the staff like to comment on that?

WITNESS VAIL: Yes, this is Lance Vail. And just to make sure everyone understands, one of the unique interests of this site was the fact that this proposed site overlies a sole source aquifer that has a special designation within EPA and has specific requirements on activities that would involve federal agencies. So it has a particular interest in terms of any potential impacts to the water quality. The question as to the unresolved issue is in fact associated with the fact that the limited characterization data that we have with the Catahoula did not provide adequate basis for us to come up with a conclusion of the potential drawdown impacts on the Catahoula. However, in the ESP application, they did provide some information on the impacts of the existing wells that they have that are - we understood at the time were actually completed into the Catahoula. And now it's my understanding there may be some change in the definition of where those were actually completed. But we didn't have an adequate basis we felt to conclude that the drawdowns associated with that incremental water use would be small enough that it might not induce water of lower quality to either enter from above or below into the Catahoula.

JUDGE WARDWELL: Is there any circumstance where that would end up to be a fatal flaw if in fact even minimal pumping from the Catahoula would impact the upper zones of the sole source aquifer?

WITNESS VAIL: If - a fatal flaw.

JUDGE WARDWELL: Yes. And that - to translate that fatal flaw meaning that the site would be deemed unsuitable and that it shouldn't be granted an ESP permit.

WITNESS VAIL: If the Environmental Protection Agency in the consultation that's required under the Safe Drinking Water Act which is where the sole source provision is derived from, were to identify that the Catahoula cannot be used, then there would need to be an alternative source of water identified to replace the water from the Catahoula.

JUDGE TRIKOUROS: Is this going to be discussed as part of the presentation that's being made on alternatives, which includes - design alternatives, which includes, as I understand it, various ultimate heat sink options? Is this something that we're going to be talking about later as well?

WITNESS VAIL: At this point it's not in the presentation on alternatives.

JUDGE WARDWELL: We're speaking about that operational, I forgot the right word for it, incidental water of 3,700 gallons per minute that they're proposing to use out of the Catahoula and the potential impacts associated with using that.

WITNESS VAIL: Yes, and the staff's conclusion is that with the Mississippi River being adjacent, that if the Catahoula was to be determined to be inadequate, that it was highly likely that there would be an alternative source that could replace the water demand that was expected to come from the Catahoula. So that's a part of the rationale that we used as to why this would not make the site unsuitable.

JUDGE WARDWELL: Is there a reason - what is the reason why they have decided not to - do you know of the reason why they decided not to continue use of the radial wells and instead build an intake structure for any plant makeup water such that using a similar type of well for this 3,700 gallons per minute wouldn't be - the same reason it would apply to any type of other well that they might want to develop down there, to supply this 3,700 gallons per minute.

WITNESS VAIL: I wouldn't speculate, but I suspect the applicant can answer that.

WITNESS EVANS: This is Lori Evans for the applicant. There are actually various possibilities for obtaining water supply. The Catahoula formation is a possibility. There are documented wells in the area in the Catahoula formation with discharges ranging from I think approximately 200 to 500 gallons per minute. The radial wells do have a very large capacity and theoretically could be used as a supply. The Mississippi River could be used as a supply. So there are multiple potential sources available.

And as far as the Catahoula formation is concerned, I wanted to add that there are two regulatory safeguards that would prevent us from negatively impacting the Catahoula aquifer. First is the sole source for designation which would require review, and then the second would be the state withdrawal permit. The state could deny a withdrawal permit or could reduce the quantity that could be withdrawn.

JUDGE WARDWELL: Thank you for that, but that to me amplifies the need to think a little harder on alternative sources because without definition of what that response to the Catahoula to any pumping would be in regards to potential impacts says that if there isn't alternative sources that may be a detrimental site characteristic for placing a plant at this facility. Do you know of the reason why radial wells aren't being considered for the intake structure that are now being used for the existing plant?

WITNESS EVANS: Lori Evans for the applicant. Yes, we did do a cursory review. There have been numerous detailed studies done for radial well production and it was determined that they would not have an adequate production capacity for plant service water for a new unit. However, it is possible that a radial well could be used for this other water which would be the 3,570 number that you're -

JUDGE WARDWELL: As opposed to what number that's needed for plant service water?

WITNESS EVANS: Correct.

JUDGE WARDWELL: No, what is that number, do you know off the top approximately?

WITNESS EVANS: I don't know off the top of my head.

JUDGE WARDWELL: Does anyone know what that is? It'd be nice to just.

MS. SUTTON: Mr. Zinke will answer that question.

JUDGE WARDWELL: Yes.

MS. SUTTON: Your Honor, we would like to introduce another witness to answer that question, Mr. Al Schneider. His professional qualifications are included in SERI Exhibit 1 and his pre-filed testimony has been entered into the record.

JUDGE MCDADE: Okay. Do you swear that the testimony that you give or state that the testimony that you give under penalty of perjury is true and correct, will be true and correct?

WHEREUPON,

ALCUIN SCHNEIDER

was duly sworn and assumed the witness stand.

JUDGE MCDADE: Okay, you are under oath. Please proceed. And given the fact that I'm mumbling that, it may be worthwhile for us after we finish this particular thing to take a few minute break. I think the temperature here under the lights is getting up over 100. So I need to go out and change my shirt I think. But sir? That's probably more information than we really need. The image of that at least.

MR. SCHNEIDER: I'm Al Schneider with Enercon Services speaking for the applicant. The ER has a figure, 2.3-29. I don't know that it's an exhibit, but the makeup water for the plant is 78,000 gallons a minute. And there's an additional -- in the PPE or in this figure we had an additional 3,400 gallons a minute for ultimate heat sink makeup if that were required. And then the miscellaneous makeup of 3,570 gallons a minute all added up to about 85,000.

CLERK: Can you speak closer into the mic?

MR. SCHNEIDER: Okay. A total of about 85,000 makeup was required. And based on the information that exists for the aquifers where the radial wells are installed, they just don't have the capacity.

JUDGE WARDWELL: Do you know about what the capacity, what the yield is of any one of those radial wells? Within an order of magnitude.

MR. SCHNEIDER: Eight thousand gallons a minute.

JUDGE WARDWELL: Thank you. That handles - unless there's something else anyone else would like to add on this issue, I think that satisfies my questions.

JUDGE MCDADE: Do you have anything before we take a break?

JUDGE TRIKOUROS: No, not before we take a break.

JUDGE MCDADE: Okay. It's now about 2:35. If we take a 15-minute break until 2:40, does that work for staff?

MR. RUND: That's fine.

JUDGE MCDADE: The applicant?

MS. SUTTON: Yes, Your Honor.

JUDGE MCDADE: We're in recess.

(Whereupon, the foregoing matter went off the record at 2:37 p.m. and went back on the record at 2:56 p.m.)

JUDGE MCDADE: The hearing will come to order. Before we proceed with the questioning, let me just go through a couple of preliminary things procedurally here. We anticipate we've got only a very short additional questioning on Hearing Exhibit

A. We're then going to move ahead to Hearing Exhibit B. I anticipate that our questioning on Hearing Exhibit B should probably take about an hour, give or take. We would then move on to Hearing Exhibit D. We had indicated to you the other day that we did not anticipate needing any witnesses on Hearing Exhibit C given the fact that there was - given our review of the pre-filed testimony on Exhibit C. Upon further review it appears that there's one brief question. I know the staff has a Dr. Li as the individual. We told you you didn't have to have him available here. If he is readily available and you can bring him over today that's fine. If he isn't, tomorrow, again it should be a relatively short, you know, just a matter of a few minutes.

JUDGE WARDWELL: Well, let me ask this. Maybe someone on this panel or the applicant's panel or someone else here might be able to address this. The only question I have was what is the seismic acceleration coefficient for the site if someone was going to do a pseudostatic analysis. And someone here - if someone can answer that just say that you can and we'll ask that question appropriately and then we don't have to worry about getting the seismologist here.

MR. CAMPBELL: Your Honor, this is Tison Campbell for the staff. Yung Li is in the audience so he can come forward when necessary.

JUDGE WARDWELL: Unless the applicant could answer that question. The design seismic acceleration coefficient.

MS. SUTTON: One moment, Your Honor.

WITNESS BAGCHI: Your Honor, could you kindly say that again, please?

JUDGE WARDWELL: Yes. I'm interested in what is the seismic acceleration coefficient that would be used in a simplistic analysis like a pseudostatic stability analysis or something like that for the site. The 0.whatever or the 0.1-something g that would be used as an acceleration coefficient.

WITNESS BAGCHI: The minimum design requirement in Appendix -

JUDGE WARDWELL: I don't want testimony now, I just want to know whether anyone can testify that's here so that we don't have to bring in the seismologist. Because oftentimes a geotech engineer or someone else will be able to testify to what that value is for this site.

MS. SUTTON: Your Honor, our witnesses cannot answer that question.

JUDGE MCDADE: So let's move along, finish -

MR. RUND: I'm not sure if our witnesses can, but our witness is here so when we get to that question we can bring him up and swear him in.

JUDGE MCDADE: Judge Trikouros?

JUDGE TRIKOUROS: I'd like to just close out the Hearing Issue A with a simple question, I think. There's a statement made on Page 3 of the pre-filed testimony that says that Permit Condition 2 precludes the release from the radwaste system, eliminates the necessity for further characterization. The first part of my question is, is that referring to the ESP stage or forever?

WITNESS BAGCHI: This is Goutam Bagchi with the staff. The Early Site Permit Condition, Condition Number 2 is intended to be executed for the plant design operation until plant shutdown.

JUDGE TRIKOUROS: Until what, I'm sorry?

WITNESS BAGCHI: Until plant shutdown.

JUDGE TRIKOUROS: For plant life, the entire plant life?

WITNESS BAGCHI: Right, the entire plant

life.

JUDGE TRIKOUROS: So -

WITNESS BAGCHI: I have a presentation with two slides. If you want to get into the feasibility of this permit condition, the reasons why we put it there, what are the requirements, I have gone into a little bit of detail and I have a presentation with just two slides. I could do that now.

JUDGE TRIKOUROS: When were you planning to do it, as part of B?

WITNESS BAGCHI: It's at your convenience, Your Honor.

JUDGE TRIKOUROS: If you were not planning it, then I'd like to hear it now. If you have it planned for some point down the road, then we'll wait. But there are other questions on Permit Condition 2 as well.

JUDGE WARDWELL: I think it'd be worthwhile because it also will also blend into Hearing Condition B nicely. So I think this is as good an opportunity if you're prepared to do that now. I think we'd appreciate it.

