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Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Southern Nuclear Operating Company

Docket Number: 52-011-ESP;
ASLBP No. 07-850-01-ESP-01-BD01

Location: Augusta, Georgia

Date: Monday, March 23, 2009

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NUCLEAR REGULATORY COMMISSION

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ATOMIC SAFETY AND LICENSING BOARD PANEL

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HEARING

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In the Matter of: : Docket No.

SOUTHERN NUCLEAR OPERATING : 52-011-ESP

COMPANY : ASLBP No.

: 07-850-01-ESP-BD01

(Early Site Permit for :

Vogtle ESP Site) :

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Monday, March 23, 2009

Augusta Technical College

Waynesboro/Burke Campus Auditorium

216 Highway 24 South

Waynesboro, Georgia

BEFORE:

G. PAUL BOLLWERK, Chair, Administrative Judge

NICHOLAS G. TRIKOUROS, Administrative Judge

DR. JAMES F. JACKSON, Administrative Judge

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EXHIBIT NO.	DESCRIPTION	MARK	RECD
NRC00001A-MA-BD01	Vol 1 FEIS Chap 1-4	M-1695	M-1697
NRC00001B-MA-BD01	Vol 1 FEIS Chap 5-end	M-1695	M-1697
NRC00001C-MA-BD01	Volume 2 FEIS App. A-J	M-1695	M-1697
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EXHIBIT NO.	DESCRIPTION	MARK	RECD
NRC000071-MA-BD01	Curriculum vitae for Charles Kincaid.....	M-1699	M-1700
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NRC000077-MA-BD01	Curriculum vitae for Hosung Ahn.....	M-1749	M-1750

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

8:30 a.m.

JUDGE BOLLWERK: Let's go ahead and go on the record please. Good morning. Let us begin today by identifying ourselves. To my right is Judge Nicholas Trikouros. Judge Trikouros is a nuclear engineer. He's a full-time member of the Atomic Safety and Licensing Board Panel. To my left is Dr. James Jackson. Judge Jackson is also a nuclear engineer and a part-time member of the Panel. My name is Paul Bollwerk. I'm an attorney and a full-time panel member and the Chairman of this Licensing Board.

Each of us are independent administrative judges appointed by the five member Nuclear Regulatory Commission as members of the Atomic Safety and Licensing Board Panel. Members of the Panel are designated to serve on three judge licensing boards such as this one that preside over hearings in agency licensing or enforcement proceedings in which the Atomic Energy Act permits or mandates that a hearing be held.

The Panel's administrative judges do not work for or with the NRC staff relative to the staff's review of such licensing or enforcement matters. Rather we are charged with deciding in the first

instance what issues should be litigated in a hearing and for those issues we find litigable making a determination regarding their substantive validity in terms of granting, conditioning or denying the requested license or sustaining or modifying the proposed enforcement action. Our decisions on hearing matters generally are subject to review first by the Commission as the agency's supreme court and then by the Federal Courts including in appropriate instances United States Supreme Court.

This Atomic Safety and Licensing Board is here today to conduct an evidentiary hearing regarding the so-called mandatory portion of the licensing proceeding concerning the August 2006 application of Southern Nuclear Operating Company or Southern under Appendix A of Part 52, Title 10 of the Code of Federal Regulations or the CFR for an early site permit or ESP for two new nuclear power reactor units at the existing two unit Vogtle Electric Generating Plant site near Waynesboro, Georgia. These new reactors would employ the Westinghouse Electric Corporation AP1000 Advanced Passive Pressurized Water Reactor certified design.

With us today as parties to this mandatory hearing are the NRC staff and Southern. Let's have

the parties identify themselves for the record starting with the NRC staff.

MR. MOULDING: Thank you, Your Honor. This is Patrick Moulding representing the NRC staff. With me at the counsel table are Jody Martin and Sarah Price. Good morning.

JUDGE BOLLWERK: Let me just check. Are we getting enough sound please?

(Off the record discussion.)

JUDGE BOLLWERK: Thank you. Southern please then.

MR. BLANTON: Thank you. Stan Blanton for Southern Nuclear. With me at counsel table are Kathryn Sutton of Morgan Lewis & Bockius, behind me my associate, Chad Pilcher, and Chuck Pierce is the Manager of Licensing for Southern Nuclear.

JUDGE BOLLWERK: All right. Thank you.

By way of background, an early site permit which is a special type of NRC permit is categorized as a partial construction permit under Section 52.21 of 10 CFR. Its issuance, however, does not authorize an applicant to construct a nuclear power reactor. Rather the focus of an ESP is the suitability of the proposed site for such a facility. As a consequence, the Vogtle Units 3 and 4 ESP application concerns

various Atomic Energy Act related site safety and/or National Environmental Policy Act related environmental protection matters as well as the facility plan for coping with emergencies.

In an ESP proceeding, issues can come before a hearing board such as this one in two ways. The first is as part of the contested portion of the proceeding in which specific challenges to the ESP application can be raised by an individual, group or governmental entity in a hearing petition.

With regard to the contested portion of this proceeding, last week we conducted a four-day evidentiary hearing regarding three contested environmental matters that were interposed jointly by five public interest groups. Alternately, safety or environmental issues regarding an ESP may come before a licensing board as part of the mandatory hearing portion of the agency licensing proceeding that involves consideration of matters that have not been the subject of contentions or issue statements submitted by intervening parties challenging the license application. In accord with the October 2006 Notice of Hearing in this proceeding found in Volume 71 of the Federal Register at page 60195 and Section 52.24 of Title 10 of the Code of Federal Regulations

or the CFR in this early site permit proceeding, the Board must make certain findings regarding the adequacy of the NRC staff's safety and environmental reviews.

To carry out its responsibilities under the Atomic Energy Act as reflected in the hearing notice and the agency's regulations, this Licensing Board has taken a series of steps. First in accord with September 19, 2008 memorandum and order regarding procedures relating to environmental issues for the mandatory hearing, by issuance dated October 17, 2008, the Board provided a set of 30 questions and a list of six topics for evidentiary presentations by the NRC staff and/or Southern during the mandatory hearing. Both the staff and Southern responded to the Board's questions in filings dated November 7, 2008.

Thereafter, in a December 5, 2008 issuance, the Board outlined three additional presentation topics and posed 32 safety related questions to which the staff and Southern responded on January 16, 2009. In addition, during a January 28, 2009 pre-hearing conference and by memoranda and orders dated December 31, 2008 and February 4, February 23, March 6 and March 12, 2009, the Board provided additional administrative guidance on the

conduct of the mandatory hearing as well as posed two additional presentation topics, bringing the total number of presentation topics to 11.

As outlined in the Board's February 23rd issuance, those topics and their order of presentation are as follows: Presentation 1, Water Use Impacts; Presentation 2, Radiological Impacts; Presentation 3, Groundwater Impacts on Safety Related Structures; Presentation 4, Environmental Impact of Alternatives; Presentation 5, Limited Work Authorization and Site Redress Plan; Presentation 6, Site Emergency Plan; Presentation 7, Seismic Evaluation; Presentation 8, Severe Accident Mitigation Design Alternatives; Presentation 9, Deferrals to the Combined License Proceeding; Presentation 10, Permit Conditions; and Presentation 11, The AP1000 Design Certification Revisions. In setting this presentation order, however, we noted that particularly with regard to the last four topics that the staff and Southern previously had indicated may involve shorter presentations, we might move topics forward in the schedule to avoid starting a presentation that we would be unable to finish on a given day.

Additionally, in our March 6th issuance, we indicated that to the extent appropriate we

contemplated empaneling both the NRC staff and Southern witnesses on these subjects at the same time to expedite and focus the presentations. Finally, as part of our March 12th guidance on the conduct of this mandatory hearing, we indicated that while we did not contemplate witness cross examination by counsel for the staff or Southern, we would afford them an opportunity to make opening statements. In that regard in a moment, we will turn first to counsel for the NRC staff for its opening statement.

Before we do so, however, I want to make mention of another aspect of this proceeding that took place yesterday afternoon and will occur again this evening. Under Section 2.315(a) of Title 10 of the Coder of Federation Regulations, presiding officers are authorized to entertain oral limited appearance statements from members of the public. These statements which are transcribed and placed into the official agency docket of the proceeding are intended as an opportunity for members of the public to express their views about and may help the Board and the parties in their consideration of the issues in the proceedings, both with respect to the contested and uncontested or mandatory hearing aspects of the proceedings.

As was the case yesterday afternoon, again tonight beginning at 7:00 p.m. here in this room the Board and these parties along with representatives of the Joint Intervenors from the contested proceeding will be present to listen to statements by members of the public who may have concerns about either the contested or mandatory aspects of the ESP proceeding, the latter of which is the subject of today's proceeding, and about the pending Southern application for a combined license to construct and operate Vogtle Units 3 and 4 which is the subject of a contested issue that is also pending before the members of this Board regarding the details provided in the Southern plan for storing low level radioactive waste in light of the recent closure of the Barnwell, South Carolina low level waste disposal facility.

If anyone here is interested in making a limited appearance statement tonight and you have not pre-registered to do so, I would urge you during a break to see our law clerk, Wen Bu, who is sitting over here on the right who can include you on this evening's list of pre-registered speakers.

Also I would note that today as we did last week during the contested hearing in Augusta, we will be utilizing some technology in the hearing room

that will, I hope, aid the Board and the parties in conducting a more efficient proceeding. During these ESP proceedings, we are for the first time officially implementing some of the technology that was developed originally for the recently convened high level waste repository licensing proceeding, namely, the Digital Data Management System or DDMS.

The DDMS is our attempt to digitize both the video and documentary record of an evidentiary proceeding to make it accessible and useable to the Board and the litigants in a court room setting. One of the things that we'll be doing with the DDMS during this mandatory proceeding is marking the parties' exhibits electronically rather than using an ink stamp or labels as is customary in most judicial hearings. This may involve some interchange between the Board and our Information Technology technician sitting here to my right.

Also each of the parties have been provided with a laptop computer with which via a wireless broadband internet hookup they should be able to keep track of the status of the various exhibits as well as search for and view any of the materials that currently reside in the docket of this proceeding. Additionally, we'll be recording the proceeding which

the parties will have available to them via the DDMS after the hearing for among other things making any transcript corrections. Further, we anticipate using display technology as part of the evidentiary presentations which hopefully will make the information we'll be discussing with the parties' witnesses more accessible and understandable to those in the audience today.

As last week's contested proceeding in Augusta demonstrated and frankly yesterday's limited appearance session here in Waynesboro demonstrated, use of this technology is unlikely to go off without a hitch. Nevertheless, I would be hopeful that at that close of these ESP hearings the advantages of the more technological approach to hearing data management will be obvious to the parties and the public observers of the proceeding.

As I mentioned yesterday, we had some problems with our microphones. We had to switch those out from what we used last week in Augusta. Just as you've already discovered, you need to turn the switch on and off. That would apply to the microphones at the witness table as well. And they are sensitive. If you leave them on, you will be heard including tapping on the table or making noise. So you might

want to try to keep them off when you're not using them, but certainly turn them on when you have a need for them.

Turning then back to the matter at hand as we begin today's mandatory hearing, I would note that in my pocket I have my cell phone and I am about to turn it off. I would suggest everyone else in the audience do the same. I would ask that all cell phones in the hearing room be turned off or be placed on vibrate and that any cell phone conversations be conducted outside of this room. This will be the rule throughout this proceeding and I thank you for your cooperation.

Let's turn now to staff counsel for the staff's opening statement bearing in mind the Board's request in its March 12th memorandum and order at pages one and two that counsel as part of their opening statements address the question of the relationship between the findings the Board has been directed to make pursuant to the October 2006 Notice of Hearing for this early site permit proceeding which again is found at 71 Federal Register page 60195 and those required by 10 CFR Section 52.24 as it is currently constituted following the Commission's August 2007 rule-making revising the provisions of Part 2 and Part

52 at 72 Federal Register beginning at page 49,352.

I turn to the staff.

MR. MOULDING: Thank you, Your Honor. Mr. Martin will be presenting the opening statement for the staff.

JUDGE BOLLWERK: Thank you.

MR. MARTIN: Good morning and thank you for the opportunity to make an opening statement. The NRC staff submits that its review of both safety and environmental matters concerning this early site permit application has been adequate and complies with all applicable Commission regulations.

Specifically for the safety analysis and the safety evaluation report or SER, the staff reviewed the information presented in the Vogtle application concerning the site's meteorology, hydrology, geology and seismology as well as the potential hazards to a nuclear power plant that could result from manmade facilities and activities on or in the vicinity of the site. The staff also assessed the risks of potential accidents that could occur as a result of the operation of a nuclear plant at the site and evaluated whether the site would support adequate physical security measures for a nuclear power plant.

The staff also evaluated the Applicant's

quality assurance measures and reviewed the complete and integrated emergency plans that the Applicant would implement if the new reactor is eventually constructed at the ESP site. In addition, the staff reviewed the technical information presented in the application pertaining to the limited work authorization or LWA activities being requested. Specifically, the staff reviewed the Applicant's seismic design, seismic systems and foundations as they relate to the LWA activities being requested. The staff also evaluated the Applicant's fitness-for-duty program.

The staff's environmental review as documented in the Final Environmental Impact Statement or FEIS focuses on the environmental effects of construction and operation of two AP1000 reactors including an analysis of man use impacts, water related impacts, meteorological and air quality impacts, terrestrial ecology impacts, aquatic ecology impacts, socio-economic impacts, historical and cultural resources impacts and environmental justice. This analysis also includes an evaluation of alternative sites to determine whether there is an obviously superior alternative to the proposed site. Additionally, the FEIS includes a discussion on need

for power and energy alternatives as well as a discussion of benefits and costs of the proposed action.

When conducting an uncontested hearing, the Board should conduct a simple sufficiency review as opposed to a de novo review. In other words, the Board should inquire whether the NRC staff performed an adequate review and made findings with reasonable support and logic and fact. The staff submits that its Final Safety Evaluation Report and its Final Environmental Impact Statement, both of which the staff will offer into evidence in this proceeding, provides the necessary basis for the Board to make all of the findings required by the Commission in its Notice of Hearing. The staff has also responded earlier in this proceeding to the Board's detailed questions on both safety and environmental topics.

In its presentations at this hearing, the staff will focus on certain specific areas of its review identified by the Board and the staff looks forward to responding to the Board's questions in these area. The staff is confident that these presentations will highlight that the staff's review sufficiently addressed all applicable regulations.

I would now like to address the specific

matters the Board raised in its March 12, 2009 order. In that order, the Board asked the staff to address the question of the relationship between the findings the Board has been directed to make pursuant to the Notice of Hearing for this early site permit proceeding and those required by 10 CFR Section 52.24. For purposes of this hearing, the staff believes that the findings defined by the Commission in its Notice of Hearing are the applicable standards for the Board; that the findings set forth in Section 52.24 need not be separately considered.