WITNESS BAGCHI: There are two slides related to issues on, let's see, accidental release issues. There are only two slides there, but I will make the presentation and describe my reasoning for presenting the slide, the material in the slides.

JUDGE WARDWELL: Okay. And those have been marked as an exhibit?

WITNESS BAGCHI: The presentation material has not been, Your Honor.

MR. RUND: The slides have been marked as an exhibit. If you just give us one moment we'll figure out which slides those are in and we may even be able to get that up on the display.

JUDGE MCDADE: That's fine.

MR. RUND: I believe the slide we're talking about appears in Staff Exhibit Number 18 which is the presentation slides for Hearing Issue H.

JUDGE TRIKOUROS: Did you say Staff Exhibit 18?

MR. RUND: I apologize.

JUDGE MCDADE: Staff 18?

MR. RUND: I'm sorry, that's Staff 19 for Issue I.

MR. CAMPBELL: Your Honor, it's Slides 51 and 52 from that exhibit.

JUDGE TRIKOUROS: I'm sorry, did you say

51 and 52 or 61 and 62?

MR. CAMPBELL: Fifty-one and 52.

JUDGE TRIKOUROS: Fifty-one and 52.

MR. CAMPBELL: Yes, sir.

JUDGE MCDADE: Okay, this is Staff Exhibit 19, Page 52 headed Accidental Release Issues. Is that where you are?

WITNESS BAGCHI: Yes, Your Honor.

JUDGE MCDADE: Okay, let her rip.

WITNESS BAGCHI: My presentation is on issues related to accidental release of liquid radioactive effluents. I will talk about the feasibility of Permit Condition 2, groundwater monitoring requirements associated with accidental release and the need for radwaste tank failure analysis at the COL stage.

A robust design such as that of safety-related structures, systems and components provides a reasonable assurance that the radwaste facility, including the liquid effluent-containing tanks, will not fail under postulated accidents and extreme natural hazards. Locating the radwaste facility on the nuclear island or on the power block itself enhances containment of accidental radioactive effluent spillage. Radwaste facilities are to be designed to prevent uncontrolled release of radioactive materials caused by spillage in buildings or from outdoor components. All tanks inside and outside the plant, including contents of storage tanks, should have provisions to monitor liquid levels. Designated high liquid level conditions should actuate alarms both locally and in the control room. There are over several thousand reactor years worth of operating experience to date, but there has never been any accidental liquid radioactive release event from radwaste facilities.

There is no groundwater monitoring requirement for accidental releases. Accidental release of liquid radioactive effluent is such a rare event that it can be directly associated with the plant where the event occurred. Due to construction activities associated with new reactor designs, it is not appropriate to use site properties at the ESP stage to establish an effective monitoring plan. And then let's go to Slide 2, the next slide.

As I indicated earlier, there is no groundwater monitoring requirement associated with accidental liquid radioactive effluent releases. An accidental release event is so rare that the plant is immediately identified. At the ESP stage it's not appropriate to establish a monitoring plan. As I described in my previous discussion, radwaste tank design is robust and there is reasonable assurance that the radwaste facility and the associated tanks will withstand the effects of extreme natural hazards and postulated accident conditions. Currently existing guidance should ensure the robustness of radwaste facility design during the review at the COL stage. There are requirements for alarmed monitoring of liquid effluent. This is kind of repeating myself, so I'll dispense with that.

Retention by an intermediate sump or drain tank that is designed for handling radioactive materials and that has provisions for routing to liquid radwaste system is also acceptable. Indoor radwaste tanks should have curbs or elevated thresholds with flow drains routed to liquid radwaste treatment system. Outdoor tanks should have dyke or retention point capable of preventing runoff in the event of a tank overflow and should have provisions for sampling collected liquids and routing them to the liquid radwaste system. The staff conclusions related to the hydrological safety of the proposed ESP site are based on the comprehensive and independent review of the site characteristics. Conformance to applicable regulations and in cognizance of the regulations and regulatory criteria that are applicable at the COL stage. That was my prepared presentation.

JUDGE TRIKOUROS: So what you're saying is that in answer to my original question with respect to whether the lack of site characterization requirement was for the ESP only, you're saying no, it is for the ESP and COL, for operation of the plant through the end of its design life.

WITNESS BAGCHI: That's correct, Your Honor.

JUDGE TRIKOUROS: Okay. And you're saying that that is true of both radwaste liquid inventory inside a radwaste building in addition to any radwaste that's stored in outside tanks?

WITNESS BAGCHI: Yes, Your Honor. This is the philosophy of regulating radwaste facilities as it exists today. Regulatory Guide 1.143 provides all these requirements.

JUDGE TRIKOUROS: Are there any plants in existence today that you know of that has this requirement? Or is this a new requirement associated with the next generation plant?

WITNESS BAGCHI: It was revised fairly recently. I don't have the data revision, but no, not all existing plants have this.

JUDGE TRIKOUROS: Because as far as I know, the liquid radwaste tank failure is a design basis accident for - at least, wherever I've looked. I can't say I've looked at every plant in the country. But you're saying in essence, and specifically in your slide, that the liquid radwaste tank failure is no longer a design basis accident for this plant, whatever plant - as a permit condition requirement.

WITNESS BAGCHI: That's my understanding. That's how it can be executed and carried out. This regulatory guide was revised in November 2001.

JUDGE TRIKOUROS: Now one of the things that I have a little bit of concern with is the statement that you made regarding the fact that any leakage from the tank - specifically I'm concerned with outdoor tanks, not so much indoor tanks. I think indoor tanks you can show that with proper sump flows to holdup tanks and you know, properly designed containment walls and liners you could effectively meet your Permit Condition 2 with a very, very high likelihood for any indoor system. But with respect to the outdoor tanks, you indicated that one of the reasons it's acceptable is that there would be a liquid level monitoring which really would mean that you would know that it leaked, not that you would prevent it from leaking.

WITNESS BAGCHI: Your Honor, you prevent it from spreading because you have to have curbs and other requirements in this regulatory guide.

JUDGE WARDWELL: You'd have to have what, I'm sorry?

WITNESS BAGCHI: Curbs around the tank.

JUDGE WARDWELL: Oh, curbs.

JUDGE TRIKOUROS: All right, so what you're -

WITNESS BAGCHI: Inside and outside.

JUDGE TRIKOUROS: All right. So you're saying basically that the staff would to some very high probability assure that the design of these systems would be leak-proof? As far as getting into the groundwater, getting into the earth?

WITNESS BAGCHI: I didn't say leak-proof, but I did say that it would not get into the ground or surface water with high likelihood of success.

JUDGE TRIKOUROS: All right, now what about other leakage from other sources. For example, spent fuel pool leakage, leakage in possibly other tanks that may be onsite, piping, possibly underground piping. Analogous to the problems that have been identified in plants throughout the country and as evaluated in the lessons learned task force report. So radwaste not being the only source of radioactive material that might get onto the ground.

WITNESS BAGCHI: I am aware of some of the conclusions drawn there, that that's routine release. But before I give it to my colleague Mr. Klementowicz, he's going to address the lessons learned related issues. But am going to try to address the other factors of design. By design you could have guard pipes. By design you're required to consider relative displacement between buildings and between anchors of piping. So there are plenty of ways to meet this criteria. It is eminently feasible to do this.

JUDGE TRIKOUROS: And you're saying it applies to not only radwaste, but to all sources of radioactivity onsite that might get into the groundwater?

WITNESS BAGCHI: Low level radioactivity I'm not going to address. That's routine release and Steve will address that. Please forgive me, I didn't relate to that.

JUDGE WARDWELL: I heard phrases like "very high likelihood." I heard phrases like "reasonable assurances that it wouldn't get into the groundwater." However, when I read the permit condition, those aren't the words that are used in the permit condition. The permit condition says preclude any and all accidental releases. It's hard for me to envision anyone designing something precluding any and all, because the criteria as I read it is not a very high likelihood or reasonable assurances. How do you address that?

JUDGE TRIKOUROS: And also, the permit condition says radwaste, if I remember correctly.

JUDGE WARDWELL: Yes, it's specific to radwaste systems.

JUDGE TRIKOUROS: It doesn't cover other radioactivity.

JUDGE WARDWELL: Right, correct.

WITNESS BAGCHI: Any and all is probably a little too strong, but in reality it can be achieved. That's my belief.

JUDGE WARDWELL: I think you were mentioning detention ponds. The radwaste systems do include pipes conveying this radwaste liquid to various locations of the outdoor tanks, indoor tanks, et cetera, and those pipes are part of the radwaste system or aren't they?

WITNESS BAGCHI: Next generation plants don't have those.

JUDGE WARDWELL: They don't have any piping connecting?

WITNESS BAGCHI: They - some designs might, but most designs don't.

JUDGE WARDWELL: But if some designs do as far as ESP stage, we have to still consider that.

WITNESS BAGCHI: Consider that a possibility, yes.

JUDGE WARDWELL: Okay.

JUDGE TRIKOUROS: Now with - this is strictly associated with liquid radwaste leakage we're talking about.

WITNESS BAGCHI: Yes, sir.

JUDGE TRIKOUROS: Not gaseous. So analysis of gaseous radwaste tank failures would still be design basis accidents?

WITNESS BAGCHI: That would be addressed

by someone else in the staff.

JUDGE TRIKOUROS: Okay.

WITNESS BAGCHI: I will not try to address that.

JUDGE WARDWELL: I have another question for you. If - even given the fact that there's maybe comfort that designs could be developed to preclude any and all accidental releases, is there not still a necessity to do something to assure that those designs are functioning?

WITNESS BAGCHI: If we have appropriate alarms, appropriate indications that these things are not working properly, plant operator would know.

JUDGE WARDWELL: Well, and those alarms are, I would assume, part of the monitoring. That's monitoring.

WITNESS BAGCHI: Yes, sir.

JUDGE WARDWELL: And that lets you know that there's been some release, that in fact the designs aren't working. Isn't it logical also then to include some type of monitoring around those systems to verify that when those alarms went off there wasn't a release to the adjacent environment?

WITNESS BAGCHI: I believe there is radiation monitoring instrumentation equipment in the plant.

JUDGE WARDWELL: Let me rephrase the question I guess. Isn't there a need to monitor the adjacent groundwater around the radwaste systems if in fact you are going to issue this as a permit condition to verify that in fact you are precluding any and all accidental releases of radionuclides from the radwaste system into a liquid pathway which would be the groundwater.

WITNESS BAGCHI: We probably don't need to do that at the ESP stage. At the COL stage when you do have a design, we know the proper locations of everything, there will be an adequate review to determine whether or not we need groundwater monitoring system for radioactivity.