In October 12, 2006 Notice of Hearing, the Commission instructed the Board to make certain findings. Later in its Hearing Notice concerning the Applicant's LWA request, the Commission instructed the Board to consider three additional safety issues related to the LWA and one NEPA issue related to the LWA. Because only these findings arise from specific instructions from the Commission to this Board, the staff used these as the relevant findings for the purpose of this mandatory hearing rather than the standards in Section 52.24.

This conclusion is further supported by the Commission's memorandum and order of August 30, 2007. That order responded to the Board's certified

question of "Does the Commission wish this Licensing Board to conduct the Vogtle ESP Mandatory Hearing?" The Commission responded in the affirmative and asked the Board to conduct the mandatory hearing and this proceeding as originally planned.

The staff noticed that this order was signed August 30, 2007 which was two days after the final rule revising Part 52 was published in the Federal Register. The final rule revising Part 52 substantially rewrote Section 52.24 and added the findings currently found in that section. If the Commission intended for this Board to make the specific findings in Section 52.24 instead of or in addition to those defined in the previous notice of hearing presumably it would have instructed the Board of this intention in the August 2007 order.

In any event, the staff believes that the findings the Board is being asked to make in this proceeding are analogous to the findings in Section 52.24. The findings in the Notice of Hearing are derived from an earlier version of 10 CFR Section 2.104(b). In the final rule revising Part 52, the Commission removed many of the specific requirements from Section 2.104(b). Now that section only addresses those requirements for a notice of hearing

which are common to all proceedings.

In this same rule-making, the Commission revised Section 52.24 to include the current standards. While the findings out of the Section 52.24 are not identical to those removed from Section 2.104, the staff believes that they are similar. Accordingly, the information needed by the Board to make the findings specified in the Notice of Hearing is likely the same as what the Board would need to make a determination on the current Section 52.24 standards. In any event, the staff submits that the findings the Board must make in this case are those specified in the Notice of Hearing.

In conclusion, the staff believes that its Final Environmental Impact Statement and Safety Evaluation Report document a review that meets all applicable regulations and allow the Board to make the findings specified in the Notice of Hearing. The staff looks forward to making presentations to the Board and to responding to your questions.

JUDGE BOLLWERK: Thank you very much. I appreciate it. Let's turn then to Southern.

MR. BLANTON: Thank you, Your Honor, and good morning. At this mandatory hearing for Southern Nuclear Operating Company's application for an early

site permit for two additional units for Vogtle Electric Generating Plant, Southern Nuclear will present evidence in the form of presentations on the subjects requested by the Board for the purpose of demonstrating that Southern Nuclear's application and the NRC staff's review of the safety and environmental issues will satisfy the requirements of NRC regulations and warrant issuance of the ESP.

The Commission in three previous ESP proceedings has provided the Board and parties with a roadmap and set of ground rules for the conduct of the mandatory hearing. In those orders, the Commission noted that the purpose of the mandatory hearing on uncontested issues, such as that we're dealing with today, will provide an opportunity for the Board to decide whether the safety and environmental record developed in the proceeding is sufficient to support the issuance of the ESP and, in this case, the limited work authorization, or LWA.

In contrast to a contested hearing where the Board acts the initial finder of fact, in the mandatory hearing the Board's inquiry focuses on whether the NRC staff's findings supporting the issuance of the ESP are based on an adequate review of the information provided by the Applicant and whether

those findings have reasonable support in logic and fact. In deciding the uncontested issues in this case that will be presented this week, the staff's review of the safety and environmental issues presented by the application is not to be replicated and staff's technical and factual findings are not open to reconsideration if the record demonstrates that the staff's review was adequate and its findings sufficient. For example, as to the baseline NEPA issues. although the Board must make an independent determination regarding those issues, in doing so, it should not second guess the underlying technical facts or findings by the NRC staff.

As the Board requested in its order of March 12th, I'm going to spend a few seconds and address the ultimate issues that the Board needs to decide in this case. As the Board has noted, the Notice of Hearing specifically discusses only those issues enumerated in former 10 CFR 2.104(b) and specifically called out in the Commission's 2005 order explaining the process for a mandatory hearing: those issues being (1) whether the issuance of the permit will be inimical to common defense and security and to the health and safety of the public; and (2) whether taking into consideration site criteria in Part 100

whether an AP1000 could be constructed and operated on the site without undue risk to the health and safety of the public and the baseline NEPA issues discussed above.

As the Board noted in its order the Notice of Hearing does not expressly address the criteria enumerated in 10 CFR Section 52.24 which was promulgated in August 2007, approximately one year after the application was submitted. This apparent inconsistency is due to the amendments of Part 52 which was promulgated subsequent to the publication of the Notice of Hearing in this proceeding. Although the provisions of the amendments of Part 52 were not made to expressly apply to applications pending at the time of the promulgation of the amendments unless the Applicant has specifically requested the provisions of the new rule apply.

Southern Nuclear prepared its ESP application in compliance with the Part 52 amendments and revised the application as new requirements of the amended rule became apparent. In addition, Southern Nuclear has invoked the amendment to the LWA rule in connection with its LWA request. Accordingly, Southern Nuclear believes that the current version of 10 CFR Section 52.24 applies to this ESP proceeding.

In any event, Southern Nuclear believes that the 52.24 criteria in the new rule are subsumed within the questions from former 2.104 that were restated in the Notice of Hearing. Accordingly, whether the standards from former 2.104(b) as stated in the Notice of Hearing or the newer Section 52.24 apply it does not appear to be of great significance to the Board's review of the staff's findings relative to those issues. In fact, as the NRC staff has stated, it appears that the 52.24 findings would underlie and support the ultimate findings expressed in the Notice of Hearing. Therefore, we believe that it is prudent for the Board to make both the ultimate findings of fact requested in or specified in the Notice of Hearing supported by the findings which specified in 10 CFR Section 52.24 in ruling on the ESP application in this proceeding.

As to the presentations requested by the Board for this mandatory hearing, Southern Nuclear witnesses will make presentations to the Board as a preface to the NRC staff's presentations on the following subjects: (1) environmental and safety impacts from the accidental release of radionuclides; (2) safety impacts and effects of groundwater on the safety related structures; (3) evaluation of

alternatives; (4) the scope of LWA request and site redress plans; (5) the Vogtle 3 and 4 emergency plan; and (6) the seismic evaluation of the Vogtle site.

In summary, Southern Nuclear believes the staff's findings in this matter are based on a robust record are thorough and logical. We believe the Board's review of these findings based on the record will demonstrate that each of the questions presented should be answered in favor of the prompt issuance for the early site permit and the LWA. Thank you very much.

JUDGE BOLLWERK: Thank you, sir. What I'm told by our audio technician is that we need to have the microphones a little closer if we can when you're talking and that would apply to our witnesses as well and to the other two judges.

MR. BLANTON: Is that better?

JUDGE BOLLWERK: I think. All right. Does that work?

(No verbal response.)

Okay. With that, with the opening statements of counsel which we appreciate very much, it sounds like basically we're being asked to do the same thing but just twice. Is that sort of the bottom line in terms of the findings we make?

MR. BLANTON: That's the best response I can come up with, Your Honor.

JUDGE BOLLWERK: All right. Anything further from the staff on that point?

MR. MOULDING: No, Your Honor, I think there is substantial similarity between the two sets of findings.

JUDGE BOLLWERK: All right. Thank you. At this point, do any of the two judges, Judge Trikouros, Judge Jackson, have any statement they want to make at this point or anything you want to say?

(No verbal response.)

All right. Then I think we're ready to begin the first presentation panel which deals with the question of water use impacts. And I believe there are four staff witnesses. There are no SNC witnesses or Southern witnesses on this particular panel. And we do have some exhibits we need to admit as well as swear these witnesses in.

And make sure you're near one of the microphones. We're short a mike stand at this point. We're going to try to get one for that. We'll use that as a hand-held if we need it, but I think for the second panel, we actually have a number of individuals we're probably seating all together. So we may need

that extra microphone.

All right. Let me turn to the staff and let you introduce the witnesses.

MR. MOULDING: Thank you, Your Honor. These are the four panelists for the NRC staff on presentation one which is water use impacts. From the Judges' left, we have Mr. Mark Notich, Dr. Charles Kincaid, Dr. Christopher Cook and Mr. Lance Vail.

JUDGE BOLLWERK: All right.

MR. MOULDING: And at this time, how would you like us to proceed in terms of admitting or resubmitting the FEIS as part of this proceeding?

JUDGE BOLLWERK: Let's go ahead first and swear the gentlemen in and then we'll deal with the exhibits.

Gentlemen, some of you were sworn last week, but let's go ahead and swear everybody back in again. If you would raise your right hand please and you need to respond in the affirmative orally to the question I'm going to ask you. Let's start with Mr. Notich on this end and just go one at a time down the line. Let's just do this for all the witnesses rather than having everybody say yes at one point. Just go right down the line and then it's clear to the court reporter that everybody is taken care of.

So you can all raise your right hand.

WHEREUPON,

MARK NOTICH

DR. CHARLES KINCAID

DR. CHRISTOPHER COOK

LANCE VAIL

were called as witnesses for the staff and, having been first duly sworn, assumed the witness table, were examined and testified as follows:

MR. NOTICH: I do.

DR. KINCAID: I do.

DR. COOK: I do.

MR. VAIL: I do.

JUDGE BOLLWERK: Why don't you move those two mikes a little closer and you need to make sure they're on. There you go. Okay. All right.

In terms of the exhibits, I take it at this point you'd like to go ahead and try to put in the FEIS.

MR. MOULDING: I think that would be our preference as well as if now is appropriate time to introduce Exhibits 000056 and 000057, the written responses to the Board's earlier questions. We can do both of those at this time.

JUDGE BOLLWERK: All right, and we haven't

really started with the panel. But you contemplate -- I looked through the different presentations and you anticipate going ahead and using the responses to the Board's questions at some point.

MR. MOULDING: We simply wanted to get those into the record of this proceeding. I don't know that any of the witnesses will be specifically referring to those previous responses, but we wanted to make sure that that information was in the record and available for the Board.

JUDGE BOLLWERK: All right. Let me just turn to the Board members. Do you think that's something we ought to have in the record even if they don't -- Do you think?

(No verbal response.)

All right. Let's then begin with NRC00001A-E and maybe you can describe it briefly. I have the breakdown if you need it. But if you just give a brief description of the different sections that we're dealing with. We have 1A through 1E.

MR. MOULDING: Yes, I believe that 1A represents the first portion of Volume 1 of the Final Environmental Impact Statement. I believe that is through chapter 4. 1B I believe is the remainder of Volume 1 from Chapter 5 to the end of Volume 1. 1C I

believe is Volume 2 of the FEIS. 1D is Appendix F and 1E is the errata to the FEIS.

JUDGE BOLLWERK: And I had down that the 1C was the FEIS Appendices A-J.

MR. MOULDING: Right. That would be the entirety of Volume 2.

JUDGE BOLLWERK: All right. Let the record reflect then that Exhibit NRC00001A through 1E are marked for identification.

(Whereupon, the documents referred to were marked as NRC Exhibits NRC00001A-E-MA-BD01 for identification.)

And let me just make a point with the exhibits here just for counsels' benefit and, of course, now my computer goes to blank, right. All right. Very secure. I can't use it. The exhibits in this case will be marked in a particular way. We're going to have both the transcript with the page numbers. Each one will be noted with an MA after the page number so that it will be clear that this portion of the transcript applies to the mandatory hearing and the exhibits will be marked in addition to the NRC00001A it will have some additional information appended to it. It will have a dash, an MA, a dash and BD01. That will be the total exhibit number and

you'll see them listed that way in the transcript.

For purposes here, we should refer to them by the short form which is basically the NRC00001A format. But again you'll see a somewhat longer description and that's the way they will see them being marked in the DDMS as well. And again the MA, that designation, will be for the mandatory hearing exhibits. As we indicated, for instance, this particular exhibit was also marked for the contested case. It would have the designation after the NRC part -00-BD01 which distinguishes it from the MA which would be the mandatory hearing exhibits so that the record is clear.

All right. Any questions about that? That's the way you'll see it and that's the way it should be referred to.

All right. We have identified NRC00001A, right, through E. Any objection to the admission of these exhibits?

(No verbal response.)

Hearing none, then the record should reflect that Exhibits NRC00001A, B, C, D and E are admitted into evidence.

(The documents referred to having been previously marked for identification as Staff

Exhibits NRC00001A-E-MA-BD01, were received in evidence.)

MR. MOULDING: Your Honor, since this is an environmental presentation, perhaps now is the appropriate time to introduce to you the written responses to the Board's questions on environmental matters.

JUDGE BOLLWERK: All right.

MR. MOULDING: As well as this presentation and the CVs for each of these four witnesses.

JUDGE BOLLWERK: All right.

MR. MOULDING: We can probably do the CVs by presentation unless you would like us to do all the CVs for all the presenters at once.

JUDGE BOLLWERK: No. Let's just go ahead and do them by presentation by presentation.

MR. MOULDING: Okay. The staff would like to identify Exhibit NRC000057, NRC Staff Response to the Licensing Board's Questions Regarding Environmental Matters dated November 7, 2008.

JUDGE BOLLWERK: And the record should reflect that Exhibit NRC000057 as identified by counsel is marked for identification.

(Whereupon, the document referred to was marked as

Staff Exhibit NRC000057-MA-BD01 for identification.)

MR. MOULDING: The staff would also identify Exhibit NRC000059, Staff Presentation 1 Water Use Impacts.

JUDGE BOLLWERK: The record should reflect that NRC000059 as identified by counsel is marked for identification.

(Whereupon, the document referred to was marked as Staff Exhibit NRC000059-MA-BD01 for identification.)

MR. MOULDING: Exhibit NRC000070 Curriculum vitae for Christopher B. Cook.

JUDGE BOLLWERK: The record should reflect that NRC000070 as identified by counsel is marked for identification.

(Whereupon, the document referred to was marked as Staff Exhibit NRC000070-MA-BD01 for identification.)

MR. MOULDING: Exhibit NRC000071 Curriculum vitae for Charles T. Kincaid.

JUDGE BOLLWERK: The record should reflect that NRC000071 as identified by counsel is marked for identification.

(Whereupon, the document referred to was marked as

Staff Exhibit NRC000071-MA-BD01 for identification.)

MR. MOULDING: Exhibit NRC000072 Curriculum vitae for Mark D. Notich.

JUDGE BOLLWERK: The record should reflect that NRC000072 as identified by counsel is marked for identification.

(Whereupon, the document referred to was marked as Staff Exhibit NRC000072-MA-BD01 for identification.)

MR. MOULDING: And Exhibit NRC000073 Curriculum vitae for Lance W. Vail.

JUDGE BOLLWERK: The record should reflect that NRC000073 as identified by counsel is marked for identification.

(Whereupon, the document referred to was marked as Staff Exhibit NRC000073-MA-BD01 for identification.)

MR. MOULDING: At this time, we would move to have these exhibits admitted into evidence as well, Your Honor.

JUDGE BOLLWERK: Any objections?

(No verbal response.)

Hearing none, then the following exhibits are admitted into evidence: NRC000057, NRC000059,

NRC000070, NRC000071, NRC000072 and NRC000073. And again these are admitted into evidence.

(The documents referred to having been previously marked for identification as Staff Exhibits NRC000057-MA-BD01, NRC000059-MA-BD01, NRC000070-MA-BD01, NRC000071-MA-BD01, NRC000072-MA-BD01, NRC000073-MA-BD01, were received in evidence.)

(Off the record discussion.)

JUDGE BOLLWERK: And at this point, I think we're ready for the presentation.

MR. MOULDING: Yes, Your Honor. Could you bring Exhibit 000059 please? Thank you and at this time I would like to turn it over to our staff presenters.

MR. VAIL: So you'll be making the changes in the slides as I go through. Okay.

JUDGE BOLLWERK: One second. Let's get -- My understanding is they were going to bring up on their laptop and they were going to control it. Is that what we have right now?

(Off the record discussion.)

Okay. We need to go ahead and bring up it so that they can control it. It's on their laptop I take it, right?

MR. MOULDING: No, Your Honor. We were going to use the version in DDMS and just --

JUDGE BOLLWERK: You want to use the DDMS version. Okay.

MR. MOULDING: Yes.

JUDGE BOLLWERK: Okay. You all are going to use the laptop.

MR. BLANTON: Yes, sir, and the staff is welcome to use that one if they want to.

JUDGE BOLLWERK: That's fine. You're going to use the DDMS. That will work. I just want to make sure I'm on the same page as everybody. Thank you.

MR. MOULDING: Right.

JUDGE BOLLWERK: We're in good shape now. Thank you. You guys have control.

MR. MOULDING: I'm sorry for the confusion. The witnesses can just indicate next slide and if you would be able to switch from slide from slide that would be excellent.

MR. VAIL: Can I have the next slide?

I'm Lance Vail and with Charlie Kincaid will be presenting the surface water and groundwater presentations respectively. Next. Sorry. Back. Can you go back a slide? Thank you.

In my presentation on the cumulative surface water impacts, I've broken it up into several sections. One is on the hydrological environment and I'll discuss water users in the area, water management including reservoir management in particular, drought management, and then I'll summarize in conclusions. And after I'm done, Dr. Kincaid will make a presentation on the groundwater issues. Next slide.

This slide provides a diagram, a figure, showing the entire Savannah River Basin. It starts in North Carolina, basically follows the South Carolina-Georgia border down to the Atlantic Ocean. When we did our analysis, the staff basically broke the system up into four domains for their consideration. That was above Thurmond Dam, then from Thurmond Dam down to the Vogtle site and then we considered specifically the Vogtle site and then downstream from the Vogtle site. So the primary reason for breaking it at Thurmond Dam was as we discussed in the contested hearing that that provides a primary control for water in the basin past the Vogtle site. Next slide.

The next slide in the light areas basically shows the portions of the basin that pick up that actually drain into the Savannah River between Thurmond Dam and the Vogtle site. So you can see that

there's a significant amount of area that was actually contributing both surface water and groundwater from between what happens at Thurmond Lake and what happens at the Vogtle site.

We'll discuss in a little bit more detail the operations at Thurmond Dam. Can I have the next slide?

This slide is to make a couple of points. It actually goes back from 1925. The Augusta Gauge actually goes back farther than that, quite a bit farther than that. So as a hydrologist, we feel very fortunate to have such a long term record available. That's pretty unique.

But there is a point that you can see from the 1925 period to present in that clearly around 1955 there was a change in behavior of the stream flow and that doesn't take a lot of consideration to basically say that's exactly what you expect a reservoir going into the system the exact behavior that you'd expect it to have. It basically does two things. It tends to clip off some of the higher flows which is providing its flood control function and then it tries, it pulls up some of the lower flows basically providing its drought management function. So it's basically providing the role that you would expect for

a reservoir and that clearly shows the demarcation between that period around 1952 with the installation of the reservoirs.

I should mention just for the record these are weekly average data. So they're not actually the daily values. So you actually see some values that would be slightly higher and slightly lower if you actually looked at the records. We just tried to smooth some of that out on a figure that's already shown somewhat variation. It tends to be sort of a big blob on the screen.

JUDGE TRIKOUROS: I just had a question on this data. From about 1979-1980 time frame, it appears there's a clear trend down. Am I looking at that correctly?

MR. VAIL: You know statistically we haven't been able to establish that there's a clear trend down and also I should point out that there's a change in operating policies with a reservoir that go over time and those occur for many reasons. But I mean I notice, I do see, that in those last few years and stuff there is a period of a downtrend and we'll show you some data subsequently that makes it a bit more ambiguous whether there's actually a trend there.

I should mention that we did look at

climate, you know, the climate modeling results and for this region we're not able to specifically say that there was a climate trend.

DR. COOK: I would also like to add that there are three dams that are there on the river. Thurmond Dam was put in in 1951, Hartwell was put in in 1961 and then Russell was put in in 1983. So some of the variations you may be seeing is as these reservoirs come in and put in place. Although the first one was put in in `51, they were built over a series of time.

JUDGE TRIKOUROS: But from about `80, perhaps `82-`83 time frame, down to today at least from this data it shows sort of a stair-stepping downward trend. Now you said you're going to show additional data where you've evaluated this statistically and I guess I'd be interested in seeing that.

MR. VAIL: Can I have the next slide?

This slide was basically to show the data, the releases at Thurmond Dam and the data at the Waynesboro Gauge. The reason for looking at this is looking at the amount of flow that we're picking up and with the exception of a few negative points and I'll explain what those are typically in stuff you see

a noticeable positive number and stuff and that's basically what you would expect. As we mentioned in the contested hearing, we would have liked to use the Waynesboro Gauge, but again you're seeing the entire period of record starting in 2005. And so it didn't provide us an adequate record for that assessment.

The reason that you see some of those negative values is basically there's a lag between the flows being released at Thurmond Dam and when those will actually show up at the Waynesboro site. So we didn't lag the figure. So we're basically saying at the same day we're looking at the same day of the releases at Thurmond and the flows past Waynesboro. And since it takes time for it to get there, when you ramp up those releases you actually see higher flows and that's what that negative effect is. And you also note that you only see those during high flow periods.

JUDGE JACKSON: Mr. Vail.

MR. VAIL: Yes.

JUDGE JACKSON: Roughly, what is that delay for a typical flow rate?

MR. VAIL: You know in the contested hearing Stan Simpson from the Corps was talking about nine days. We didn't have specific numbers. Nine days seem long for me from Thurmond. But I would

certainly expect that it was going to be at least three to five days.

JUDGE JACKSON: Okay. I guess that would have something to do with since these data are averaged over a week period. It probably has something to do with where in that cycle the release occurs.

MR. VAIL: Yes. Sorry. These are actually daily data.

JUDGE JACKSON: These are daily.

MR. VAIL: These are actually daily data. We had a short enough record that actually putting the daily values wasn't a problem.

JUDGE JACKSON: Okay. I guess that would make more sense then.

(Off the record discussion.)

That would make sense then because I was concerned if these were averaged weekly, then that would make a real difference in how these data would, that difference, would show up.

MR. VAIL: You're absolutely correct.

JUDGE JACKSON: Okay. Thanks.

JUDGE TRIKOUROS: You preempted our question. That's an awful big negative though. It's almost -- It's about 4,000 cfs. That doesn't --

That's consistent with the way they operate Thurmond Dam that they might release that large amount of flow and the difference would show up that way?

MR. VAIL: Yes. The magnitudes of those numbers seemed high to me, that 4,000, because normally you're restricted to ramping up flows relatively gradually. But again remember these are differences and it's 4,000 in a period where you're already releasing. You're at relatively high flows because those negative values correspond to periods where you're pretty high in the flow. So incrementally it probably wasn't a significant flow.

It wasn't like they were going from 4,000 at Waynesboro and then releasing 8,000. You know we weren't in a low flow period. We were in a high flow period. But they do have operating policies that set what those releases are.

JUDGE TRIKOUROS: So it makes sense that over a nine day period if they incrementally release you might get a point, say, at the eighth day which has yet to record at Waynesboro that you could have a 4,000 cfs difference between Thurmond and Waynesboro.

MR. VAIL: Right. I think it would be a case where you were seeing the difference between a 15,000 at Waynesboro and a 19,000 at a Thurmond

release.

Can we have the next slide.

JUDGE TRIKOUROS: But this doesn't address the issue of that trend question I had asked you. This data is only a couple of years old or a few years old. The trend that I was talking about from the previous slide was closer to 30 years or certainly 25.

MR. VAIL: You mean the trend from 1994 down on the Augusta data?

JUDGE TRIKOUROS: It was on the previous slide. It seemed to be a fairly -- The slide before this.

JUDGE BOLLWERK: That would be page six, right?

JUDGE TRIKOUROS: Right. This one, eyeballing it from about 1980 seems to show a downward trend to me. Now I'm just asking your opinion on that and you said you had done some additional statistical --

MR. VAIL: You want to keep in mind that there the view here gets a little bit weighted toward the end and we right now are in a drought of record. So that last period's clearly down and then we did have a drought in 2000-2003 period which actually brought that period down. So we sort of got hit by

those two periods.

I think if you looked at it and you basically held out the 2000 drought and the current drought I think if you didn't have those in the figure and stuff it wouldn't bias your view to seeing that as a downward trend.

JUDGE TRIKOUROS: Okay. I'm not trying to second guess your expert evaluation. What I'm trying to make sure of is that subject came up. You looked at that. You're convinced. You've evaluated it. You're convinced that there is no trend that you would be concerned about. That's really where I'm going with this. I'm not trying to second guess you in any way.

MR. VAIL: I would say that we're concerned about everything like those behaviors and that's why we did look at the climate record. I will show you another figure that's actually later in the presentation that sort of tries to show some of the patterns there and I think it will be more difficult for you to see that there's a trend and also when we look at the reservoir operations you'll see those two lower periods.

JUDGE TRIKOUROS: We had some testimony in the contested portion of the hearing where they

indicated that I guess they were releasing 3100 cfs from Thurmond Dam for the first time. I believe I remember something along those lines. Is that consistent with what you're -- Do you remember?

MR. VAIL: That's correct. They did until recently. For several months, they released 3100 cfs and they had brought that down. That was part of the plan, the drought contingency plan, or the deviation plan because of this current drought. The staff is in a difficult -- This is an awkward time to be doing an assessment when you're doing an assessment on water during the drought of record. But we did try to reflect that appropriately.

JUDGE BOLLWERK: Go ahead. Are we on the right slide now?

MR. VAIL: Yes.

JUDGE BOLLWERK: Number eight.

MR. VAIL: Yes, we're on the right slide.

JUDGE BOLLWERK: Okay. Just one record matter for all the witnesses. We've agreed we're going to the next slide. If you could just mention the slide number, it would make it easier when we go back to the record and look. We can tie your testimony to the particular slide in this exhibit which is NRC000059 I believe. Thank you.

MR. VAIL: Yes. Just to correct something that we had mentioned earlier, Dr. Cook has just reminded me that I think when Stan Simpson was making his testimony he was talking about the travel time from Thurmond Dam actually all the way down to Savannah and that was where we were talking about this eight to nine day period and stuff. So the fact that it would be considerably shorter than that to this site makes sense.

The slide that we have in front of you shows some of the process the staff uses in looking at consumptive water use. And consumptive water use estimation over large regions is always difficult because of the lack of available data. Typically you might have withdrawal data, but it's less likely that you actually have direct estimates of consumptive use and you have to use some mechanism to come up with that actual information.

So to give you, there are several examples here and these are basically the region between Thurmond and the Vogtle site. There are several facilities that we've listed there and, for instance, I'll mention the Urquhart Station. When we do that, this is basically a once through plant, but we do attribute some consumptive water use to the induced

evaporation of the water that is going to be going back into the river and we typically do that.

Another one as an example is with South Carolina. South Carolina had a real limit on the amount of data available for water use and all we were able to obtain really was a USGS has county by county estimates of water use by sector and you can make some estimates based on the sector of the water use about what fraction of that is going to be consumptive. In this case, we just assumed that 100 percent of that water use was going to be consumptive because it was hard to separate it into its sectors.

I should point out that these were county water uses. These are counties along the Savannah River, but it's not clear that they were actually withdrawing water from the Savannah River in those estimates of withdrawal. So based on this sort of methodology, we come up with what we think are estimates of withdrawal and conservative estimates of what we think would be consumptive water use.

However, I'll point out in this case that we did rely on the fact that regardless of what these numbers are, because in that earlier slide where I showed you we're picking up water as we move downstream between Thurmond and the Vogtle site that

we actually are picking up water. So any water that we're actually losing here we're actually already compensating for in the assessment.

JUDGE JACKSON: Those consumptive losses that you show for the two once through power plants, they look like they might be fairly conservative. Just in a word, how were those estimated?

MR. VAIL: Basically, the D-Area Powerhouse was slightly different because we actually did have data in that case that the Department of Energy had on both their withdrawals and their discharges. So we actually had specific numbers.

In the case of the Urquhart Station, we just assumed it was the equivalent of a wet tower and we basically came up with a 20 cfs which I'll admit is extremely -- we expect to be extremely conservative. It's a combined cycle plant and the water use some people would consider that as once through with no consumptive water use at all. We do credit some consumptive use because of the induced evaporation.

JUDGE JACKSON: After the water is used?

MR. VAIL: After the water is used, yes.

JUDGE JACKSON: Okay.

MR. VAIL: And also on the D-Area Powerhouse that's also, besides the power generation

there, used as feedwater for steam in the plant. So some of that is actually used in a more consumptive manner than just in the power generation process.

JUDGE JACKSON: Okay. Thank you.

MR. VAIL: But they are conservative. Can we have the next slide please?

These numbers show the consumptive water use of the combined units one through four at different flow levels and again as we've talked about in the contested hearing we think it's appropriate to consider the average flow of 8,830 and 3800. We, however, did provide for context in the fact that we are in a drought, the values for 3,000 and 2,000. However, in these cases, we still show that the consumptive water use of the Vogtle site is going to be more than compensated for by the amount of water that's getting picked up between Thurmond Dam and the Vogtle site. Can we have the next slide please?

JUDGE BOLLWERK: This would be number 10.

MR. VAIL: I'm sorry. Slide 10. This figure shows you the location of the proposed intake and the existing intakes, existing discharge and the proposed discharge. All I'm trying to make with this point is that in considering the consumptive water use there is actually over this relatively small reach you

need to consider that the water that gets withdrawn at the proposed intake won't get returned until quite a way downstream. So that means effectively the decrease in water is not the consumptive water use. It's the water withdrawal at that point.

And so basically as you move downstream, you have the normal flow of the river. You come to the proposed intake structure and then the flow drops by the withdrawals of units three and four. That's the withdrawal number. It's decreased, not the consumptive use.