JUDGE WARDWELL: Isn't it reasonable to assume that you would if in fact you're going to have a permit condition like this as the only mechanism to assure that you are precluding any and all? I'm not saying defining what it is, I'm just saying isn't it logical to assume that there will be some sort of groundwater monitoring around the radwaste systems, however defined it is at the COL stage, to assure that this permit condition is being achieved.

WITNESS BAGCHI: Your Honor, conceptually you're looking forward and perhaps there is nothing wrong with that, nothing wrong with what you've suggested. But in order to have an effective plan, we would have to speculate where these things are going to be. Just to have a generality that there shall be some kind of a monitoring is not very effective or attractive to me.

JUDGE WARDWELL: It may not be attractive, but there will be a reason why we need to address that as we'll see later on in our questioning. So let me ask you this question. In your professional opinion, do you think it is likely in order to assure that this permit condition is being achieved that there will be some groundwater monitoring around the radwaste systems? Yes or no.

WITNESS BAGCHI: There are other ways to achieve that. For example, having hydraulic gradient towards, concentrated towards the radwaste facility. There are so many ways to do that aside from just -

JUDGE WARDWELL: I'll ask the question one more time and then I'll quit asking it. In your professional opinion do you believe it is likely that there will be some sort of groundwater monitoring related to the radwaste system that will be implemented to assure that the applicant is achieving this permit condition which requires them to design that system to preclude any and all accidental releases of radionuclides into the potential liquid pathway?

WITNESS BAGCHI: It would be a reasonable measure to implement at that stage.

JUDGE WARDWELL: Thank you.

JUDGE MCDADE: Let me interject something here. I just want to make sure that I understand it, that in response to an earlier question from Judge Wardwell, I thought you said that "any and all" might be a bit of an overstatement. Am I correct? Is that what you said?

WITNESS BAGCHI: I did say that, Your Honor.

JUDGE MCDADE: Now, the way the permit condition is currently worded, if we were to approve the application as currently worded that would be a requirement and they would be in violation if the system did not in fact preclude any and all. Are you suggesting that that permit condition be modified?

WITNESS BAGCHI: No, Your Honor. I think the permit condition can be achieved through design.

JUDGE MCDADE: But that permit condition is preclude any and all.

WITNESS BAGCHI: Yes, Your Honor. With a strong emphasis on the design itself it could be achieved, so at this point I would say that the permit condition is restrictive but not unreasonable.

JUDGE MCDADE: Okay. So we start out with the premise that any and all release of radwaste is prohibited. But we now talk about accidental, and obviously accidental by its definition is accidental. As I understand it, you say we don't need a ground - and on your slide Page 51 of Exhibit 19 you indicate that groundwater monitoring is not required for accidental release, and I believe the reason that you said is because of other systems within the plant. If there were such a release, you would be aware of it at the time and would be able to take appropriate action and be able to determine whether or not the engineering did in fact prevent the release of any and all of the radwaste, is that correct?

WITNESS BAGCHI: Yes, Your Honor.

JUDGE MCDADE: Okay. And am I correct that you believe that that - the design plus those additional engineering factors within inside the plant are sufficient to ensure that the condition is being met, that there is not in fact any radwaste that is being released into the groundwater?

WITNESS BAGCHI: That's a correct interpretation of what I wanted to say. Yes, sir.

JUDGE MCDADE: Okay. And in your professional opinion no more is required. Because under the permit no more is required.

WITNESS BAGCHI: That is - yes, and I will preface that by saying the following. We do the reactor design with all kinds of preventive measures and defense-in-depth and all those other kinds of safeguards. Nevertheless, accidents can happen.

JUDGE MCDADE: Okay. But as I understand on this, the condition is that even if an accident happens, it will be designed so that there will not be a release. And you believe that there are sufficient monitoring devices within the facility that no separate monitoring of groundwater is necessary in order for the NRC to ensure that this permit condition is being met throughout the operating life of the facility. Am I correctly interpreting what I think you're saying?

WITNESS BAGCHI: Yes, sir.

JUDGE MCDADE: Okay.

JUDGE WARDWELL: And does that include what you labeled as outside tanks? Or maybe it was one of the judges on the panel.

WITNESS BAGCHI: It can be designed that way, yes sir.

JUDGE MCDADE: Okay. Does the applicant have anything to add to that?

WITNESS MORRIS: Marvin Morris for the applicant. I guess I'd just like to clarify that our understanding is that the permit condition only applies to liquid radwaste.

JUDGE MCDADE: That's what we're talking about.

WITNESS MORRIS: Okay. Secondly, I think groundwater monitoring to prevent the release to the environment is kind of after the fact.

JUDGE MCDADE: Well, it's to identify as opposed to preclude.

WITNESS MORRIS: Right.

JUDGE MCDADE: It identifies it.

WITNESS MORRIS: As far as meeting the permit condition, what you would do is to monitor the tank failure itself or the possibility of the tank failure to make sure that there is no release instead of monitoring the ground to find out that you had one.

JUDGE WARDWELL: How does the tank get filled if it's an outside tank?

WITNESS MORRIS: Well, if you have an outside tank it's filled from the radwaste system inside, the components inside.

JUDGE WARDWELL: But how does it get from the outside to the inside?

WITNESS MORRIS: It's generally piped.

JUDGE WARDWELL: Is that pipe - are there any pipes that are below - are there any pipes that are not visible?

WITNESS MORRIS: I think if you had buried pipes and you had to meet this permit condition, you would have to put guard pipes to ensure that if there were any leaks that they would be contained.

JUDGE WARDWELL: And your definition of a guard pipe is a pipe within a pipe?

WITNESS MORRIS: That's correct.

JUDGE WARDWELL: And what -

WITNESS MORRIS: I'm sorry?

JUDGE MCDADE: A subterranean gutter?

JUDGE WARDWELL: A pipe within a pipe. What assurances are you that the guard pipe will not leak?

WITNESS MORRIS: Well -

JUDGE WARDWELL: Whatever caused the original pipe to leak may cause this one.

WITNESS ZINKE: George Zinke with the applicant. I think we are - we're going down a strange path because the Early Site Permit focused on site issues and the questions that Marvin is trying to answer have to do with what are the features of the design, which is something that gets specified within the, like a design certification licensing process. There is an interface, so when the staff has presented this license condition, we understand the permit condition places on us the requirement to pick a design that meets - that the staff has determined has met their design requirement. So the requirements of that design and how the staff reviews what are the specific requirements in order to meet the staff's words get reviewed when the staff reviews the design. It doesn't get - it's not associated with the Early Site Permit.

JUDGE WARDWELL: Right, and I certainly understand that. And the reason I was asking these questions leads us into Hearing Issue B because the hypothesis, to just give you a preview attraction of what's going to come next, is that the hypothesis states that there is - to achieve this condition, to assure that this condition is met, there will be groundwater monitoring. Because that's the only way to assure that this condition is met. Now that's a hypothesis. Let's refute it. So don't look at me cross-eyed and say you're nuts. The point that I'm raising, this doesn't say it's my hypothesis. It's our straw man one that we need something on the record to say this is a lousy hypothesis. But the lousy hypothesis I am presenting says there will be groundwater monitoring because there is no way to design absolutely to assure that as is stated in the permit condition precluding any and all. That's an absolute, that's not a gray area. Therefore, the only way to assure that the applicant's meeting that is there's going to be groundwater monitoring. Now, this site, to continue on with our hypothesis, has such adverse existing conditions in the groundwater that a person is unable to detect any type of accidental release from the radwaste system. That's where we're going to go with Issue B, and that's why I was leading this question of it seems - I do not know of any design that precludes this from ever happening. And so I want to get some support for where that comes back to at an Early Site Permit unless you've characterized what the existing contamination or lack of contamination is, i.e., the baseline conditions for the ESP plant. You don't know where you're at at this point whether or not. You could have an adverse situation at that plant right now that would preclude us from using groundwater monitoring in regards to meeting this permit condition.

MS. SUTTON: Given that prelude, Your Honor, to Issue B it seems that the first part of your hypothesis was just addressed through the line of questioning between Judge McDade and Mr. Bagchi.

JUDGE WARDWELL: Right, it is. I'm satisfied, I just wanted to address why I understood what he was saying.

MS. SUTTON: I understand.

JUDGE WARDWELL: That doesn't refute why

we're at - why we went under A anyhow, and we haven't even gotten into B yet. I just wanted to give you a highlight of where I was going with this. I am not after what is your design there at the COL stage. I am just trying to give a flavor for what's there, why there's some potential for it and why someone could easily make that hypothesis at the ESP stage to say you've got an unmonitorable site because there are sites that are unmonitorable, not necessarily power plants, but there's lots of other environmental sites where people - there are other sites where people wanted to build something that are unmonitorable and it precluded that construction because you can't tell whether or not the site is performing as you wish it to. That's where I'm going with it.

WITNESS ZINKE: Yes sir, and I understand where you're headed. The part of the hypothesis that doesn't fit with what we have to do as the applicant with the license condition is that I do not have the choice of saying that this design plus ground monitoring meets that license condition. I don't have that option in order to say that meets the license condition. The license condition says the design has to prevent. Ground monitoring can't prevent. So I cannot add any form of ground monitoring and say well now I meet that license condition.

JUDGE WARDWELL: Right, but the regulatory staff, in order to comfort themselves that you are meeting that, besides just your word, oh I promise and here's my design, that concrete will never leak. Well, we know concrete leaks. Those liners in the detention pump will never leak. Well, we know they leak. So let me just finish this. Go ahead.

JUDGE MCDADE: I was just going to say, for our purposes at the Early Site Permit stage, the question is whether or not there has been an adequate characterization of the existing conditions so that if there is an accident subsequently, that will be determined. And whether or not it is appropriate for us to have a condition for additional characterization of the existing conditions as a condition of the Early Site Permit. Am I correctly interpreting where we are on this?

JUDGE WARDWELL: Well, we aren't there yet because we're not in Issue B yet. So that's where we'll go, but not to the degree you think -

JUDGE TRIKOUROS: You've indicated that the staff will review the design of the radwaste system. It will review it at the COL stage, possibly as part of the DCD, and determine for themselves. I'm assuming it'll involve some sort of an engineering plus probabilistic risk analysis, possibly procedural evaluation, to assure themselves that the design criterion is met. That's what I think I heard. It will be evaluated at that level.

With respect to leakage, what I also heard was that level indications on tanks, possibly radwaste indication, rad monitoring indications inside of buildings, et cetera. Some design method will be utilized to give - for the staff to have comfort that they're meeting that permit condition. That's what I heard.