Then we go down to the existing intake and discharge structure. Those are very close. So effectively you're going to see right below the existing intake the consumptive water use is of one and two plus the water with withdrawal from three and four. And then as we move down further, we get to the point where we have the proposed discharge and at that point we have the consumptive use of three and four and of one and two.

But I just wanted to point out that there is a reach in here that sees the withdrawal rates, not just the consumptive use rates. But again, this is a very small stretch of the river that we're talking about. Can I have the next slide please?

Now I'm going to talk about the water management and particularly the reservoir management practices and reservoir managers are always trying to balance a set of conflicting objectives. People downstream want water. The people upstream want to keep the pools and the reservoirs fixed. The reservoir managers are trying to balance flood control with hydro power and it's a constant conflict between all these different objectives and can make their operation, their lives, pretty miserable and stuff at times.

But to do this, basically what they come up with is what we're calling the Corps' Guide Curve and I'll show this to you graphically on a subsequent figure. But basically this guide curve and these have been augmented now with a drought plan to be actually a set of guide curves are basically there so that when you're above the guide curve you're basically releasing water to try to pull the pool down. When you're below the guide curve, you're trying to fill back up to that level and as you drop further and further below that you may go into more controlled release practices. So the next slide, slide 12.

On slides 12 through 13 I actually show a period from 1980 to 2009. I've broken it up into two

sections because it became too busy on one slide. But basically what these figures show you is the observed elevation are in the blue lines and that's the elevation of the pool. The red line that has exact same pattern is the average elevations over time. The green line is the guide curve that we just mentioned and then over on the right side you can see after the drought had occurred around `89 they actually instituted these other drought levels. And so those three lines that you see are the other levels. So basically from the green line down to the bottom is what we call the conservation pool. That's basically when the water that you get to operate with.

The blue lines as you move across you can see early on there was a drought around `81 or a low water period around `81, had three relatively good years, a couple of low years, had `89 which was a bad period and then if you can move to the next slide.

This brings us up to date and again you can see we've had two periods of drought with periods of these, periods where you've actually be actively spilling or releasing water to try to pull the pool down because whenever you're above that green line it means that you've sort of compromised some of your flood control capacity. The reason that the green

line is jagged is just because of the seasonal pattern of flood risk.

JUDGE TRIKOUROS: Did you notice any trend, in other words, the frequency of droughts clearly at least from that 1980, was it, period? It seems like we've had two droughts fairly close together and in a fairly long term period of that we maybe had one drought. Did that cause you any --

MR. VAIL: You know it's hard to base a conclusion of trend basically on two droughts that occurred over a relatively short period of time. So I don't see anything in here to suggest that clearly we're in anything other than just having a really bad drought right now and you have to again look at it over a longer period of record to assess what those overall patterns are.

JUDGE TRIKOUROS: I guess officially we're still in this current drought, a fairly long drought, relative to others. I guess slightly longer than the last one or comparable to the last one at least at this point.

MR. VAIL: Right. We want to make sure I mean drought, when we're talking about it we're talking about the reservoir drought. There are droughts that you can have just because the soil

moisture is low or the air temperature. You know you can have crop droughts and agricultural droughts. What we're really talking about is a reservoir drought and it sort of has to do with the capacity of the reservoir system that we're dealing with. But we're clearly in the drought of record.

JUDGE TRIKOUROS: Are there any implications if this continues for another year or two or three?

MR. VAIL: If we continued at our current level, I think based on my most recent consultations with Stan Simpson and stuff is that if we basically had a repeat of last year this upcoming year we could get close to touching drought level four and that means the hydro power system basically goes off and reservoir management becomes more of a nightmare than it is right now.

JUDGE JACKSON: You have the drought level three line clearly indicated, the red line, right?

MR. VAIL: Right.

JUDGE JACKSON: So they were in drought level three there very near the end and now is it correct that it looks like they're slightly above drought level three right now?

MR. VAIL: The last time I checked which

was before I flew out here last week was that we actually sort of jumped up quite a bit out of drought level three. We were still down in drought level two. We were down in drought level two, but as far as I know we're in drought level one.

Well, Dr. Cook just mentioned to me last night we were at 321.8 on the pool.

JUDGE JACKSON: Okay.

MR. VAIL: So we're well out of --

JUDGE JACKSON: Out of being in drought level 3.

MR. VAIL: -- away from drought level three. But that's not to say that we can't get back there.

JUDGE JACKSON: And you just mentioned that it's possible they could reach drought level four, but you don't indicate on here what drought level four is on this chart.

MR. VAIL: Well, the drought level four is basically when you hit the bottom of the -- The conservation pool is the bottom of the figure. So basically when you reach 310.

JUDGE JACKSON: Three ten.

MR. VAIL: You're basically in drought level four.

JUDGE JACKSON: Okay.

MR. VAIL: Can we go to the next slide.

We talked about these in the contested hearing also and the 3100 had come up this morning. Basically historically, they'd operated closer to 3600, had been their minimum, their sort of low flow release. When they came up with the original drought management plan, they moved that minimum actually up to 3800 and in the revised, the temporary deviation drought plan they actually proposed 3100 for part of the year. That's basically the part of the year that isn't sensitive for fishes. They felt like they could actually take it down to 3100. They've since moved that back up to 3600 because we're back into that sort of fish sensitive period.

These target flows when they talk about these they're actually flows I think at North Augusta is basically what they're using as their criteria. So it's not that they're releasing necessarily flows at Thurmond Dam to meet that. If they're going to picking up water below that, they would actually account for that and could actually release less water if they were picking up water. But the goal is that at North Augusta they would be meeting the 3600 number at least.

So can we go to the next figure?

JUDGE BOLLWERK: This would be slide 15, correct?

MR. VAIL: Yes, I'm sorry. Slide 15. This figure shows you 365 day moving average values. So what we're basically looking at is that if you basically look at a year and you basically sort of slide that year period along you will see some trends or that's the data you're seeing there and if you look from -- the period runs from 1944 up to present and basically is trying to show you that when you integrate this over a year period it's harder to see some of those trends that you were mentioning earlier.

Now we do want to mention to keep in mind that these flows are regulated flows and so there's not a direct correlation with this precipitation and discharge and also this is precipitation at Augusta, one place within the basin. So you'll actually see some things that look potentially anomalous because they're high flows, higher flows, in low precipitation periods.

And notably like around in the period that's shown there between `96 and 2000 you see a particularly low precipitation period with a relatively high runoff period. That just means that

it was really dry for a 365 day window at Augusta. Now there are other places in the basin that obviously you're picking up precipitation to counter-balance that.

JUDGE JACKSON: The other thing that seemed curious is that following periods of high precipitation, then the discharge rate is often quite a bit lower. As you say, that's kind of counterintuitive. What's going on there?

MR. VAIL: There is the -- With reservoirs, there is a lag between when you necessarily will see some of that release in the precipitation. But remember. This is an entire year period.

JUDGE JACKSON: Okay.

MR. VAIL: So it's -- You have to be sort of integrating it over a larger time period and stuff. We often do this sort of analysis in part to sort of establish that you can see some of those longer term persistent trends and this is part of what we would look at to basically see if we actually thought that there was a persistent and significant decline in flow and we're always dealing with lots of variability in the hydrological system from the meteorology that is the mechanism that drives all of our assessment to

these periods. And I submit that although we see in there recently you have several drought periods, that there isn't necessarily a strong trend into those lower flow periods.

JUDGE TRIKOUROS: It just appears that when there's persistent rainfall in the 35-inch range. I'm sorry. Can you hear me now?

MR. VAIL: Yes.

JUDGE TRIKOUROS: When rainfall is in the 35 inch range, that's kind of a low rainfall for this area it looks like and over the last -- from about 2000 to today it's been hanging in that 35 inch range for fairly long periods of time. It's hard to tell with this chart really how it correlates to the dam flow because, yes, it is counterintuitive. But you didn't see a trend here either. In other words, rainfall trend did not concern you in doing these evaluations. You looked at that and you feel --

MR. VAIL: Yes, we clearly acknowledge that we had two relatively recent drought periods. The 2000 drought and the one that we're currently in were significant droughts. But we don't see those as necessarily being indicative of long term trend.

JUDGE TRIKOUROS: Thank you.

MR. VAIL: So the next slide, slide 16.

These are my conclusions and then I'll be handing it over to Dr. Kincaid. We acknowledge that the wet cooling towers will reduce the flow whenever they do consumptively use water. So we will have a reduction in flow.

The consumptive water use of the plants is nearly constant. It doesn't vary seasonally significantly. It's basically a constant consumptive loss rate. So the fraction of reduction --

JUDGE JACKSON: Your microphone.

MR. VAIL: I just heard myself. Wow, that's scary.

The fractional reduction in flow will increase as the upstream flow decreases. There's not any real mystery in that and that the consumptive water uses between Thurmond Dam and the Vogtle site are more than offset by the flows that we are picking up between Thurmond Dam and the Vogtle site.

And that we believe that the 3800 cfs was appropriate for the NEPA analysis, although we did include values at 3000 and 2000. And the staff at this point has no reason to believe that the ongoing drought is representative of a persistent trend into the future and that we believe that our conclusions of the water cumulative impacts being small is

appropriate.

JUDGE JACKSON: So after having looked at this for a long time and evaluated it you would say that the long-term impact according to your best guess right now, your best estimate, would be on the order of perhaps three to four percent of the river flow. Is that --

MR. VAIL: That's correct.

JUDGE JACKSON: Okay. Thanks.

(Off the record comments.)

DR. KINCAID: We'll move onto the groundwater segment. Slide 17 please. My name is Dr. Charles Kincaid. I have a Ph.D. from Utah State University in Engineering and I've been working at the Pacific Northwest National Laboratory in the area of surface water, actually in the area of soil physics and groundwater, for the better part of 29 years.

The topics I'll touch on are four. One is on groundwater resource use and then there will be three on quality aspects. One of those is on tritium and the groundwater aquifer, the Savannah River Site groundwater plumes and saltwater intrusion and then I'll have a slide again on just concluding remarks. Next slide please.

On slide 18, I have some summary remarks

on the groundwater resource use associated with the facilities. There's a projected two percent cumulative groundwater resource use and it's a one percent increase from the proposed Vogtle units. The normal operation of these units, all four units, is 2.13 million gallons per day. That's 3.3 cubic feet per second.

The deep aquifer base flow, a low estimate of that, is 119 million gallons per day, 184 cfs. This is based on a USGS report published in 1987. It draws upon a severe drought period in 1968. Data were taken at Augusta basically and below the site the difference in that flow in the river was attributed to -- Well, actually, the difference in the flow of the river was also corrected for tributary flows and the remainder was associated with base flow in the aquifer.

JUDGE TRIKOUROS: Did it concern you at all that it was 1987 data?

DR. KINCAID: It wasn't 1987 data. It was 1968 data and the survey --

(Off the record comment.)

It was published in 1987. The data they drew upon was the entire record that Mr. Vail has been discussing up to that time and they identified a

period of drought between September 24 and October 7 of 1968 and they reported that as being the extreme low flow in that record. That's the data they used to arrive at this number.

JUDGE TRIKOUROS: You would have no reason to believe today that that's a valid number today, the 184 cfs number.

DR. KINCAID: Well, I have not studied the flow records of this past year. So, no, I do not.

JUDGE TRIKOUROS: Just based on the numbers that we've seen for rainfall and just the general situation it just would seem to me that the numbers today would be lower than that and this is not something that concerns you at all?

DR. KINCAID: One aspect, the number we're looking at here, the 184 cfs, it is the deep aquifer base flow number. The Aucott reference studied, of course, the base flow coming into the river from the water table aquifer, the tertiary aquifer and the deep aquifer as a combined value. That combined value was 223 cfs.

The portion I'm discussing here in terms of the groundwater resource that the Vogtle plant draws upon today and will draw upon in the future is the deep aquifer base flow. That deep aquifer base

flow is relatively unaffected by droughts that we see in 2000 or today's drought. This is a long-term deep base flow quantity. The age data of these water are on the order of thousands of years.

So of the overall 223 MGD and the 119 that we're talking about here, of that overall number, there could be some shift. That's possible. I think with respect to the deep base flow number it's going to be pretty solid.

JUDGE TRIKOUROS: Thank you.

DR. KINCAID: Okay.

The next item here, drawndown impacts, we viewed those as acceptable. In the Cretaceous aquifer, we have 120 meters or 400 feet of confining head. The projected drawndown at the boundary of the site is approximately four meters. At the nearest neighboring well, it's three meters. And we have noted that there's a possible flow reversal from tertiary cretaceous aquifers but this would be very, very local to the onsite pumped wells where you would have had your cone of depression creating that very local effect.

The conclusion we reached as that the production of groundwater will not impact substantially the groundwater resource or adjacent

water users. Therefore, the impact is small. Slide 19 please.

On this slide, I'll be discussing the tritium and the water table aquifer. There was a discovery of tritium in this water table aquifer in 1988 and there were subsequent studies conducted by the Georgia Geological Survey and the U.S. Geological Survey to evaluate its presence and its origin.

All lines of reasoning led to the conclusion that the tritium source was atmospheric release from the Savannah River Site. The Vogtle units one and two and the proposed units three and four do not withdraw water from the water table aquifer or make releases to it.

Our conclusion then is that there is no reason to believe that the proposed project will contribute to the issue of tritium in the water table aquifer. Therefore, the impact is small. Slide 20 please.

Question.

JUDGE TRIKOUROS: You said all lines of reasoning lead to the conclusion the tritium source was atmospheric releases. Does that really -- What does "all" mean?

DR. KINCAID: Okay. Could we go back to

the previous slide, slide 19? Thank you.

All lines of reasoning, the Georgia Geological Survey undertook an areal study, if you will, looking at the levels of tritium in the water table aquifer and in the confined system beneath in this vicinity, in the vicinity of Burke County and beyond. They also looked at the amount of tritium in rainfall. They looked at the tritium profile in the vadose zone as that water would recharge the water table aquifer. They also looked at whether there was -- By engaging the U.S. Geological Survey, we also looked at, they also looked at whether or not it was at all feasible that ground water contamination at the Savannah River Site was actually crossing the river and contributing to this in some way.

Now what they discovered was that within the region the groundwater contamination was basically restricted to Burke County. The high points in this system in terms of its concentration were at Hancock Landing which is just upriver of the Vogtle site and immediately across the river from the Savannah River Site. They found those were the highest concentrations there both in groundwater and surface water and that lower concentrations then promulgated through the county.

So it looked in all appearances just from the groundwater aspect to be local and to be focused on something coming from the Savannah River Site perhaps. The atmospheric -- The precipitation that they collected did show evidence of tritium. The vadose zone profile did show evidence of tritium migrating downward and evidence that releases occurring in the past had moved into the profile.

The groundwater work has shown that the Savannah River actually separates the aquifer systems in South Carolina from those in Georgia. Clearly in terms of the water table aquifer and the tertiary aquifer, those are both intercepted by the river directly because it cuts into their sediments.

The deep aquifer through the modeling of the survey early on in this work back in `94 through `97, published first in `97, showed that water upwelling from the deep aquifer system came into the Savannah River alluvium and discharged into the river. They showed some traces from that site, from the Savannah River Site, the site side of the river, that actually came across into Georgia a very, very short distance before it upwelled.

So all these lines of reasoning led them to believe that the source was the atmospheric

releases from the Savannah River Site, its deposition through rainfall, its movement into the water table aquifer.

JUDGE JACKSON: There were very low trace levels of tritium due to atmospheric testing of nuclear weapons that occurred. Now presumably these levels when they came along and were measured were much higher than that.

DR. KINCAID: Yes. I'm not familiar with the levels you might expect in atmospheric testing per se. But the measurements in the aquifer high values, highest values, were on the order of 1700 picocuries per liter, low values -- well, de minimus values really. The surface water, the highest measured value in the surface water, was a spring located northwest or west of Hancock Landing and its value was I believe three -- My recollection is it's 3500.

JUDGE JACKSON: That sounds as though there was evidence that these concentrations were higher around Savannah River Site.

DR. KINCAID: Yes.

JUDGE JACKSON: Okay.

DR. KINCAID: Back to slide 20 please.

As I was saying, the Savannah River does incise the water table aquifer and the tertiary

aquifer and intercepts those plumes. The groundwater modeling done by the U.S. Geological Survey does show evidence of that. The regional system does discharge into the river as well.

Our conclusion regarding Savannah River Site groundwater plumes is that the existing proposed production groundwater at the Vogtle site does not appear to contribute to the broader migration of Savannah River Site contamination and therefore the impact is small.

Slide 21, saltwater intrusion. The State of Georgia in combination with the State of South Carolina and U.S. Geological Survey has studied the saltwater intrusion problem along the coast and the State of Georgia in their report by the Department of Natural Resources in 2006 identified Burke County as one of 19 counties not contributing substantially to the development or extent of saltwater intrusion. It's also apparent that the quality of water withdrawn from wells in Burke County is not impacted by saltwater intrusion.

Our conclusion is the production of groundwater for the proposed project will not contribute substantially to saltwater intrusion occurring in coastal regions in Georgia and South

Carolina or be impacted by saltwater intrusion. Therefore, the impact is small. Slide 22.

This is just concluding remarks. Based on our evaluations of these four potential impact areas, groundwater resource use, the tritium and the water table aquifer, Savannah River Site groundwater plumes and saltwater intrusion, all four of these having been looked at, the staff determined that the impact to groundwater would be small.

JUDGE BOLLWERK: Any additional questions from the Board?

JUDGE JACKSON: No.

JUDGE TRIKOUROS: No.

JUDGE BOLLWERK: Any other comments from the staff witnesses on this subject?

(No verbal response.)

All right then. Very good. Thank you, gentlemen. You are dismissed subject to being recalled if necessary. Thank you.

All right. At this point, it's a little bit after 10:00 a.m. Why don't we take a 10 minute break. We'll come back at just a little bit after 10:15 a.m. Off the record.

(Whereupon, a short recess was taken.)

JUDGE BOLLWERK: On the record. All

right. We're back after our break. We finished at this point with the panel on water use impacts and again on behalf of the Board I would like to thank the gentlemen who were part of that panel with the information that was very useful and we appreciate good service to the Board.

At this point, we're ready to move onto the second subject. There are actually two panels, one from Southern and one from NRC staff on radiologic impacts and at this point we've seated the witnesses for both parties. The lead party on this particular presentation is Southern with the staff kind of giving an additional presentation after that one is finished. But we've empaneled all the witnesses, the idea being that to the degree as we're going through the Southern slides if staff witnesses have any comments on the slides they would make them at that point. The same thing would go with Southern. As we're going through the staff's presentation if they have any comments on what they're hearing.

A couple things that will make this work a little bit better if you would bear in mind. We're going to introduce all the witnesses in a second, the ones that haven't been already. But as each of you, particularly the ones that if you may be commenting on

something that someone else is talking about, if you identify yourself for the record and you say that, it will make it easier on the court reporter. He's sitting here getting older by the second as he sees the number of witnesses we have up there.

Also remember that you are addressing the Board. So your comments should be addressed to the Board, not necessarily the other gentlemen that you may be commenting on their information. Also it would be best for instance and you're doing something since we're dealing on a slide by slide basis if you can hold your comments until they're ready to move to the next slide and interject at that point if you have anything to say. That way we don't interrupt anyone. If you have some paper you can make some notes and just hold on. This is one of these instances where you think of something and you want to interject it. It would be best to hold onto it until we get to a natural break and a lot of times that would be the next slide if you would.

But again the object of this is to allow you all to make a presentation and you all to make a presentation but also to get some interchange as well as respond to the Board's questions to the degree it's appropriate and hopefully we'll get a better record

that way. That's kind of the basic idea. Any question from anyone at this point?

(No verbal response.)

All right. Let's go ahead then and we'll swear these witnesses in. We'll go ahead and start with the Applicant witnesses. We'll go ahead and swear witnesses in and then -- I'll tell you what. Let's do the Applicant witnesses, deal with their exhibits, staff witnesses, deal with their exhibits and then we'll get everybody sworn in rather than mingling them together. All right.

MR. BLANTON: Thank you, Your Honor. Let me introduce the Applicant's presenters first. Mr. Philip Young from Tetra Tech will address radiological impacts and environmental perspectives and Dr. Angelos Findikakis will address radiological impacts and safety perspectives.

JUDGE BOLLWERK: All right.

MR. BLANTON: And we have several exhibits for both of these.

JUDGE BOLLWERK: All right. Gentlemen, we'll go and swear you in then. If you could both raise your right hands. You need to respond orally in the affirmative to the question and if you would individually as well.

WHEREUPON,

PHILIP YOUNG

DR. ANGELOS FINDIKAKIS

were called as witnesses for Southern Nuclear and, having been first duly sworn, assumed the witness table, were examined and testified as follows:

DR. FINDIKAKIS: I do.

MR. YOUNG: I do.

JUDGE BOLLWERK: Thank you. All right and then we're going to deal with some exhibits.

MR. BLANTON: Yes, Your Honor, if we could mark for identification first of all SNC00001 is the Environmental Report that was also introduced in the contested proceeding that we would like marked for identification and it unfortunately is a 15 part exhibit A-O.

JUDGE BOLLWERK: Right. And the exhibit number that will reflect is SNC00001A-1O. So that's the way, 0000 and then 1A-1O and that's the way we'll do that one. All right. Let the record reflect then that SNC00001A-1O which are the environmental report for Southern Nuclear Operating Company Vogtle early site permit application are marked for identification.

(Whereupon, the document referred to was marked as Exhibit SNC00001A-1O-MA-BD01 for

identification.)

MR. BLANTON: Thank you, Your Honor. Our next exhibit and this is another general exhibit is the SNC's response to the Licensing Board's questions regarding environmental matters from November 7, 2008 and that's Southern Nuclear Exhibit 000068.

JUDGE BOLLWERK: All right. And the Board had talked about both 68 and 69 and I think we're interested. It's not clear that any of your witnesses are necessarily going to refer to this, but I think we are interested in having this in the record. So let's go ahead and reflect then. It's SNC000068 as identified by counsel is marked for identification.

(Whereupon, the document referred to was marked as Exhibit SNC000068-MA-BD01 for identification.)

MR. BLANTON: All right, sir. And then SNC000069 is SNC's responses to the Licensing Board's questions regarding safety matters filed January 16, 2009.

JUDGE BOLLWERK: All right. Then the record should reflect that Exhibit SNC000069 is marked for identification.

(Whereupon, the document referred to was marked as Exhibit SNC000069-MA-BD01 for

identification.)

MR. BLANTON: Thank you. SNC000070 is the SNC presentation regarding radiological impacts on the Board's environmental topic.

JUDGE BOLLWERK: All right. Let me just clarify one thing on this one. I think 70 also includes part of the presentation for topic three if I remember correctly.

MR. BLANTON: It's a little confusing, Your Honor. Seventy is the environmental presentation. Seventy-three is the safety presentation. They were submitted, at one point they were submitted together I think and we then broke them up.

JUDGE BOLLWERK: All right.

MR. BLANTON: Before the hearing. So 70 will be the environmental presentation. Seventy-three will be the safety presentation.

JUDGE BOLLWERK: All right. Then SNC000070 as identified by counsel is marked for identification.

(Whereupon, the document referred to was marked as Exhibit SNC000070-MA-BD01 for identification.)

MR. BLANTON: Thank you, Your Honor.

SNC000071 is the CV of Mr. Young.

JUDGE BOLLWERK: All right. The record should reflect that SNC000071 as identified by counsel is marked for identification.

(Whereupon, the document referred to was marked as Exhibit SNC000071-MA-BD01 for identification.)

MR. BLANTON: SNC000072 is the Vogtle Offsite Dose Calculation Manual which referenced and cited in Mr. Young's presentation which is identified as SNC000070.

JUDGE BOLLWERK: And the record should reflect that SNC000072 as described by counsel is marked for identification.

(Whereupon, the document referred to was marked as Exhibit SNC000072-MA-BD01 for identification.)

MR. BLANTON: Thank you, Your Honor. And SNC000073 as I said is the Southern Nuclear presentation on Safety Topic No. 2 which is also radiological impacts.

JUDGE BOLLWERK: And I believe that one has -- It's an SNCR00073.

MR. BLANTON: Yes, Your Honor.

JUDGE BOLLWERK: Am I right? As described

by counsel SNCR00073 is marked for identification.

(Whereupon, the document referred to was marked as Exhibit SNCR00073-MA-BD01 for identification.)

JUDGE BOLLWERK: SNC000074 is the CV of Dr. Findikakis.

JUDGE BOLLWERK: And the record should reflect that SNC000074 as described by counsel is marked for identification.

(Whereupon, the document referred to was marked as Exhibit SNC000074-MA-BD01 for identification.)

MR. BLANTON: And lastly SNC000075 is the Plant Vogtle Site Safety Analysis Report Chapter 2.4.

JUDGE BOLLWERK: And the record should reflect that SNC000075 as described by counsel is marked for identification.

(Whereupon, the document referred to was marked as Exhibit SNC000075-MA-BD01 for identification.)

MR. BLANTON: And I would note to the Board that these exhibits are referenced in red on these slides as you go through so you can tell what slide refers to what.

JUDGE BOLLWERK: All right. Thank you.

MR. BLANTON: We would move to admit those exhibits.

JUDGE BOLLWERK: Any objection?

MR. MOULDING: No objection.

JUDGE BOLLWERK: There being no objection, then the following exhibits will be admitted into evidence: SNC00001A-1O, that's the letter O, SNC000068, SNC000069, SNC000070, 71, 72, SNCR00073, SNC000074 and 75. All those exhibits are admitted into evidence.

(The documents referred to having been previously marked for identification as Exhibit SNC00001A-1O-MA-BD01, SNC000068-000072-MA-BD01, SNCR00073-MA-BD01, SNC000074-MA-BD01, SNC000075-MA-BD01 were received in evidence.)

MR. BLANTON: Thank you.

JUDGE BOLLWERK: All right. And with that I think we can turn then to the staff witnesses.

MR. MOULDING: Thank you, Your Honor. For presentation number two let me introduce the staff's witnesses. From the Board's left, Mr. Christian Araguas, Mr. Mark Notich, Dr. Charles Kincaid, Dr. Hosung Ahn, Mr. James Van Ramsdell, Jr., and Mr. Michael Smith.

JUDGE BOLLWERK: All right. I believe Dr. Kincaid and Mr. Notich have already been sworn in. Is that correct?

(No verbal response.)

All right if the other four gentlemen, Mr. Ramsdell, Mr. Smith, Mr. Araguas. Am I pronouncing that correctly?

(No verbal response.)

All right. And Mr. Ahn could raise their right hand then please and I need you to respond affirmatively to the question and those of you that are sitting I think there's a microphone right there on the table. You need you to turn that on and pick it up so it will -- Just hold it for them. I would appreciate that. Sorry for the lack of a mike. We're still trying to figure that one out. Okay. Affirmatively again to the question and each of you start at this end and just go right down the line in terms of the witnesses we're swearing.

WHEREUPON,

CHRISTIAN ARAGUAS

DR. HOSUNG AHN

JAMES VAN RAMSDELL, JR.

MICHAEL SMITH

was called as a witness for the NRC Staff and, having

been first duly sworn, assumed the witness stand, was examined and testified as follows:

MR. ARAGUAS: I do.

DR. AHN: I do.

MR. RAMSDELL: I do.

MR. SMITH: I do.

JUDGE BOLLWERK: All right. Thank you very much.

MR. MOULDING: We have a couple of exhibits to introduce at this time, Your Honor. I think we would like to begin with Exhibit NRC000056, Safety Evaluation of the Early Site Permit Application in the Matter of Southern Nuclear Operating Company for Vogtle early site permit site dated February 2009.

JUDGE BOLLWERK: All right. The record should reflect that Exhibit NRC000056 as identified by counsel is marked for identification.

(Whereupon, the document referred to was marked as Exhibit NRC000056-MA-BD01 for identification.)

MR. MOULDING: At this time we would also like to introduce Exhibit NRC000058 which is the NRC staff response to the Licensing Board's questions regarding Safety Matters dated January 16, 2009.

JUDGE BOLLWERK: The record should reflect that Exhibit NRC000058 as identified by counsel is marked for identification.

(Whereupon, the document referred to was marked as Exhibit NRC000058-MA-BD01 for identification.)

MR. MOULDING: Exhibit NRCR00060 entitled Staff Presentation 2, Radiological Impacts, Environmental and Safety Reviews.

JUDGE BOLLWERK: All right. The record should reflect that Exhibit NRCR00060 as identified by counsel is marked for identification.

(Whereupon, the document referred to was marked as Exhibit NRCR00060-MA-BD01 for identification.)

MR. MOULDING: And then we have a few staff CVs those that have not already been introduced as exhibits.

JUDGE BOLLWERK: All right.

MR. MOULDING: Exhibit NRC000074, Curriculum vitae for Christian J. Araguas.

JUDGE BOLLWERK: The record should reflect that Exhibit NRC000074 as identified by counsel is marked for identification.

(Whereupon, the document referred to was marked as

Exhibit NRC000074-MA-BD01 for identification.)

MR. MOULDING: Exhibit NRC000075, Curriculum vitae for James V. Ramsdell, Jr.

JUDGE BOLLWERK: The record should reflect that Exhibit NRC000075 as identified by counsel is marked for identification.

(Whereupon, the document referred to was marked as Exhibit NRC000075-MA-BD01 for identification.)

MR. MOULDING: Exhibit NRC000076, Curriculum vitae for Michael A. Smith.

JUDGE BOLLWERK: The record should reflect that Exhibit NRC000076 as identified by counsel is marked for identification.

(Whereupon, the document referred to was marked as Exhibit NRC000076-MA-BD01 for identification.)