I also heard that as a result of that there will be no onsite characterization either at the ESP stage or at the COL stage. I asked the question regarding the lessons learned task force and I didn't get an answer to that question. I understand that those recommendations are not yet haven't been promulgated into formal requirements, but I'm simply asking that it is likely, given the circumstances, that they may be. Is there anything that can be done as part of this Early Site Permit to capture that, and is there any reason to do that as part of the Early Site Permit? Because we're talking about systems, not radwaste.

WITNESS KLEMENTOWICZ: Yes, this is Steve Klementowicz. I worked on the lessons learned task force report. I wrote the health physics regulatory requirement section. You threw out a lot of items that we addressed in the lessons learned task force. Let me just start by saying our conclusion about the regulatory requirements. There are no existing regulatory requirements that require either an ESP or a currently operating facility to have groundwater monitoring to detect inadvertent releases. That was our conclusion. So bringing that forward to an ESP, there are no regulatory requirements that the staff could impose to require onsite groundwater monitoring. And you're correct, the recommendations in the task force report were recently the subject of a Commission vote. And it was decided that those recommendations would not be subject to Commission follow-up, that it would remain within the program office to appropriately address those recommendations. So the staff does not know or have a sense or feeling if those recommendations will become regulations or not.

JUDGE TRIKOUROS: So what you're saying is the ESP should not address it at all?

WITNESS KLEMENTOWICZ: I'm saying that the staff has no regulations to back up if it were to say onsite groundwater monitoring is a permit condition. I have nothing, no legal regulatory basis to cite for that. Our existing - in my testimony I did discuss that the radiological environmental monitoring program, the REMP, is primarily an offsite monitoring program. There is a provision that if the licensee is using any onsite water for drinking water purposes or for their personnel, then that water must be included in the REMP. Very few operating facilities actually perform onsite water monitoring. Most have chosen to import water from offsite. In discussion with the applicant and review of their environmental monitoring report, they do in fact have an onsite well. But I could not even venture to guess that that would be able to adequately pick up any inadvertent releases from any of the radwaste systems.

JUDGE TRIKOUROS: It sounds like you're saying there is no basis for including any discussion of this subject in the ESP.

WITNESS KLEMENTOWICZ: That's correct, that's what I'm saying.

JUDGE WARDWELL: And are you saying that in regards to the need to characterize the aquifer both in regards to existing impacts from the existing plant, background let's just call it now existing water quality and transport mechanisms?

WITNESS KLEMENTOWICZ: This is Steve Klementowicz. What I'm saying is, well, I do not have any knowledge or expertise in that area. What my expertise is in effluent monitoring and environmental monitoring. The issue you're addressing is the quality of the aquifer and I only deal with the radiological releases and the surveys and monitoring required to make a dose assessment from them. So I can't address that.

JUDGE TRIKOUROS: Let's assume that this plant has a liquid radwaste tank failure that it's an outdoor tank, that somehow it gets into the groundwater by virtue of some operator error perhaps or some unanticipated situation which would then be an event that was outside the design basis of the plant. Do I assume then that what would happen there is that an analysis would be done of the radiological effects of that release and a report issued, et cetera, that that would be basically the implications of that?

WITNESS KLEMENTOWICZ: Let me give you the larger picture for outside tanks. There is a technical specification, a condition which limits the quantity of radioactive material that can be contained in that outside tank. The basis for that control is to limit the concentrations of radionuclides that they will be less than the effluent concentrations contained in Table 2 of Appendix B to 10 C.F.R. Part 20. Should there be an uncontrolled release of that tank so that the concentrations would not exceed those Appendix B values at the unrestricted area. So I have a little bit of a differing opinion here. The NRC has a tech spec condition that gives some credit that these tanks may have an uncontrolled release and therefore we have limited the potential health impact by limiting the amount of radioactive material that can be contained in those outside tanks to keep it within the limits of 10 C.F.R. Part 20. So that's the basis for those tanks.

As far as the inadvertent release, 10 C.F.R. Part 20, 20.1501 requires surveys and monitoring commensurate with the radiological hazard of a discharge. And we have practical experience, if you obviously have read the lessons learned task force report, of numerous facilities that have leaked from their spent fuel pool or have had a radioactive waste line corrode and leak into the ground. Once that becomes - once that information appears, the licensee is required pursuant to 20.1501 to perform surveys and radiological monitoring to assess, evaluate and to see if there is any dose impact to workers and to members of the public.

JUDGE WARDWELL: This is onsite monitoring we're talking about.

WITNESS KLEMENTOWICZ: Yes.

JUDGE WARDWELL: And would that include groundwater monitoring?

WITNESS KLEMENTOWICZ: Yes.

JUDGE WARDWELL: If in fact that it's unknown what the existing was before this would happen, how would you know whether it was coming from the recent - and again, rather than a failure, I like to just use, you know, small leakage out of this over a long period of time and all of a sudden you're concerned about. Isn't there a possibility that you'd be unable to discriminate between what was there before and what has occurred from this recent incident?

WITNESS KLEMENTOWICZ: Yes.

JUDGE WARDWELL: And how do we address that - and isn't that a fundamental site characteristic that in fact if the existing groundwater was in such shape that it would preclude what you just mentioned as what would take place if there was indications of a potential problem, a potential release from an outside radwaste system, that it would preclude this site from being an acceptable site.

JUDGE TRIKOUROS: Let me just interrupt. Is groundwater monitored offsite?

WITNESS KLEMENTOWICZ: Yes. It's a requirement as part of the REMP.

JUDGE TRIKOUROS: All right. So the only indication you would have with respect to Judge Wardwell's question would be offsite, changes in the offsite monitoring data?

WITNESS KLEMENTOWICZ: And there would - if the - well, let's talk about currently operating plant. If they use the groundwater, onsite groundwater for any purposes for their personnel, then that must be included in their monitoring program. So if they did detect licensed radioactive material, they would have some indication that something is unusual.

Going back to the regulation 20.1501, yes, that is an after the fact once you discover that there has been a leak or that you have radioactive material where you didn't expect it, and that's where the regulation kicks in that you shall do this monitoring and evaluation. The lessons learned task force report did acknowledge that there could be inadvertent discharges that could be undetected until they reached the unrestricted area. And that's why the recommendations were put in that the NRC needs to consider additional onsite groundwater monitoring. But as I say, as of today there is no regulatory requirement for us to impose that condition.

JUDGE TRIKOUROS: There's also no regulatory requirement to have radwaste systems designed to preclude any and all leakage.

WITNESS KLEMENTOWICZ: That's not an area that I'm experienced in. I deal with it after it leaks.

JUDGE WARDWELL: I was trying to

formulate a question that says - that asks you whether in your professional opinion, what would be the difference if in fact the permit condition said instead just what those limitations were in 20 whatever this is, 10 C.F.R. 20, whatever that - where you say it's below the effluent limitations. That to me seems more realistic than saying preclude any and all, and I just, I don't know why the "any and all" is there. It seems to make more sense that you'd do it in regards to just what's required by those regulations for those discharge. That's all you can store out there, so that's what you're allowed to discharge if there's an accidental release.

WITNESS KLEMENTOWICZ: If I may add that our systems and components individual who was on the task force also made some conclusions that the existing systems and components, the piping are essentially commercial grade. And they have leaked, and there's no NRC requirements that would basically require safety grade material to prevent the underground radwaste line from leaking. Again, so those were some of the recommendations that increased monitoring or leak detection systems, the pipe within a pipe such as they have for spent fuel pools. They have the tell-tales. And that was a situation at the Salem plant where the licensee, the water got around and it was not visible through the tell-tales and seeped out. So the recommendations are that, you know, some of the systems have increased monitoring to see if there is a leak. But again, those are just recommendations. What will happen to them, I do not know.

JUDGE WARDWELL: The task force didn't - wasn't a motivator for the wording that's in this particular permit condition or have anything associated with that type of thing?

WITNESS BAGCHI: It was after the fact, Your Honor. This is Goutam Bagchi. So the task force lessons learned was not a factor in getting these words. But something bothered me about what you said. Isn't it better to have the requirements of minimum radioactive inventory in the tanks and so forth. There is a technical specification requirement. This is technical specification. Those requirements are there. So why would one add something that is not necessary? It will come as a result of any operating license granted as a result of construction of a new plant.

The other thing that you said concerned

me a little bit - or let me just elaborate why there was any and all. "Any" is considering leakage from the radwaste treatment facility itself and "all" meaning the storage locations around the yard. So "any and all" made sense at the time when we wrote the condition.

JUDGE TRIKOUROS: Could you say that again? That's interesting.

WITNESS BAGCHI: My thought was that "any" would come from radwaste treatment system itself, so we want to preclude that. Radwaste treatment system would be robust and would be designed to preclude any release. That is the basic tenet and the philosophy of Reg Guide 1.143. As a matter of fact, it goes on further to say that if you design your facility to this regulatory guidance, then you achieve as low ALARA, as low as reasonably achievable. So given that philosophy, it was - this permit condition was in sync with that thinking.

And "any" came from the fact that, well, if we have radiation treatment system we should not allow any kind of release from the radwaste treatment system. And "all" meaning if there were distributor holding tanks out there in the yard and so forth, so "all" was a catch-all word to capture things like that.

JUDGE TRIKOUROS: What reg guide did you say, by the way?

WITNESS BAGCHI: 1.143.

JUDGE WARDWELL: Let me just - and I think that's appropriate to have that as a goal and as a guideline for focusing your design that you can then compare the applicant's design to this goal. But I think there's a monumental leap when it's now transferred into a permit condition. And that's what I'm having a hard time still - we're getting there, but we needed to talk about this some more in regards to how it relates to whether or not the site is characterized sufficiently to allow this to be a reasonable, practical type of permit condition.

WITNESS BAGCHI: Oh, I have no doubt in my mind whether or not the site is suitable for siting a new power plant. It is eminently suitable. I have not found any impediment, as I said at least a couple of times during my statements, that it has no intrinsic impediment to siting a plant. You know, irrespective of what your hypothesis said, there is a nuclear power plant that's producing power safely operating for over 20 years or so. I was involved in the plant when it was being built. In a different capacity, not in hydrology, but nevertheless I visited the plant, I did the plant site tour and I have kept informed about how safely the plant has run.

JUDGE WARDWELL: Well, and that's - it's the presence of that plant that drives this line of questioning that we'll address once we get to Issue B.