MR. MOULDING: Exhibit NRC000077, Curriculum vitae for Hosung Ahn.

JUDGE BOLLWERK: The record should reflect that Exhibit NRC000077 as identified by counsel is marked for identification.

(Whereupon, the document referred to was marked as Exhibit NRC000077-MA-BD01 for

identification.)

MR. MOULDING: At this time we would move that these be admitted into evidence.

JUDGE BOLLWERK: All right. Any objection?

(No verbal response.)

Hearing none, then the following exhibits will be admitted into evidence. NRC000056, NRC000058, NRCR00060, NRC000074, 75, 76, and 77 are all admitted into evidence.

(The documents referred to having been previously marked for identification as Exhibit NRC000056-MA-BD01, NRC000058-MA-BD01, NRCR00060-MA-BD01, NRC000074-77-MA-BD01 were received in evidence.)

Does that jive with your list?

MR. MOULDING: Yes, Your Honor.

JUDGE BOLLWERK: All right. Thank you very much. And then I think at this point we will go ahead and start with Mr. Young and you all are going to control your slides. Correct?

MR. YOUNG: That's correct.

JUDGE BOLLWERK: All right.

MR. YOUNG: Good morning, Your Honor.

JUDGE BOLLWERK: Good morning.

MR. YOUNG: My name is Philip Young and I'm with Tetra Tech. Have been with the company for 19 years. I'm a certified health physicist. Have spent my entire career analyzing the environmental impacts of nuclear facilities, both power plants and also Department of Energy facilities. Tetra Tech is a subcontractor to Southern Nuclear Company supporting the preparation of the environmental report for Vogtle Units 3 and 4 and I'm here today to talk about radiological impacts.

The radiological impacts presented in the environmental report and the results therein are compared against various regulatory requirements including 10 CFR 50 Appendix I, 10 CFR 20, Part 1301 and 40 CFR 190.

I want to bring forth a couple of definitions first to make sure we're all on the same page. The first definition is "maximally exposed individual" which we'll talk about quite a bit in my presentation. The maximally exposed individual is a hypothetical individual who because of the proximity, activities or living habits could potentially receive the highest possible radiation dose of any member of the public and the radiation dose to the maximally exposed individual is an individual dose expressed in

millirem or in SI units in sieverts.

The second term I'd like to discuss here is "population dose." This is collective radiation dose to the population within a 50 mile radius of the Vogtle site.

JUDGE BOLLWERK: You're on your slide five, correct?

MR. YOUNG: Yes, slide five. Thank you.

The collective dose is expressed in terms of person rem or person sieverts in SI units.

Just going to slide six, the potential sources of radiation exposure to either the maximally exposed individual or the offsite population could be through a liquid effluent releases from the plant, gaseous effluent releases or direct radiation which is direct irradiation from the facilities themselves. So the environmental report analyzes the potential exposure to members of the public from each of these three pathways and I'm going to describe the methodology and the results for these analyses.

Starting with liquid effluents, I'm on slide seven now. Exposure pathways considered, these are the standard exposure pathways that members of the public could be exposed through and the analysis that was performed was to evaluate which of these exposure

pathways would be applicable to the public near the Vogtle site. Exposure pathways could be ingestion of aquatic food, ingestion of drinking water or direct irradiation exposure from activities associated with shoreline or water users.

Moving to slide eight, of those pathways I just described, drinking water was not evaluated in the environmental report. The Southern Nuclear Company at Plant Vogtle, they're required to do a land use census every year annually as part of their offsite dose calculation manual which is Exhibit 72. The purpose of the land use census is to evaluate if changes in population or habits of the population near the Vogtle site would affect the methods or the results of the dose calculations. And as part of this land use census, Southern Company looked for drinking water users downstream of the Vogtle site and that census showed that there are no downstream drinking water users of the Savannah River within 100 miles downstream of the Vogtle site.

JUDGE JACKSON: Mr. Young, that's just from the Savannah River and not from wells located nearby.

MR. YOUNG: That's correct. The liquid effluent dose pathway would be through releases to

surface water ultimately into the Savannah River. So that was -- The analysis looked at potential users of that water that could be impacted by liquid effluent discharges.

Therefore, the liquid effluent pathways, exposure pathways, were ingestion of aquatic food and then direct irradiation from various activities in or around the receiving body of water which is the shoreline exposure, swimming and boating activities.

Moving to slide eight the methodology for calculating irradiation doses from liquid pathways was the use of the LADTAP II computer program. LADTAP II is a computer program specifically created for calculating liquid effluent doses from power reactors. This program is specifically referenced in the Environmental Standard Review Plan, NUREG 1555, for a calculation of liquid effluent doses to support license applications. The effluent release rate in terms of curies for each radionuclide curies per year released from the proposed units was taken from data in the Westinghouse DCD Rev 15.

JUDGE BOLLWERK: That's for the design certification document if I remember.

MR. YOUNG: That's correct. Design certification document.

JUDGE JACKSON: Excuse me. Would there be -- Are you aware of how this might be changed in the later revisions 16, 17?

MR. YOUNG: I believe that based on what I know of the later revisions to the DCD I don't believe that those numbers have changed, the liquid effluent release numbers.

In addition to the effluent release rates, LADTAP requires additional input factors and these are site specific factors, the discharge rate dilution factor which is a function of the receiving bodies of water and transit time to receptor and also consumption and usage factors and these are consumption of fish, other aquatic organisms and drinking water.

JUDGE TRIKOUROS: Is LADTAP II incorporated into your offsite dose calculation manual?

MR. YOUNG: That's correct.

JUDGE TRIKOUROS: And it goes through -- I guess you have procedures for maintaining it to be at the most current state and all of that.

MR. YOUNG: That's correct. The Vogtle, thank you, offsite dose calculation manual is a control document that implements the LADTAP II code at

the Vogtle site and as I mentioned earlier it incorporates any changes in land use. It has a requirement for land use census and is submitted to the NRC every time there's a revision. The document that was admitted in as Exhibit 72 is actually Revision 24 of the offsite dose calculation manual. So it's very much a living document.

JUDGE TRIKOUROS: And just a related question. How did the normal releases in the DCD compare to the Vogtle 1 and 2 normal releases? Were they significantly different? Are you -- Perhaps you didn't look at the Vogtle 1 and 2.

MR. YOUNG: We actually have doses presented in the cumulative dose analysis for Vogtle Units 1 and 2 and 3 and 4. So when we get to the cumulative analysis that may give you an indication of the relative magnitude. I don't remember specifically in terms of curies.

JUDGE BOLLWERK: Can we stop one second? Is there a reason we lost the slides?

(Off the record comment.)

Why don't you continue on? He doesn't have the slides.

MR. YOUNG: I can't see my slides.

JUDGE BOLLWERK: All right.

MR. BLANTON: Can you see them on the laptop?

MR. YOUNG: No, I can't see them on any of these screens.

JUDGE BOLLWERK: One second here. I guess maybe at this point why don't we go ahead and take a recess until we can locate Mr. Deucher and bring him back? Thank you. Off the record.

(Whereupon, a short recess was taken.)

JUDGE BOLLWERK: On the record. All right. We've had a break to fix some information technology problems that we had in the display. I think we're about ready to go back to Mr. Young and slide 10 of Exhibit SNC000070.

MR. YOUNG: Thank you. I think I was on the final bullet which is additional LADTAP II inputs being consumption and usage factors including ingestion rates. Next slide please.

Methodology for gaseous effluent dose. It's similar to liquid effluents. We start with looking at what are the various exposure pathways. We considered a variety of standard exposure pathways including immersion in the radioactive plume which is a direct irradiation dose, direct exposure from radioactivity, that's been deposited onto our ground

surface or other surfaces, inhalation of radioactivity, ingestion of locally produced garden fruit and/or vegetables and ingestion of locally grown or locally produced beef. Of these, we evaluated these pathways again with the methodology described in the offsite dose calculation manual and in that manual the land use census indicates that there are no milk cows within a five mile radius of the Vogtle site. So the ingestion of milk was not considered as a pathway. But all the other pathways listed on this slide were considered.

JUDGE TRIKOUROS: Just a quick question on that. How do you account for the possibility of milk cows being there later?

MR. YOUNG: That would be if milk cows were to -- if someone were to move close to the Vogtle site and bring milk cows with them. The annual land use census would identify that and would also indicate the impact, if that would have an impact on the calculated doses and if it were to require a change in the dose calculation method. If so, that change would be documented in a revision to the offsite dose calculation manual which would be provided to the NRC at that time.

JUDGE TRIKOUROS: So for something like

that you would issue a revision to the offsite dose calculation manual? Just for that?

MR. YOUNG: There's a process described in the offsite dose calculation manual, an analytical process, which is if it could cause a change in the calculated dose, then it would be incorporated into the next annual dose calculations. If it would result in a change above a certain fraction, if it's a large change, then it would be implemented immediately and that's all described in the offsite dose calculation manual. Next slide please.

This is basically a repeat of the previous slide. Let's go to slide 13 please.

Again the gaseous pathway doses to members of the public that were calculated using the GASPAR II computer program again such as LADTAP II GASPAR is a computer program specifically designed and specifically created for calculating doses to members of the public from gaseous effluents from nuclear plants. And again it's specifically referenced in the environmental standard review plan.

JUDGE JACKSON: I'm going to ask the same question as before in terms of gaseous effluent releases from DCD Rev 16 and 17. Are you aware of any changes from Rev 15?

MR. YOUNG: I'm not aware of it.

JUDGE JACKSON: Have you checked?

MR. YOUNG: I have done dose calculations based on the subsequent revs in Rev 16 and 17 and I don't remember there being a change.

JUDGE JACKSON: Excuse me. I was having trouble hearing you. Did you say you have done calculations with the --

MR. YOUNG: For subsequent applications, we have done dose calculations for Rev 16 and Rev 17 of DCD and I don't remember based on the results of those a change from Rev 15.

JUDGE JACKSON: Okay. Thanks.

MR. YOUNG: Next slide please.

In addition, there's additional inputs required for the GASPAR II code. Again, these are site specific data population, data population in each sector within a 50 mile radius of the Vogtle site and that's population in the sector at various distances from the site.

Atmospheric dispersion factors, this is basically the Chi over Q values, the meteorological data presented in the environmental report for Vogtle. Ground deposition factors, these are also a function of local weather principally precipitation values.

Receptor locations and consumption factors. These are all inputs to the GASPAR II code. Next slide please.

Okay. This slide shows the comparison of the calculated liquid and gaseous effluent doses to the maximally exposed individual. It presents the calculated results and the comparison with the design objectives contained in 10 CFR 50 Appendix I. These design objectives are the most stringent of the radiation dose standards that were listed in the first slide of my presentation.

The categories listed on the left here under Liquid Effluents, Total Body Dose and Maximum Organ Dose and then the various gaseous effluent endpoints, Gamma Air Dose, Beta Air Dose, etc., those are specifically called out and defined in 10 CFR 50 Appendix I. They each have a specific regulatory definition. And again this table here is Table 5-9 from the final environmental impact statement. Next slide please.

That was everything I've said so far was maximally exposed individual dose. Now I want to discuss the collective dose. This is a person rem. This is to the population within 50 miles of the Vogtle site and FEIS presents the calculated value for this as being 1.83, basically about 1.8 person rem per

year, to this population and that could be compared to the natural background radiation dose. This same population is receiving radiation dose from natural background radioactivity of about 2430 person rem per year. Next slide please.

And the final pathway that was evaluated was direct irradiation from facilities on Vogtle site. Primary sources of direct radiation that were considered were the reactor buildings and the independent spent fuel storage installation. Next slide.

To attempt to come up with a number for the contribution from Vogtle facilities to offsite direct radiation dose we used actual measured TLD. That's Thermal Luminescent Dosimeter data from a ten year period. This is data that's collected by the Vogtle staff in accordance with our offsite dose calculation manual and their radiological environmental monitoring program.

They collect two types of TLD data, control data which is meant to give an indication of background radiation. This is radiation that does not include contribution from the Vogtle site and then indicator stations which are those that would measure background irradiation plus any contributions from the

Vogtle site. You could see the numbers here on the slides the range of control station average annual direct exposure and the range of the indicator station direct exposures which very clearly indicate no contribution at the indicator locations from Vogtle facilities.

JUDGE JACKSON: I assume these control and indicator stations are located in the same positions, or basically so.

MR. YOUNG: The indicator stations are a ring of TLDs at or near I believe the plant perimeter, whereas the control locations are, the control TLD stations, are located far enough away that they would not include any contribution from dose from Vogtle. The results of these TLDs are reported every year in the radiological monitoring report which is provided to the NRC.

JUDGE JACKSON: I just wanted to get an idea. The control stations then are pretty much in the exclusion area boundary?

MR. YOUNG: The control station?

JUDGE JACKSON: Or the site boundary?

MR. YOUNG: Well, the control stations are located at a distance, some distance away to be background. The indicator stations are I believe at

the Vogtle property line.

JUDGE TRIKOUROS: This summary data doesn't really tell the whole story. The indicator stations were not skewed -- Did you evaluate the indicator stations differently other than to just look and see if they're within a range of 48 to 54.4?

MR. YOUNG: Yes. We looked at all of the data for the entire ring of indicator stations to make sure that if we took just an average of the entire set of indicator stations that might mask if there were any, say, geographical distances, if there were indicator stations in a given direction that might be higher. So we looked at each one of them individually and compared that against the control station locations. There were more than just the -- For the purposes of this slide, we wanted to just present the sort of upper level data.

JUDGE TRIKOUROS: So that evaluation that's not discussed here, the broader evaluation, showed that your conclusion was sustained that you were not contributing more than significantly or significantly above the natural background.

MR. YOUNG: That's correct.

JUDGE BOLLWERK: Will any of these stations change relative to Vogtle 3 and 4 from what

they are with 1 and 2 now? The two additional ones, do they move anywhere else, further out or closer in?

MR. YOUNG: There will be additional TLD locations nearer to the location of Units 3 and 4. That's as much for worker protection, worker radiation doses, as for public doses. I don't believe that there will be changes in the offsite TLD program from the additional 3 and 4.

JUDGE BOLLWERK: All right. Thank you.

MR. YOUNG: You're welcome. Next slide please.

And finally we wanted to look at a cumulative impact which is the cumulative impact of Vogtle 1 and 2, Vogtle 3 and 4 and also any other nearby facilities that use or store radioactive material that could contribute radiation dose to these same receptors.

JUDGE TRIKOUROS: I'm sorry to interrupt you. Could you identify what your sources of information were for the Savannah River? I assume for the MOX facility it was the license application.

MR. YOUNG: I believe it was the final environmental impact statement for the MOX facility. For the Savannah River Site, they are required by DOE regulations to produce an annual environmental report

and that environmental report includes estimates of public doses from their operations.

JUDGE TRIKOUROS: So you used the latest environmental report.

MR. YOUNG: Yes. The latest as of the time of the application. Of course, the other facilities that could contribute to radiation dose to these receptors are the Savannah River Site, its existing operations and planned operations and then the proposed MOX facility. Also looked at potential contributions from other nuclear facilities in the area such as the Barnwell Disposal Facility and the now closed I believe it was called Starmet facility and that evaluation showed that those facilities would not contribute radiation dose to these receptors.

The conclusion of this analysis was the cumulative dose to the maximally exposed individuals calculated from all of these activities to be 2.9 millirem per year. I would like to stress this is a very conservative number. This is simply summing the maximally exposed individual doses reported for each of these facilities; whereas, in reality the facilities are located some distance apart and the maximally exposed individual for each of those facilities would not be located in the same place. So

this is a conservative number. The cumulative population dose value is calculated to be 30 person rem per year to the 50 mile population.

JUDGE JACKSON: What would that work out to be for the average person within that radius then?

MR. YOUNG: Of 30 person rem per year the population is 500,000 or 600,000 people. It's a very small fraction of a millirem per person.

JUDGE JACKSON: Yes, I'm sure it would be. I just wondered what it was. That's something that you don't normally calculate apparently.

MR. YOUNG: Yes. It's an intermediate calculation in coming up with the 30 person rem per year. Actually calculate the average dose to each person in each sector and then sum those up.

JUDGE JACKSON: I just didn't see it reported. To me it's an interesting number to report as well as the cumulative population dose.

MR. YOUNG: Next slide.

That was all for routine radiological impacts of normal operation. I would like to touch briefly on radiological environmental impacts of postulated accidents. I'm going to give you a fairly upper level overview of these. Basically the postulated accidents evaluation is two parts. First,

it's design basis accidents. Second, being severe accidents.

JUDGE BOLLWERK: We're on slide 20, right?

MR. YOUNG: Yes, slide 20. The evaluation of design basis accidents, the identification of the design basis accidents is taken from Rev 15 of the design control document which includes evaluation of the consequences of these accidents which are based on specific radionuclides released, the radionuclide distribution for each accident, the quantity of each radionuclide and then the meteorological conditions.

The DCD evaluation for source term methodology is directly from Reg Guide 1.183 and then the Chi over Q methodology is from Reg Guide 1.145. So it's a standard methodology.

JUDGE JACKSON: Could you respond to the same question on Rev 16 and Rev 17 with respect to the design basis accidents and your understanding? Are they changed significantly on the later revisions?

MR. YOUNG: I'm actually not aware.

JUDGE JACKSON: Okay. Thanks.

JUDGE TRIKOUROS: I believe they made a change. I guess we can come back to that at some point, but it may come up in the staff presentation. I'm not sure. When you say source term based on 1.183

and the source terms were actually derived from the DCD, right?

MR. YOUNG: Yes. That's the DCD calculated and then based on Reg Guide 1.183.

JUDGE TRIKOUROS: The methodology was 1.183.

JUDGE JACKSON: Basically the key factor then is just a scaling of the Chi over Qs, right?

MR. YOUNG: Yes. Next slide please.

The environmental impacts of the design basis accidents, there is a couple of categories of impacts. First is the dose at the EAB. This is calculated as a short term dose. This is a two hour dose and uses the short term Chi over Q values presented in the environmental report. Also calculated a longer term dose for design basis accidents. This is dose at the LPZ, low population zone. This is the entire term of the accident which is approximately 30 days.

All of the doses whether at the EAB or the LPZ are presented in terms of total effective dose equivalent in rem again with the site specific meteorological data. In all cases, the site specific dose values are considerably smaller than the NRC review criteria. And the final environmental impact

statement concludes that the environmental consequences from the radiation doses from design basis accidents are small.

JUDGE TRIKOUROS: That two hour dose, that's the largest two hour dose over an increment of time. It's not the first two hours I assume.

MR. YOUNG: Right. I believe that's right.

JUDGE TRIKOUROS: Yes.

MR. YOUNG: Next slide.

Severe accidents, defined as accidents that are beyond the design basis accidents and these might contain substantial, might result in substantial damage to the reactor core or degradation of the containment. In the Rev 15 of the design control document Westinghouse has completed a probabilistic risk assessment model. For severe accidents this model, of course, was not site specific. That was based on generic meteorological conditions and regional conditions.

For the environmental report, this is section 7.2 of the environmental report. It contains an update of this generic probabilistic risk assessment to include site specific characteristics which is site specific meteorology, site specific

population data and impacts over the entire life cycle of the severe accident. This analysis in Section 7.2 of the environmental report discloses the complete impacts of a severe accident at the Vogtle site and it demonstrates that it is bounded by the data presented in the design control document and also will support any future severe accident mitigation alternatives analysis. Next slide.

The consequences of severe accidents are presented in terms of three primary pathways: air, surface water and groundwater pathways. The MACCS2 code was used to model the environmental consequences of these pathways with the exception of groundwater which I'll discuss in the next slide. The MACCS2 code is a code that's -- I'm sorry. Can we go back to the slide 23 please?

The MACCS2 code is a code that was specifically created to model the consequences of accidents from operating nuclear power plants. The MACCS2 code focuses on atmospheric releases including deposition of radioactivity and includes the following pathways: direct exposure to the passing plume, exposure to materials that have been deposited from the plume on to surfaces such as ground surface, inhalation of radionuclides in the plume or

radionuclides that were deposited onto the ground or other surfaces and then subsequently re-suspended and inhaled and finally ingestion of contaminated food and water. This is food or water that was contaminated from deposition of material in the plume. Now next slide please.

The MACCS2 code does not include consideration of fishing, swimming or groundwater pathways for these analyses. Information from the generic environmental impact statement was used to provide this information.

JUDGE BOLLWERK: You're on slide 24, right?

MR. YOUNG: Yes. Slide 24. Thank you.

Consequences of severe accidents are presented in terms of three different endpoints: human health, economic cost and land area affected by contamination. Standard methodology, NRC methodology for severe accident analyses. Next slide.

The human health consequences are expressed in terms of risk where risk is defined as the probability of the accident per year multiplied by the consequences of the accident which is a radiation dose in terms of rem. In all cases, the risks for all risk categories for severe accidents were determined

to be small.

In addition to the acute, the population risks that I've just discussed, the NRC also determines average individual fatality risk for severe accidents. NRC compares these risks to their NRC safety goal policy statement. FEIS Table 5-16 shows this comparison demonstrates that the risks are for severe accidents at Vogtle are well below the NRC safety goal policy values. Next slide.

I'm on slide 26 now. The final environmental impact statement concludes that the environmental risk from the probability weighted consequences of a severe accident at Vogtle Units 3 and 4 are small.

JUDGE JACKSON: Could you tell us a little bit about how the probability weighted consequences are derived? This is a combination of the results you talked about and they're combined in a probabilistic analysis.

MR. YOUNG: That's right. The consequences are derived from the output of the MACCS2 code which uses as its input the source term for a given accident. The probability of that accident is calculated based on the plant specific probabilistic risk assessment contained in the design control

document.

JUDGE TRIKOUROS: You used the GEIS for the non-gaseous consequences you said.

MR. YOUNG: For groundwater and I believe aquatic ingestion. I think it was fish ingestion.

JUDGE TRIKOUROS: That would be the liquid side.

MR. YOUNG: Right, although MACCS2 does include an ingestion of water that's been contaminated from deposition from airborne radioactivity.

JUDGE TRIKOUROS: Did the events line up? The GEIS, was it event specific or was it just basically a source term? I'm assuming when you did the probability weighted consequences you had the probability of some event at the AP1000 and you correlated that event to the MACCS2 consequences and you added the GEIS consequences to the MACCS2 consequences. Was that a clean process? In other words, were you able to determine, I don't have the GEIS in front of me, that it was clear from the GEIS how to correlate to the individual events in the AP1000?

MR. YOUNG: I believe it was a fairly clean analyses, yes, like you said. I believe that additional dose with the additional risk from those

other pathways was fairly small compared to the risk from plume and the gaseous effluents.

JUDGE TRIKOUROS: MACCS2 incorporates an emergency plan implementation and evacuation pathways.

MR. YOUNG: Yes, and that's one of the site specific parameters, site specific data, that goes into it is evacuation time estimates.

Okay, and finally related to severe accidents, severe accident mitigation design alternatives. I will not cover here. They will be addressed in a separate presentation by the NRC. Next slide.

JUDGE JACKSON: Just a quick question. You mentioned the Chi over Qs would change to be site specific. You mentioned the emergency response obviously would. Could you tick off any other factors?

MR. YOUNG: Site specific?

JUDGE JACKSON: Yes.

MR. YOUNG: Population distribution.

JUDGE JACKSON: Population.

MR. YOUNG: Location of receptors and then distribution of population throughout the 50 mile radius. Meteorology. Actually land values factor into it because one of the endpoints is economic cost.

JUDGE JACKSON: Economic impact.

MR. YOUNG: So you have site specific parameters of the amount of farmland in the area versus the amount of other types of land uses. Those are the main ones that are coming to my mind now.

JUDGE JACKSON: Okay. Thanks.

MR. YOUNG: You're welcome.

JUDGE TRIKOUROS: I mean we're going to get into this on the staff review side.

MR. BLANTON: I think we need SNCR00073 or SNCR00073. Seventy-three.

JUDGE BOLLWERK: Okay. Fine. Let me just check. I think that no one from the staff had any comments on that presentation at all at this point. No one said anything so I'm going to assume we're just move on. All right. Thank you.

MR. BLANTON: And I just note for the record, Your Honor. As you can see, Dr. Findikakis is also going to address the impacts of groundwater on safety related structures. That's sort of the Part 2 of this presentation. So that's why the title page reflects two sets of presentations there.

JUDGE BOLLWERK: All right. I think we're ready to proceed.

DR. FINDIKAKIS: Thank you. My name is

Angelos Findikakis and I work for Bechtel that supports Southern's application. Can I get the next slide please? One more. One more.

My education includes advanced degrees from Stanford University and I have 35 years of professional experience in environmental hydraulics and hydrology, including the analysis of flow and transport problems and several modeling studies. Next slide please.

JUDGE BOLLWERK: We're now on slide five. Is that right?

DR. FINDIKAKIS: Slide five, yes please.

In my presentation I'm going to address all the points raised in the Board's letter on safety topic number two including the relevant aspects of the site hydrology, the location of the effluent release points, the transport pathways, the site characteristics that affect radionuclide transport through the subsurface and how these characteristics were defined based on site specific data and I'm going to demonstrate how basically through our analysis we demonstrated compliance with the applicable Federal regulations. Next slide please.

I would like to start by discussing some key hydrologic features of the site starting with the

surface hydrology and the main feature of the site is the Savannah River which is to the west of the location of the proposed Units 3 and 4 and the site of both Units 1 and 2 and Units 3 and 4 is surrounded by local streams that all eventually drain into the Savannah River. Of special interest is Mallard Pond, a pond to the north of the site of Units 3 and 4 which flows into an unnamed creek that eventually first flows to the north and eventually turns to the east and flows into the Savannah River. To the west of the site of Units 3 and 4 there is an unnamed creek that is a tributary to Daniel's Branch where it later flows into Telfair Pond and Telfair Pond basically into a creek which also flows into the Savannah River. Next slide please.

In terms of the subsurface, there are three units of interest. There are three major aquifers, the water table aquifer, the Tertiary aquifer and the Cretaceous aquifer. The water table aquifer is of course an aqueduct for the other two and they are isolated hydraulically from the water table aquifer by a thick layer of very low permeability material, the Blue Bluff Marl, which basically separates the water table aquifer from the tertiary aquifer. Next slide please.

JUDGE JACKSON: Excuse me. Could you tell us how that permeability is determined on your previous slide, the last bullet?

DR. FINDIKAKIS: I'm going to talk a little more about the permeability especially for the water table aquifer, but I can tell you now that for the permeability of the water table aquifer there were several tests, both from the time of the construction of Units 1 and 2 and specific hydraulic tests that were conducted as part of the investigation for the ESP for Units 3 and 4 and this included also laboratory tests for the permeability of the Blue Bluff Marl. So all the values are based on hydraulic testings. Different methods were used for the different units and I'm going to go into more detail in a later slide.

JUDGE BOLLWERK: So we're now moving to slide eight.

DR. FINDIKAKIS: Now the next slide is slide number eight. The water table aquifer consists of different materials of the Barnwell Group which includes sands, clays and silts of the Barnwell formation and discontinuous deposits of the Utley limestone. The water table aquifer is defined, the bottom of the water table aquifer is defined by the

properties of the Blue Bluff Marl and the outcrop of the Blue Bluff Marl along the Savannah River and to the south and southwest of the site basically defines the edge of the water table aquifer and I have a slide that illustrates this in two or three slides down. The depth of the water table at the site of Units 3 and 4 is of the order of 60 feet or more. Next slide please.

The groundwater flow at the site was determined, based on monthly groundwater level data that was collected over a period of almost two years between June 2005 and July 2007. This data showed a relatively small seasonal variability. The maximum variability was 1.7 feet and they also showed that the direction of groundwater flow over this period didn't change. If we could go to the next slide please.

JUDGE TRIKOUROS: How do you determine the direction from the wells?

DR. FINDIKAKIS: I'll make that clear in the next slide. The next slide shows the location of the groundwater monitoring wells that were used in this investigation and these are the wells that were monitored over the two year period that I mentioned. And based on the water levels measured at this data, it would develop contours of the potentiometric

surface or basically all of the water table and based on those contours, we can determine the direction of groundwater flow, of course, going from the direction from high potentiometric head to low potentiometric head and in this particular case on this slide we can see the layout of the Units 3 and 4 overlaid over this figure and we can see that from the location of Units 3 and 4 the direction of the flow is to the north because the potentiometric surface decreases as we move north and it's in the direction basically directed towards Mallard Pond. And there is another feature here which is that you see we have here a high -- This is the highest water level. So this area here sort of forms a groundwater divide and on the other side of the cooling towers the flow is to the south. Next slide please.

JUDGE TRIKOUROS: So the difference in level between two well locations is the driving head for flow. Is that how --

DR. FINDIKAKIS: Right, and of course in order to look at the direction of flow in two dimensional, three dimensional space obviously we need more than two points. So we use all the points to develop the contours and the direction of the contours basically. The contours define the surface. So the

slope of the surface indicates the direction of groundwater flow.

JUDGE TRIKOUROS: It's the slope of the surface.

DR. FINDIKAKIS: The slope of the surface, right.

JUDGE TRIKOUROS: So the slope of the surface affects the -- Okay. There's a correlation between the surface conditions and the groundwater conditions.

DR. FINDIKAKIS: When I'm saying surface, I'm referring to the potentiometric surface, basically the surface that represents equal heads or equal water levels let's say.

So in the next slide, I'm sorry. Go back please. This slide --

JUDGE BOLLWERK: This is slide 11, correct?

DR. FINDIKAKIS: This is slide 11, yes.

JUDGE BOLLWERK: Thank you.