JUDGE MCDADE: Perhaps also if I could interject right now at this point in time, we're sort of floating from A to B. I think we've gone past the brink and we're well into B. We are then going to move on to D. What I wanted to just mention to both the staff and the applicant, if you have witnesses who you feel that you can release at this point in time and they wish to leave. We're not trying to throw anybody out. If you want to stay, please stay. All I'm saying is that if you're not finding this as fascinating as we are and you're not going to be offering further testimony today on Hearing Issue B or Hearing Issue D and you want to go and do something else, to just allow you the opportunity right now to think about that. And if you want to tell any of your witnesses they can go with the understanding we're going to move forward to B and then to D today and that should take us to the end of the day. Do you want to take a moment to discuss this?

MS. SUTTON: No, Your Honor, we're ready to proceed with B.

JUDGE MCDADE: No, but my question is did you want to discuss whether or not any of your people you want to release, or would you prefer to keep them here?

MS. SUTTON: On behalf of the applicant we do not want to release them. They will stay here.

(Laughter)

JUDGE MCDADE: And they knew that beforehand, right?

MS. SUTTON: Yes, they did.

MR. RUND: I'll leave it up to the witnesses. I mean, I think almost everybody up there would be up there for B or D. If they are only involved in D they could step down and come back. It makes no difference to me.

JUDGE MCDADE: No, I just want to make sure that the witnesses here don't say 'Why the heck was I sitting there the last two hours, you know, when I could have been out doing something more productive' in their mind.

JUDGE WARDWELL: Are you through with A?

JUDGE TRIKOUROS: I am through with A for now.

JUDGE WARDWELL: So we want to sit the witnesses for B now.

JUDGE MCDADE: Well, I mean I think all the witnesses for B have pretty much wandered in during the course of the proceeding. It is a question now not of seating new people, but releasing - and I hate to use the word "old" because he'll interrupt and say "old witnesses" just like "old aquifers" are inappropriate. But the witnesses who were testifying earlier. That's all. Let's move ahead. Doesn't seem like anybody wants to leave. If they do, they're free to.

Well actually, some of the people that I see getting up are witnesses on Exhibit D and B. So you know, before you let them go, make sure that you've got your witnesses on B and D.

MR. RUND: I'm sorry, are we going to go right from B to D so if somebody's on D you'd like them to stay up there?

JUDGE MCDADE: Yes.

MR. RUND: Okay. I'm sorry then.

JUDGE MCDADE: I mean they don't have to stay right there in the box.

MR. RUND: Oh yes, okay.

JUDGE MCDADE: They can wander around, but -

JUDGE WARDWELL: They need to be here. I think it would be better if they weren't sitting there during B so it doesn't get confusing.

MR. RUND: Mr. Bagchi and Mr. Klementowicz are our witnesses for B so if they could please stay put and everybody else.

WITNESS BAGCHI: Lance can stay also?

MR. RUND: Yes, I think if he'd like to.

WITNESS BAGCHI: Well, I might need his help.

MR. RUND: Absolutely then.

JUDGE MCDADE: Okay. That little administrative matter took longer than I thought it was going to, but I guess we're ready to go ahead. And let me ask the witnesses who are here on B who have been told they can't go, do you need a couple of minutes before we get started or are you ready to just soldier on?

WITNESS KLEMENTOWICZ: I'm ready.

JUDGE MCDADE: Everybody over there on the staff?

WITNESS BAGCHI: Yes, Your Honor.

JUDGE MCDADE: And the applicant's witnesses?

MS. SUTTON: We're ready, Your Honor.

JUDGE MCDADE: Okay. And just as an aside, and you know, well, let's just move ahead. Okay. Roll them.

JUDGE WARDWELL: And I think the hypothesis is beaten to death here, but just quickly -

JUDGE MCDADE: The first hypothesis, but we're talking about, you know, only a particular kind of release and site characterization. If you wish to kick further down the field?

JUDGE WARDWELL: I'll reiterate it and maybe say it in a different fashion. It is a fact that there's an existing plant there and raising the issue of whether it's of interest to determine what is the existing groundwater quality for use in determining whether or not this is a suitable site under the hypothesis that there could be such adverse impacts from the existing plant, however unlikely, that need to be refuted to assure that anything that's done in the future to verify that Permit Condition 2 is being achieved is not preempted from being achieved once we get to the COL stage. So with that in mind I guess I'll just ask the question, do any of the panel members know of any water quality data at the site that would indicate - let me just ask, is there any water quality data from the power plant, the power block area, to define or even indicate what types of constituents might be in the groundwater that exists to date.

WITNESS KLEMENTOWICZ: This is Steve Klementowicz and I have, and I guess we'll have to enter this into the file, the 2005 data from the Annual Radiological Environmental Operating Report for the Grand Gulf Nuclear Station. And as I mentioned earlier, they do onsite groundwater monitoring. So there is data in this report on the radionuclide or lack of radionuclides in this groundwater. So that data is known.

JUDGE WARDWELL: Do we have a plant view of where those wells are located and can you comment on what is the water quality based on that? You're saying you have to submit this as an exhibit. It hasn't been submitted yet?

WITNESS KLEMENTOWICZ: Yes, it will have to be submitted, and there are figures that outline the sample collection sites.

JUDGE MCDADE: How long would it take you to lay your hands on this data in a hard copy form?

WITNESS KLEMENTOWICZ: It was handed to me. But however, the data is in the NRC's ADAMS. It is a public document. And by just typing in the name of the station and the report it would come right up.

JUDGE MCDADE: One of the things about judges is we don't type stuff in, we just ask people to give it to us.

WITNESS KLEMENTOWICZ: Right, and I will enter this into the record.

WITNESS EVANS: Excuse me. Lori Evans for the applicant. We do not have data that is that current, but we do provide similar data within the ESP application. And those have already been submitted as exhibits.

JUDGE MCDADE: Do you have the exhibit number?

WITNESS EVANS: Yes. The map is SERI Exhibit 3. The exact well location is not marked on here. We do have - we have a modified version of this figure that will show the well locations. Essentially you see the water tank labeled on this map and the wells are located just to the west of that, just outside of the setback line boundary.

JUDGE MCDADE: Okay. Before I lose track of that, I would want to note when we next break if you could give that data to - I need to get closer to the microphone. I've been telling other people to do it and I've been not doing it myself. I apologize. But the next time we break if you can give that data to Mr. Rund and please have that then marked as Staff Exhibit 46, get the appropriate copies made and hand it out. But at this point we can proceed.

(Whereupon, the above-referred to document was marked as Staff Exhibit No. 46 for identification.)

JUDGE WARDWELL: Are these the same wells that you have data for, or are they other supplemental wells that you have data for also?

WITNESS KLEMENTOWICZ: They should be the same wells unless the applicant licensee has changed the locations.

WITNESS EVANS: They are the same wells. Sometimes the samples I believe are taken from the - actually from the water distribution system. And we do have a table that provides the sampling locations. That is SERI Exhibit Number 16. And then monitoring results are provided in SERI Exhibit Number 18.

JUDGE WARDWELL: And how many different locations in the power block area do we have water quality data from?

WITNESS EVANS: Pardon me, can you repeat your question please?

JUDGE WARDWELL: How many different locations within that power block area do we have samples and water quality data from?

WITNESS EVANS: None, Your Honor, just from these wells that are immediately adjacent to it.

JUDGE WARDWELL: Could you just point out right behind you. Just point out right there where those wells are that you're speaking of? And that's the only location. So there's - when you said wells, there must be several at the same spot?

WITNESS EVANS: That's correct, Your

Honor. There are two wells that are actively in use currently.

JUDGE WARDWELL: Okay. And just so the record is clear you pointed to the far left side of the exhibit.

MS. SUTTON: Your Honor, we have an additional exhibit that indicates the wells that Ms. Evans is referring to and we would like to enter them into the record as SERI Exhibit 31. We'll provide you hard copies. Mr. O'Neill will provide them stamped.

(Whereupon, the above-referred to document was marked as SERI Exhibit No. 31 for identification.)

JUDGE MCDADE: You have no objection?

MR. RUND: We have no objection.

JUDGE MCDADE: Okay. It's received.

(Whereupon, the document previously marked as SERI Exhibit No. 31 for identification was admitted into evidence.)

JUDGE MCDADE: And I also should note we

made reference to Exhibit 46. We'll handle it the way we did the earlier exhibits. I'm going to admit it at this point in time.

(Whereupon, the document previously marked as Staff Exhibit No. 46 for identification was admitted into evidence.)

JUDGE MCDADE: When we have a break, give the counsel for SERI an opportunity to review it. If they have any objection to it and are considering it, just note that and it can be withdrawn at a later point in time. But for now it is admitted as Exhibit 46 and the witness can refer to it subject to it being stricken later if there's an objection.

MS. SUTTON: There's no objection.

JUDGE WARDWELL: Would you comment on the actual water quality results?

WITNESS KLEMENTOWICZ: This is Steve Klementowicz. From the 2000 report that I have there were no detectable radionuclides observed at this well.

WITNESS MORRIS: This is Marvin Morris

for the applicant. I reviewed the REMP reports for the last eight years at SERI and for all of the years for each annual report there was no detectable radiation in the water wells either onsite or offsite.

JUDGE WARDWELL: Have you looked at a rough estimate of what the potential travel times are from the existing plant to say that, yes, if there was problems it should have reached this particular location by now?

WITNESS MORRIS: I have not looked at those.

JUDGE WARDWELL: Has anyone?

WITNESS MORRIS: We don't have that with us.

JUDGE WARDWELL: And your testimony is that there is - everything's below detection levels.

WITNESS MORRIS: That is correct.

JUDGE WARDWELL: Do those tables show what the detection limits are? Because I know sometimes they can vary widely.

WITNESS MORRIS: Yes, it's done on an isotopic basis, the isotopes they're looking for, and it gives the lower limit of detection and what they measured. But what they measured was all LLD.

WITNESS KLEMENTOWICZ: This is Steve Klementowicz, and yes, the report I have, it does indicate the LLDs that were used for each radionuclide.

JUDGE WARDWELL: Hang on just a second. Take a quick nap while I'm floundering here. So with this supplemental testimony, is it fair to say that in response to Question - well, in the Answer 5 on Page 5 of Issue B where the staff says that they did not receive any data in the SERI application on radiological conditions at the site, we now can say that at least we have a sample from one well, one location through a couple of wells with radiological data.

WITNESS KLEMENTOWICZ: Steve Klementowicz. Yes, that's correct.

JUDGE MCDADE: Is there anything in that data that gives you pause about the suitability of the site?

WITNESS KLEMENTOWICZ: Steve Klementowicz. No. There's no - the data is good. And by "good" I mean there were no detectable radionuclides of plant origin.

JUDGE WARDWELL: In regards to Answer 7 on Page 6, it stated that the NRC has experiences with licensees who have performed monitoring and using that as one of your bases for why it's not a particular issue or whatever. But could you elaborate more on - do you have any experience with existing sites where they're proposing a new site in addressing any situation like we have here?

WITNESS KLEMENTOWICZ: You're asking the question - this is Steve Klementowicz - you're asking the question if there are other ESP applicants that I'm aware of that have had inadvertent leaks or are proposing increased onsite monitoring? Is that the question?

JUDGE WARDWELL: You say in your testimony in A-7 that hypothetical inadvertent radiological releases from the proposed new plant could be separated from historic impacts through a program of radiological surveys and specialized monitoring.

WITNESS KLEMENTOWICZ: Yes, that's correct, and the practical experience we have is for multi-unit sites. Once they discovered an accidental leak or spill, the licensee did extensive surveys and monitoring, did excavations, installed groundwater monitoring, and basically used that to backtrack to the source of the leak. A particular plant that had a - suspected that the leak came from a spent fuel pool did very extensive groundwater monitoring to trace it back to the source. So my discussion here related that once they know that there is a leak, whether it's a single-unit, multi-units, licensees can through extensive and specialized monitoring determine which particular unit did the leak, or that the leak occurred. But your previous discussions were relating, you know, before the fact, and that's where I stated we have no regulatory requirements before the fact. It's after the fact, once they become aware of it.

JUDGE TRIKOUROS: You're saying that a proper design which includes instrumentation to determine that there has been a leak would be sufficient to implement an onsite monitoring program that would provide very valuable information regarding the quantity of leakage and the location of the leakage?

WITNESS KLEMENTOWICZ: Well, let me not take all that credit. The lessons learned task force report, the collective all of us on the task force discussed all of the recommendations. And when we looked at systems components, NRC requirements, surveys, monitoring capabilities, it was our opinion and our recommendation that if the NRC put out guidance and requirements to require increased or required onsite monitoring, that then, you know, an inadvertent leak would be detected well before it went into the unrestricted area. So they would know that they had a leak and could work to fix it, but it would still be onsite and so it would not get into the public domain.

JUDGE TRIKOUROS: But wouldn't it be better to have a more direct indication? For example, if you did have a guard pipe around underground radwaste piping and radiation detection capability within that guard pipe, that you would immediately know if there's a leak occurring before it even gets out of the guard pipe, that in essence - knowing it at that point seems to me would be more useful.

WITNESS KLEMENTOWICZ: This is Steve Klementowicz. I'm looking through the conclusions of the systems and components section and - from what I read here it looks like, yes, they do recommend improved maintenance trending and use of leak detection and monitoring systems along with increased quality grade of the piping. Obviously in a health physics perspective you want to contain the radioactive material at the source. That's always the preferred option.

JUDGE TRIKOUROS: Some of that might actually get implemented in the process of implementing Permit Condition 2.

WITNESS KLEMENTOWICZ: Yes, that would be my opinion.

JUDGE WARDWELL: How many sites do you know of where there is multiple power plants there where they're able to discriminate the actual source through these post investigations?

WITNESS KLEMENTOWICZ: Approximately half a dozen.

JUDGE WARDWELL: Okay, so a significant number, not just one or two.

WITNESS KLEMENTOWICZ: Correct, yes.

JUDGE WARDWELL: And is that what you mean by your first sentence to Answer 7 in regards to this program of radiological surveys and specialized monitoring. Is that again all post monitoring?

WITNESS KLEMENTOWICZ: Yes.

JUDGE WARDWELL: Okay. At the very last sentence in that paragraph, or well let me read up a bit above that. It says, in addition there is a requirement in 10 C.F.R. 50.36(a) to submit an annual report that specifies a quantity of each of the principal radionuclides released to unrestricted areas in liquid and gaseous effluents. However, the regulation does not required the data to be reactor-specific. As a matter of practice, licensees do a best effort to apportion the radioactive effluents to each reactor unit. Do you have any idea what's involved with that apportioning effort?

WITNESS KLEMENTOWICZ: Yes, on multi-unit sites, some facilities - there's a green light on. Okay.

JUDGE WARDWELL: I was sitting too close. Everyone heard my heavy breathing and thought - well, I don't know what you thought -

WITNESS KLEMENTOWICZ: Okay, there we go. So multi-unit sites sometimes share a common discharge point. However, when you go follow that trail of radwaste systems back to the individual reactor, there are separate radwaste gas storage tanks, separate liquid radioactive storage tanks specific to each unit. As part of the discharge process, the licensee knows what is in each tank. So they keep an inventory of the radioactive material in each tank and when they go to make a discharge to the environment they have to sample, analyze and run calculations on the projected dose from each unit, from each tank. So they do have very unit-specific information. And so when they submit this annual effluent release report, all along each unit has been tracking the amount of radioactive material released and the resultant - the dose from those discharges. Which follows with the tech spec requirement to keep effluents ALARA in accordance with Appendix I to Part 50 which is unit-specific. So in order to demonstrate compliance with that requirement, they do have to be able to separate, you know, be able to measure and quantify the radiological effluent discharges per unit to comply with Appendix I.

JUDGE TRIKOUROS: These are not inadvertent. We're talking normal -

WITNESS KLEMENTOWICZ: These are the routine, normal effluent discharges.

JUDGE WARDWELL: All those last sentences deal with just the license discharge.

WITNESS KLEMENTOWICZ: That's correct.

JUDGE WARDWELL: I think I just have - no, I've got two more questions. I just want to verify that under Issue A, Answer A-9 on Page 13, the first full paragraph on Page 13 says a groundwater sample is taken at two wells, and again, isotropic and tritium analysis are performed. Those are the wells that we're speaking of?

WITNESS KLEMENTOWICZ: Yes. This is Steve Klementowicz. Those are the REMP, the Radiological Environmental Monitoring Program routine wells.

JUDGE WARDWELL: And do you concur, as the applicant?

WITNESS EVANS: This is Lori Evans for the applicant. One sample is taken onsite, one well location, and one well location is offsite.

JUDGE WARDWELL: But those were the ones that, sentence refers to what we were talking about about a half hour ago -

WITNESS EVANS: Correct, Your Honor.

JUDGE WARDWELL: - we were pointing out the wells. I just wanted to confirm that.

WITNESS KLEMENTOWICZ: That's correct.

JUDGE WARDWELL: Then I think I'll ask one more question and that is in your professional opinion, do you believe there is reasonable expectations that a post investigation would be able to discriminate between power plants, duplicate -

multiple power plants at a given site if there was an inadvertent release.

WITNESS KLEMENTOWICZ: This is Steve Klementowicz. Yes, I do believe that, and experience and the data we have shows that to be true.

JUDGE WARDWELL: Thank you. Thank all of you. Does the applicant have anything they want to add into this mix in regards to what we've been talking about?

MS. SUTTON: We have nothing further, Your Honor.

JUDGE MCDADE: Okay, I think -

MS. SUTTON: One administrative matter. We do now have marked the copy of SERI Exhibit 31.

JUDGE MCDADE: Okay. And if you could just pass that up.

JUDGE WARDWELL: And we will be getting the staff's marked version also, correct?

JUDGE MCDADE: Yes. It has already been accepted as Exhibit 46. We are now going to move on to Hearing Issue D. It might be appropriate for us to take a very brief break. It is now 20 minutes after. Can we take a break until 4:30 and then come back promptly at 4:30? Is that enough time for the applicant?

MS. SUTTON: Yes, Your Honor.

JUDGE MCDADE: For the staff?

MR. RUND: That's fine for the staff.

JUDGE MCDADE: We are in recess.

(Whereupon, the foregoing matter went off the record at 4:23 p.m. and went back on the record at 4:36 p.m.)

JUDGE MCDADE: The hearing is now called to order. A question arise - we have finished with Hearing Issue B. Is the staff's witness with regard to Hearing Issue C currently present?

MR. RUND: Yes, he's seated in the witness box.

JUDGE MCDADE: Okay. And is the applicant ready to proceed with?

MS. SUTTON: Hearing Issue C by Mr. Bachhuber, yes.

JUDGE MCDADE: Okay. Would you please identify the witness, I believe you said Dr. Li?

MR. RUND: Yes. Dr. Li, please identify yourself for the Board?

WITNESS LI: Yes. Yung Li, seismologist working with the Division of Engineering at the NRC.

JUDGE MCDADE: Okay, thank you. You

don't need to stand and in fact it would be better if you don't because then you can be closer to the microphone and our court reporter won't yell at me anymore.

WITNESS LI: I understand.

JUDGE MCDADE: Okay. Or as much. The witness for the applicant, would you please - no, but just for the record to identify yourself.

WITNESS BACHHUBER: Yes. Jeff Bachhuber from William Lettis & Associates representing SERI.

JUDGE MCDADE: Okay. And you have already been sworn, but Dr. Li you have not. I would ask that you state that subject to the penalties of perjury that everything that you will say in testimony will be true and accurate.

WHEREUPON,

YUNG LI

was duly sworn and assumed the witness stand.

JUDGE MCDADE: Okay. You are under oath. We are ready to proceed. Judge Wardwell?

JUDGE WARDWELL: Yes, I just have one question. You probably have already heard it and that is what is the acceleration coefficient for the site that would be used in any type of simplistic pseudostatic analyses as an extra driving force or caused from the site earthquake.

WITNESS LI: If I understand it correctly you are referring a conventional methodology used to estimate a seismic load input in the building codes, building design or conventional building design or regular building design.

JUDGE WARDWELL: And it's also used, and we use it - it's been used in slope stability analyses also.

WITNESS LI: Yes. But in the critical structure such as nuclear facility we use site-specific response spectrum, which is expressed by the SSE, or called a safe shutdown earthquake ground motion.

JUDGE WARDWELL: I'm aware of that, but somewhere later on and I can't remember where it's come up, and I will know it once we get to it later on in the hearing, in regards to someone brought up this acceleration coefficient. And so I thought at least if you did know it, I'd like to get it on the record for what someone would use in case we do want to use it later on. I understand - let me back up a bit. I have read your seismic analysis. I found it very thorough and knowing where the site is and the low seismic activity that takes place there I see no need to address anything in the work you've done. I thought it was very well done and very well presented. I just - that's why originally yesterday I said we have no questions for you. In something I read within the last 24 hours this came up and I said we ought to get it on the record in case we need it later on. And I was afraid you might even laugh at me for asking this because it is, certainly in your field you must just cringe when anyone wants to use this coefficient. But if you happen to know what is the map coefficient that Algermisen used to - originally did, and other people have amplified maps showing this acceleration coefficient for a site. I would appreciate anyone who would know what that is to present that at this time.

WITNESS LI: Okay. Yes, as I just mentioned, in the critical structure like nuclear facility we do a site-specific analysis. The final result from that site-specific analysis including the controlling earthquake input and the soil response issue is the safe shutdown earthquake ground motion. It's not a single point acceleration record. It's a continuous response spectrum, relatively smooth. So at that, if you want to know a specific point there I can let you know there's a P ground acceleration which is 0.19g for this particular site.

JUDGE WARDWELL: Do any of the - anyone else want to comment on that particular value from the staff? From the applicant, do you have any comments on that?

WITNESS BACHHUBER: Yes, Jeff Bachhuber from the applicant. Mr. Li was correct in that for a critical facility you do calculate a site-specific ground motion for that analysis. We did calculate the SSE not for the purpose of performing slope stability analysis, but it does provide bounds. And the value of 0.19g that was mentioned from that design spectra would be appropriate for an initial assessment of slope stability. During the COL phase, quantitative analysis will be performed. That work is deferred to the COL stage because it depends on the exact location, embedment, design of the plant so that critical location or cross-sections for analysis could be determined. And at that point the level of earthquake input would be conferred or developed specifically for that analysis. But it would more than likely be around

0.19g.

JUDGE WARDWELL: Are you familiar with the Algermisen maps that were initially created I think in '54 or so and have been updated since, that present given return periods and acceleration factors?

WITNESS LETTIS: This is William Lettis for the applicant. The Algermisen maps were the national probabilistic hazard maps for the U.S. They've been updated a number of times by Art Frankel now and they provide return periods of 10 percent in 50 years and 2 percent in 50 years. So did you have a question in regards to those?

JUDGE WARDWELL: And you are familiar with those maps.

WITNESS LETTIS: Yes.

JUDGE WARDWELL: Do you have any idea what that map would show in regards to the acceleration factor?

WITNESS LETTIS: Yes, it's - I don't know that off the top of my head.

JUDGE WARDWELL: Does anyone? I understand someone from staff may know what that is.

WITNESS LI: May I comment on this issue? That map is for a general design purpose.

It's not applicable to the critical facility because you don't have site-specific input.

JUDGE WARDWELL: I'm aware of that.

WITNESS LI: Okay.

JUDGE WARDWELL: Just I think later on it may come up and I can't remember why and I just want to get it on the record so in case we need it we have that available. Hopefully we won't even need it because I can't remember where it came up, but I thought while I had you available I would get what this is. And I wasn't - in fact, I'm a little surprised it's as high as 0.19 but it's probably because of the conservative nature of your analysis and being a very critical facility it's a very high value compared to what I'm used to, but that's fine. I just wanted to get it on the record. Yes.

WITNESS BAGCHI: This is Goutam Bagchi. I just wanted to point out that the frequency associated with the national hazard map was described by Dr. Lettis and those frequencies are considerably lower - I mean higher than the frequency for earthquakes considered for this particular design. It's 10 to the -5 median. It is highly conservative. And I would venture to guess without - I don't know what that hazard map will call for at Grand Gulf site, but it would be considerably less than 0.19gpga.

JUDGE WARDWELL: That would be my guess too. Yes. Okay, thank you, that's all. And I understand, I know the sensitivity. We accept your testimony and what you've provided in the pre-filed testimony as what is needed for this facility. Absolutely, there's no question. We are not proposing to use this whatsoever unless it happens to come up. And maybe I dreamt it last night for that matter, I don't know.

WITNESS LI: If you come across it in the next few days, I mean whenever -

JUDGE WARDWELL: You will know about it.

WITNESS LI: We are ready to answer your question.

JUDGE WARDWELL: Sure, thanks.

WITNESS LI: Thanks.

JUDGE MCDADE: And when everybody has been using the word "guess" here in this context, they mean based on their training, experience and their professional judgment they infer that it would be. That's the definition of "guess"?

WITNESS BAGCHI: Yes, Your Honor.

JUDGE MCDADE: Okay.

(Laughter)

JUDGE WARDWELL: I was trying to expedite the hearing here though.

JUDGE MCDADE: So are we ready to proceed to Hearing Issue D?

MR. RUND: We're prepared and I guess we could dismiss Dr. Li for now.

JUDGE MCDADE: Yes. Thank you.

WITNESS LI: Thank you.

JUDGE WARDWELL: Ready to roll? Many of my questions have already been addressed under slope stability, but let's continue to pursue it. In Hearing Issue D on Answer A-3, Page 2 there was a discussion of what had taken place. And the question I have is what data did the staff use that's available to ascertain the sheer strength of the geologic materials, and what are the values that were used in the preliminary estimates that are mentioned under this Answer A-3 on Page 2. The last sentence of the second paragraph talked about preliminary estimates of simplified soil stability evaluations, indicated standoff distances on the order of 100 feet, potential failure to surface through the bluff material would not intersect the plant cross-section. And my question is what available sheer strength values are there for the various strata and then what values were used in this preliminary assessment.

WITNESS CONSTANTINO: This is Carl Constantino. With respect to the loess material, Engineering Report 02 indicates that strength tests from the UFSAR, friction angles of the order of 33 - 34 degrees were typical. And based on that, doing a simple linear back to the envelope, a simplified analysis on slope stability, you could back out the potential range that any slope would - how far back it would break out using that simplified model. The materials below -

JUDGE WARDWELL: By linear -

WITNESS CONSTANTINO: Linear failure.

JUDGE WARDWELL: So your infinite slope analysis, if you will.

WITNESS CONSTANTINO: No, no, a triangular slope. Infinite slope.

JUDGE WARDWELL: Okay.

WITNESS CONSTANTINO: So it's a triangular slope stability simplified and that sort of bounds the range to make a judgment on what an appropriate setback distance would be if you wanted to get away from that slope failure.

JUDGE WARDWELL: And that that you pictorially represent on one of your exhibits, the failure plane that ends up -

WITNESS CONSTANTINO: Yes -

JUDGE WARDWELL: - level, that's at a factor of safety of one. That said it would fail at that point. Right.

WITNESS CONSTANTINO: Approximately it would fail. So otherwise you'd have to go into a detailed numerical analysis which wasn't done. And I think in fact that conservative estimate, instead of using 33 degrees we used 30 degrees or something simple.

For the lower materials slope stability wasn't really an issue but the strengths based on the SPT blow counts were very much higher. So that evaluation indicated that if there was a slope failure it would be restricted to the loess material. We weren't too concerned about slope failures in the stiffer materials below.

JUDGE WARDWELL: I think it's mostly in the loess -

WITNESS CONSTANTINO: Yes, right.

JUDGE WARDWELL: - that that's of interest. Do you have any indication of any information that would talk about creep displacements of the loess as an over-consolidated material such that they would continue to retrogressively work their way back to the plant, given enough time?

WITNESS CONSTANTINO: Long-term behavior of the loess material, that's an issue. I think the data available would indicate, or not the data available. The data available is really relatively simplified. You couldn't make judgments of that from the data that's available. These kind of fine grain materials are susceptible to long-term creep effects. I think where our recommendation was what is the potential - let's assume such creep effects will occur. What long-term impact would that bring to the design of the plant. I don't think there's any information that we saw which would preclude the consideration of a creep effect. Especially if one talks about in addition to creep, erosion due to ground - Mississippi - erosion of the base or just normal rainfall runoff. So I think our perspective was creep may occur, probably will occur in the long-term and how can we design the plant to ensure that that's not an issue from the plant. And that led to the estimate of the standoff distance and also placing - making sure that the foundation of the base mat is located suitably below any potential breakout point of a failure plane. So the strengths available from a lateral stability point of view would not be a problem.

JUDGE MCDADE: Doctor, in this context when you use the term "long-term" can you give us an idea temporally of what that means? Are we talking about years, decades, centuries?

WITNESS CONSTANTINO: Well, I know I'm old, but in my lifetime I've seen many slopes disappear, creep. So when I talk about long-term, I think of the order of 5, 10, 15 years is relatively long-term for these materials. Loess materials are particularly unusual also because they have these peculiar characteristics. When they're dry they look very fine and if they happen to be wet for some reason they could lose their strength characteristics. They're a different kind of material than the silts you would normally see. So my perspective always was let's assume this is going to happen and how we can ensure that that's not a major player in the evaluation of the plant facility.

JUDGE WARDWELL: In your professional

opinion is there anything in the information you've gathered in your review on the behavior of that loess that would preclude this from being a suitable site from the plant location.

WITNESS CONSTANTINO: No, provided we take care of those issues of moving the plant foundation down deep enough and doing an evaluation of lateral stability, sliding, overturning and SSI evaluation of this profile, this topographic profile which has this also. So both of those I think. If you do that, I have no issue with your being able to design the facility. But I think you have to do that.

JUDGE MCDADE: So for your purposes this is a situation where there is a reasonable possibility that this will occur within the timeframe that the plant will be open and operating, and that therefore in order to have the site suitable, you have to assume that it will occur and plan accordingly, but that that does not pose any insurmountable engineering barriers.

WITNESS CONSTANTINO: Oh no, I think that's true. I think from a safety perspective you wouldn't always consider that situation, but I think the process to design the facility to incorporate that is very straightforward. So I don't think there's any indication that it would preclude you from using the site.

JUDGE WARDWELL: Any comment from the applicant?

WITNESS BACHHUBER: Yes. Jeff Bachhuber representing the applicant. And just to reinforce a couple of points and also add some additional information to what Carl had discussed. The strength values in the loess actually were determined during the ESP from samples collected from borings for the ESP program. We performed a number of tri-axial sheer tests and a value of 33 - 34 degrees for the loess was determined on the basis of those tri-axial tests. We also performed four CPT soundings that were extended all the way through the loess and based on that we were determining undrained sheer strengths of around 2,000 to 8,000 pounds per square foot. So relatively high values for that material. And so we do have specific measurements from the ESP program.

WITNESS CONSTANTINO: Jeff, before you leave that point, could I respond?

WITNESS BACHHUBER: I would like to keep going.

WITNESS CONSTANTINO: Oh, you can keep going, I just want to respond to the comment you made about -

WITNESS BACHHUBER: Sure.

WITNESS CONSTANTINO: - using the CPT data. Just to clarify that issue. All the CPTs were taken in the center of the site, basically. There was really no major effort to look at strength values for the loess along the slope. And if I was evaluating the slope I would worry about that. So I just wanted to clarify that point. There is a difference of opinion.

WITNESS BACHHUBER: Okay. And the loess deposits are a continuous layer. Where we did perform the CPT soundings they were in the same layer of loess that's exposed in the slopes.

WITNESS CONSTANTINO: But it's pretty clear -

WITNESS BACHHUBER: Based on comparisons of the various CPT and borehole data the loess is pretty consistent in properties. And so what we see in the slope face, we visually examined the loess. It was similar to the loess that we encountered in the borings and within the zone of the CPT testing. And so based on that we were able to correlate that it's a reasonable approximation of the loess in the slope face. Now, we will perform in the COL phase additional investigations very close to the slope where we are going to perform the slope stability analysis, just to confirm that that is indeed a fact.

All the slopes do expose loess. As Dr. Constantino mentioned, the loess is lower strength than the underlying alluvium and this would tend to force any failures to be constrained to the loess deposits. In fact, the loess extends below the base of the slopes, both the Mississippi River bluff, the tributary slope near Basin A and the cut slope that runs across the site all expose loess. And so that is a fundamental strength property to use for the slope stability analysis.

With regards to long-term performance of the loess, the Mississippi River bluff slope has existed for thousands of years and so it actually is a long-term analog regarding the behavior of loess. We could push it way back. And this record of time would include high stages of Mississippi River, periods of intense rainfall. So we think it's a good model of the long-term performance of the loess, an actual model onsite. And in that slope we do not see any evidence of large-scale retrogressive-type failures that extend for significant distances back from the top of the bluff slope. And so based on that comparison we were able to rule out that that is a likely scenario, that we would have large-scale retrogressive failure working back from the river bluff.

A couple of the exhibits we have help illustrate some of the relationships between the slopes and the ESP plant area. And that would be Exhibit SERI 5 and SERI 11. And also SERI 3 is an exhibit that's useful. I'll start out with SERI 3 if you could pull that up. This is a plan map showing the exploration locations, both explorations for the ESP project and also for the UFSAR. And on this map, within the circular ESP envelope you can see four dark triangles and those represent the locations of our CPT soundings and you can see that there is one of these triangles labeled CPT 3 that occurs near the top of the river bluff. And so one is this shows that our CPTs are distributed throughout the ESP envelope and they also are located very close to the river bluff.

On Figure SERI 11, pull that up. This is a cross-section through the river bluff and it shows the same CPT that was shown on that plan map, WLA CPT 3, and you can see it as a vertical line near the top of the river bluff. And so that shows the spatial position of that data point with relation to the bluff slope. This also shows that the Layer 2, which is the loess, it extends - it makes up the face of the Mississippi River bluff and extends back below the site. And so the characterization of that layer, it's a continuous layer. And so our other CPTs also provide reasonable information to help bound the properties of the loess.

And then on Figure SERI 5 this is a cross-section. The previous cross-section in SERI 11 has a vertical exaggeration. This cross-section in Exhibit 5 is at a 1-to-1 scale. So it shows the true slopes and geometric relationships between the river bluff and the ESP envelope. And on this figure you can see the proposed reactor building envelope defined, the Mississippi River bluff and also the setback zone that's established around the ESP site envelope. And here I'm showing a projection, a hypothetical failure plane that would extend from the base of the bluff slope to the edge of the setback line. And in order to have a failure plane extend back to the setback it would have a low angle on the order of 15 degrees. If we have a projected a hypothetical plane all the way to the reactor or building envelope it would be lower, perhaps on the order of 8 degrees. And comparing that angle, inclination angle, to the sheer strength of 34 - 33 degrees, it shows that we have a significant factor of safety with relation to development of a failure plane back to the envelope area.

JUDGE WARDWELL: In your professional opinion is there anything in the behavior of the loess that would lead you to believe that the site would be precluded from being adequate for the siting of a new power plant?

WITNESS BACHHUBER: No.

JUDGE WARDWELL: Thank you.

WITNESS BACHHUBER: We believe the setback zone we have established provides a very conservative safe distance back from the river bluff.

JUDGE WARDWELL: Are you prepared to discuss further or submit any extra testimony in regards to recent observations that you've taken place at the site, or is that too preliminary? You mentioned it earlier in the hearing in regards to the -

WITNESS BACHHUBER: No, I -

JUDGE WARDWELL: - slough areas.

WITNESS BACHHUBER: Let me check.

JUDGE WARDWELL: You've already mentioned that it's now, as I'll paraphrase what I remember you saying, and I'll look at the transcript, but that some of these areas that were mapped as sloughed areas may in fact not be. I'm sure you want to - that's the inference I got from your statement. I'd have to read it again, but it wasn't a definitive statement that they definitely are, it's just you were kind of just updating us, so there wasn't really much meat in that testimony. I was wondering whether you'd want to say any more about that, a more definitive position on what those are or aren't.

WITNESS BACHHUBER: First I'd like to make a statement that all the analyses and information I just described were based on the ESP only. So all of that data is within the SSAR. It does not include the additional -

JUDGE WARDWELL: Right, I assume that was, so that's good. And your concluding remark in your professional opinion that based on the ESP data and analysis that you performed, there's nothing in your professional opinion that precludes this site from being suitable for the plant from a slope stability aspect?

WITNESS BACHHUBER: That is correct.

JUDGE WARDWELL: Okay.

WITNESS LETTIS: This is Bill Lettis for the applicant. Regarding the additional work performed since the ESP, the staff has not had the opportunity to review any of that information and so it would be most likely inappropriate for us to present those findings or any conclusions based on that without having provided the opportunity to the staff to look at that.

JUDGE WARDWELL: That's good, I just wanted to make sure that I didn't preclude that. I think that's the appropriate approach. Okay.

JUDGE MCDADE: At this point do you have anything further, any further comment on that?

WITNESS CONSTANTINO: This is Carl Constantino again. Yes. There are a number of points where Jeff and I disagree. One of them is to use the tri-axial data, available tri-axial data unless there is new data you're talking about, from samples taken near the center of the loess to those taken at the boundary because of the confinement issues. You would run those tests at different confining pressures. So that's one issue.

One of the overriding issues is the potential impact of the construction on the slope away from - slope between the edge of the construction to the Mississippi River. That's an issues that has to be looked at. Its potential impact is to weaken that loess material. And my concern always would focus on the loss of capacity of that loess and how that would potentially impact the plant. That none of those issues have ever been evaluated yet, none of the advanced reactor systems look at that issue, and I would presume that it would be something you would worry about.

JUDGE MCDADE: Starting at this point and going back to sort of my preface to this earlier today, we aren't here doing a sort of de novo review of the application and the data, we're doing a review of the staff's review, and we have been instructed when the staff's position is reasonable and it has a reasonable basis in fact and logic to give whenever possible deference to that opinion. So it seems, given the guidance that we have, this is a real issue and we start to decide that this is something that needs to be planned for. Although there may be a difference of professional opinion as to the probability or possibility of this occurring, it seems from our standpoint the bottom line is assuming that it might, what then. And I take it from the standpoint of the applicant, the applicant takes the position that although they consider the drift of this particular area to be unlikely based on all of the data available, that nevertheless as part of the application you concede that as part of your engineering you will be required to assume that it is a possibility and the engineering will take that into consideration. And the engineering will be built accordingly so that it would not pose a problem if in fact the staff's evaluation as to probability is the, you know, correct. Am I correct in that?

WITNESS BACHHUBER: That is absolutely correct and that is our plan, that we will perform additional stability analysis considering all potential failure modes once the plant design is selected and we can determine the most appropriate location for the analysis.

JUDGE MCDADE: Okay. And the question I

guess to the staff and it may be to the witnesses and it may be to the staff counsel, is there anything currently in the proposed permit which would mandate that either the applicant submits additional data to the staff on which the staff changes its professional opinion as to the likelihood or in the alternative will require that the engineering design is such that it will account for, take into consideration the possibility and ensure the safety of the facility even if this was to occur. What is there currently in the proposed permit that handles that? Are you prepared to respond to that?

WITNESS CONSTANTINO: Yes. If I look at - I'm trying to find it - where in the table. If I look at Action Items 210 and 11, both of those really address those issues.

JUDGE MCDADE: And you're satisfied that that meets the concerns that you have just raised here?

WITNESS CONSTANTINO: Yes. If they are addressed, I think that satisfies my interest.

JUDGE WARDWELL: And these are COL action items, and what are the numbers again?

WITNESS CONSTANTINO: 2.5-10 and 2.5-11.

Page A-8.

JUDGE WARDWELL: And as far as the applicant is concerned that would be the approach that you would take in the future action? Or you have no comments in regards to that -

WITNESS BACHHUBER: That is correct and that's a typical standard of practice for design of a nuclear facility.

JUDGE WARDWELL: And the only other additional thing is look forward to future discussions with staff's reviewer in regards to professional opinions on how this is approached. And that's always healthy. I wish I was invited to join you.

(Laughter)

JUDGE WARDWELL: But I can't. That's all the questions I have. I appreciate the input from both, unless there's some other final statements people would like to have on that issue. It was very helpful.

JUDGE MCDADE: Okay. Is there anything further from the staff?

MR. RUND: Staff has nothing further on Issue D.

JUDGE MCDADE: Okay, from the applicant?

MS. SUTTON: Nothing further.

JUDGE MCDADE: Okay. It is now after 5:00 and what I'm proposing we do is recess for this evening, pick up again tomorrow at 9 o'clock in the morning with Hearing Issue E. Is there any other preliminary matter that needs to be taken care of before we recess for the evening?

MR. RUND: Staff has nothing.

JUDGE MCDADE: The applicant?

MS. SUTTON: Nothing further.

JUDGE MCDADE: Okay. For the witnesses that remain here, I do want to thank you very much for being here and for the testimony that you've given. It has been extremely helpful and we appreciate the work that's gone into being prepared as wonderfully prepared as you were. We greatly appreciate it and we would ask the staff to convey to those of your witnesses who have left those comments as well.

JUDGE WARDWELL: That's what I was going to say when I raised my finger, I just wanted to thank everyone for their candor and their straightforwardness with which the questions were answered. That makes the hearing go much more - it's much more informative and makes it go in a more expeditious manner. I look forward to more tomorrow.

JUDGE MCDADE: Judge Trikouros, anything further?

JUDGE TRIKOUROS: I have nothing further, thank you.

JUDGE MCDADE: We're in recess. We'll see you all in the morning. Thank you.

(Whereupon, the foregoing matter went off the record at 5:14 p.m.)

CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: Grand Gulf Early Site Permit Hearing

Docket Number: 52-009-ESP

Location: Rockville, Maryland

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Charles Morrison

Charles Morrison
Official Reporter
Neal R. Gross & Co., Inc.