DR. FINDIKAKIS: In this slide you will see a plot of the water level monitored at each of the 22 monitoring wells over the two year period that we have data for and as you can see there is relatively little variability and all the wells basically behaved

the same way, so basically either all go up or down at the same time which again is another indication that the direction of flow doesn't change over time.

JUDGE JACKSON: What happened to your data there for that one period? I notice that you didn't get any data over one period.

DR. FINDIKAKIS: I'm sorry.

JUDGE JACKSON: You have a time span without data. The period of time without data, how did --

DR. FINDIKAKIS: Are you referring to the gap into the data?

JUDGE JACKSON: Yes.

DR. FINDIKAKIS: I think that inadvertently data was not collected for two months and that's why we have this gap.

JUDGE JACKSON: Okay. It wasn't anomalous or something.

DR. FINDIKAKIS: No. It's nothing anomalous. I don't know the exact reasons, but my understanding is that the people who were responsible to collect data failed to collect data during these two months and I don't know the specific reasons why.

JUDGE JACKSON: Okay. That's fine.

DR. FINDIKAKIS: But from all that we can

tell we don't expect anything special to have happened during that period. And as you can see the trend basically that you see before this gap continues after this gap more or less in the same direction. Next slide please.

The next slide shows the different hydraulic tests and data that were available to determine the hydraulic conductivity which is one of the key parameters, of course, for analyzing and estimating the velocity of groundwater flow. And we had several data available from the construction of Units 1 and 2. This included five pumping tests in the Utley limestone and several falling head and constant head tests also in the same unit. In addition to those, we had hydraulic tests for the Barnwell sands and also tests for the backfilling material that was used for the construction of Units 1 and 2.

In addition to this data that existed from the prior work, nine slug tests were conducted at the site of Units 3 and 4 and the data from these tests were used to estimate the hydraulic conductivity. Next slide please.

So based on all this available data, we developed a groundwater model and the purpose of the

model was to integrate the data interpretation and also help us predict future groundwater conditions after the construction of Units 3 and 4. The model that was developed was a single layer model of the water table aquifer and it was also developed as a steady state model which was basically to represent the long-term average conditions of groundwater flow at the site. Next slide please.

JUDGE JACKSON: Could I just ask a quick question? In many cases, the NRC specifies not only the analytical techniques or computer codes or whatever to be used but the method of obtaining the key input parameters. Is that the case with these hydraulic conductivities? You mentioned several kinds of testing. You had a pumping test and so on. Are these also specified in any part of the guidance from NRC as to how these should be done to obtain the parameters that you're going to use in the analysis?

DR. FINDIKAKIS: All this data were obtained using standard methods that are basically widely used in the industry and, of course, all of the data that were obtained were all QAd for following our procedures.

JUDGE JACKSON: But they are not necessarily all specified in the guidance, the NRC reg

guides. They're just standard good practice that practitioners in this areas use?

DR. FINDIKAKIS: It's the good practice in the industry. At this point, I can't think of a specific NRC document that prescribes the methods and maybe one of the other NRC staff could help us with this question.

DR. AHN: This is Hosung Ahn, Hydrologist with NRC. Currently you don't have a guidance to specify which method they use. So it's totally dependent on the applicant.

JUDGE JACKSON: Okay.

DR. AHN: There are general guidance on the hydrogeologic onsite measurement. However we don't have a specific guidance on that.

DR. FINDIKAKIS: If I may. For example, the methods for conducting the tests and analyzing the tests followed standards like ASTM standards, for example, that exist for the specific type of tests that were conducted. So we used standard industry practices and available standards like ASTM standards where applicable and available.

JUDGE JACKSON: All right. Thank you.

JUDGE TRIKOUROS: Now when you say single layer model, do I take that to mean a 2-D model with

the assumption that there's no difference in the axial direction?

DR. FINDIKAKIS: That's correct. Based on the data that we had available, we couldn't distinguish a vertical hydraulic gradient within the -- and also the materials themselves did not present a well defined pattern of more than one layer. So that's why they were treated basically as a single layer. So from a hydraulic point of view, the water table aquifer behaves as a single unit because if you measure the head at any point vertically basically you have the same head.

JUDGE TRIKOUROS: But does the model that you used MODFLOW was capable of axial three dimensional representation or is that a 2-D model?

DR. FINDIKAKIS: The model we used was MODFLOW. MODFLOW of course can be used in a three dimensional mode. But we described the water table as a single layer and what we did was that we varied the hydraulic properties horizontally based on the distribution of the materials that we measured from the data.

So slide 14. I'm sorry. Let me finish with slide 14 very quickly. Slide 14 basically again addressed the point that the model was developed based

on site specific data. We used the MODFLOW groundwater flow model which is standard model in the industry and specifically we used the visual MODFLOW which is an interface for the use of the standard MODFLOW model. And the model was first calibrated using the measured water levels and I'll talk about the calibration a little more. And once it was calibrated, then it was used to test alternative plausible conceptual models to basically sort of bracket any uncertainties that may exist in terms of a groundwater flow direction.

JUDGE TRIKOUROS: And in your experience the computer code -- If you had used another computer code other than MODFLOW, is it your experience that all of these codes that might be available get essentially the same answers?

DR. FINDIKAKIS: More or less. I think the greatest variability is in basically what parameters you use and how you conceptualize the problem. I mean the numerical codes themselves, I think they won't produce much different results. At this point, the state of the art is such that most available codes give about the same results.

JUDGE TRIKOUROS: They use potentially the same equations, the same data.

DR. FINDIKAKIS: The same equations. Maybe different numerical methods for the use of the equations, but any differences in these results are relatively small compared with differences due to the uncertainty in defining the problem and the parameters.

JUDGE TRIKOUROS: So the problem is really input assumption driven rather than anything to do with the computer code itself.

DR. FINDIKAKIS: Yes. The problem basically is how one conceptualizes the problem and how basically one defines the problem in the model and second what parameters one uses.

JUDGE JACKSON: When you say it was calibrated using measured water levels, I assume that you would then model a situation, look at the measurements and do you have a parameter or a conductivity or something else that you then use to adjust it in terms of the calculations?

DR. FINDIKAKIS: I will go into a little more detail on the calibration approach. It's two or three slides down the presentation.

JUDGE JACKSON: Okay. Sorry.

DR. FINDIKAKIS: Next slide please.

JUDGE TRIKOUROS: Just before you move on,

the staff has no problem with what you've just heard. Right?

(No verbal response.)

DR. FINDIKAKIS: This slide which is slide 15 shows the area that was covered by the model and again as a reference point the site of the proposed Units 3 and 4 is near the center of this area. And the model is bounded by these two lines, the red line and the yellow line, where it covers an area of one and a half to two miles East to West and about three or a little more than three miles to the north side and the two lines that delineate the model domain indicate two different types of boundary conditions.

The yellow line here is along the outcrop of the Blue Bluff Marl which basically marks the edge of the water table aquifer. So the water table aquifer basically ends at this point and discharges to the surface and this is supported by observations that where we've seen seeps and springs along this boundary. So this area was treated basically using the so-called drain boundary condition in the model which allows flow out of the model.

On the other hand, the red line along the north side of the model in the northwestern boundary of the model, this line is along the water shed line.

So it basically works as the surface water divide and here we made the assumption that the groundwater divide coincides with the surface water divide which means that this is a line of no flow. So this is a no flow boundary because water on one side of this line flows in one direction and on the other side in the other direction. So along this line we have basically no flow. Basically these two boundary conditions were to define the boundaries of the model.

Again, as I said in the model, we used different -- We used all the data that we had to define the distribution of the hydraulic conductivity and, of course, once we defined it we made adjustments to calibrate the model and we used also a variable groundwater recharge accounting for the surface features and characteristics like accounting for example from the slope of the ground surface for the land cover, whether we're in a forested area or nonforested area, whether we had areas that were paved or covered by buildings and so forth.

And based on this and after considerable effort, we calibrated the model and here the next slide shows an example of what we see in the calibration. And what we have here now we are zooming in part of the model domain. This is the area again

around Units 3 and 4 and this is the area where we had most of the data. What we have here in the yellow boxes is this so-called residuals and by residuals we mean the difference between the measured water level and the calculated water level and, of course, the objective of the calibration is to minimize these residuals everywhere. So if we could get basically zero residual everywhere which means zero difference between the calculated and the measured heads, then we have a perfect model. But, of course, this is not possible. So the objective of the calibration is to minimize the residuals.

And we did this, of course, through an iterative process in that at the same time we were trying to reproduce the shape of the equipotential surfaces in the direction of groundwater flow to make it to match the observed data, the contours that were developed based on the observed data.

But also we used the different statistical measures and the next slide shows an example of this and what we have here is that on the horizontal axis we have the measured water levels and on the vertical axis we have the calculated water levels at each individual well.

And, of course, if we have a perfect

calibration, they should fall on a 45 degree line because the two values would be the same. And again the objective of the calibration exercise is to bring these points as close as possible to the 45 degree line.

In the process of doing so, we used different statistical measures and some of them are listed here at the bottom of this slide like, for example, the root mean square residual as we tried to minimize our correlation coefficient or the maximum residual, the absolute maximum value of the residual and so forth. So we used all this in combination and using judgment basically we came up with what we considered as the base calibration.

Now the calibration consisted primarily at varying two parameters, the hydraulic conductivity and the groundwater recharge. And as I said, we had different zones of groundwater recharge and, of course, when I say we varied these parameters we varied them within a range of expected values for this region. We had data from the Savannah River Site. So the variation of the groundwater recharge was within that range and, of course, for the hydraulic conductivity our guidance was the data that we had and the distribution of the materials that we had. So we

tried basically to make the variability of the hydraulic conductivity both in terms of its special variability, but also in terms of the actual values and tried to make it consistent with the data and at the same time, of course, achieve the best match with the observed groundwater levels.

JUDGE TRIKOUROS: Can I ask? Is this a hand process? Is this automated or is this done by the analyst?

DR. FINDIKAKIS: There are two ways to do it. One can do it using an automated process like an inverse procedure that basically tries to do this match automatically. But it can be done by the analyst. In our case, we didn't choose an automated process because one of the parameters that we had to vary was the zonation, basically the how to define the different zones of hydraulic conductivity and this required some judgment that cannot be captured in an automated process. So the answer to your question is that the calibration process was not automated. It was basically done -- It was a process basically trial and error and see what works and, of course, in every step of the way we are learning a little more and we're hopefully moving in the right direction.

JUDGE TRIKOUROS: This is a rather time-

consuming process.

DR. FINDIKAKIS: It is, yes.

JUDGE TRIKOUROS: So the adjustments on level were made to match the known data on hydraulic conductivity in the different zones.

DR. FINDIKAKIS: That's correct.

JUDGE TRIKOUROS: With 22 different variability.

DR. FINDIKAKIS: Right.

JUDGE JACKSON: Let me make sure that I understand. You were not using one characteristic, hydraulic conductivity. You were varying that by -- it was spatially dependent then.

DR. FINDIKAKIS: Right.

JUDGE JACKSON: And so you had quite a lot of --

DR. FINDIKAKIS: There were quite a few variables.

JUDGE JACKSON: Quite a lot to play with and I assume that precipitation or the recharge similarly was space dependent and --

DR. FINDIKAKIS: Yes. That's correct. And again this involved some judgment because obviously, for example, we know what is the annual precipitation which is around 44 inches. So we know

that in general the rate of groundwater recharge is between 10 and 20 percent of precipitation and we had some specific numbers also from groundwater recharges of estimates at the Savannah River Site and then, of course, we used judgment because we know that for example in an area that is flat you'll have most likely more recharge than in an area that is on a steep slope and an area where you have -- is forested probably you'll have less groundwater recharge because you have more use of the infiltrating water by the trees and so forth. So all these were indicators that help us define the relative distribution of groundwater recharge.

And then, of course, there was the element of calibration what worked and what -- But again the calibration, these parameters were not arbitrary. It was based on judgment and within physical constraints.

JUDGE TRIKOUROS: This tool is a steady state tool.

DR. FINDIKAKIS: The model -- The tool itself can be used for transient simulations, time dependent simulations, but in this particular case we used it as a steady state model because our objective was to predict two things. Of course, groundwater levels is the subject of the next presentation, but in

this particular case the pathways and the travel times. Some small changes in the groundwater levels on a seasonal basis won't have much impact on estimating longer term travel times. And in addition what we observed was that the variability of groundwater levels was relatively small.

JUDGE TRIKOUROS: That's sort of the other question that I had was the data that you showed for levels and for all 22 monitoring wells over the course of that two year period, they were actually dropping. At least, a number of them were to my observation. They may continue to drop in the future. The relation -- The 2-D steady state relationship that you calculated, would that be preserved as the levels drop over time?

DR. FINDIKAKIS: No, the steady state really a condition that I showed and that we used is representative of sort of a long term average. In this particular case, the water levels were dropping slightly in 2007, but the important point here is that they were dropping all at the same time and sort of at a similar rate which means that the direction of groundwater flow was not changing. So for the purpose of estimating travel times, this shouldn't have much of an effect.

JUDGE TRIKOUROS: But if the drought continues and these levels continue to drop as long as they all drop uniformly, then your 2-D steady state assumption would apply into the future.

DR. FINDIKAKIS: Right.

JUDGE TRIKOUROS: But only if there is a change to the level distributions, then something could change.

DR. FINDIKAKIS: That's correct. But again, since what most likely was driving the drop of the water levels was the drought conditions this affects more or less the entire area in the same way. So we don't expect to see any changes in the direction of the flow in the distribution of it.

JUDGE TRIKOUROS: So your answer is that over time if there continues to be drought there would be no reason to assume that there would be any different distribution, that the drought would affect all the wells basically the same way. They would all drop uniformly. Your 2-D assumption would apply into the future. Is that what you're saying?

DR. FINDIKAKIS: That's correct. Yes.

So if we move to the next slide please.

JUDGE BOLLWERK: We're on slide 18 now.

DR. FINDIKAKIS: So once we had the

calibrated model, we introduced in the model some changes to reflect future conditions at the site and the primary changes were first in the topography because of the grading of the site, some changes locally in subsurface material because of the introduction of the structural backfill, and changes in the distribution of the recharge as the results of grading and covering several surfaces with pavements or the construction of the buildings and so forth.

And the next slide please shows an example of -- This is an example of the distribution of groundwater recharge. So this shows a total of eight different zones differentiating between again forested areas, areas with minimal vegetation. That is on steep slopes and areas with different types of cover like well drained areas, areas covered with gravel, areas covered with buildings or pavements and so forth.

And again this is an illustration of changes that were introduced in the model especially, of course, in the area of Units 3 and 4 in order to make predictions of post-construction conditions. Next slide please.

This slide shows the predicted water table over the entire model domain under post-construction

conditions and basically what it shows shows that the direction of groundwater flow from the area of Units 3 and 4 after construction would not change from what it is today. So it would continue to be to the north and in order to illustrate this we did the so-called particle tracking which means basically that we introduced in the model a number of particles whose travel we followed through the model and traced here their trajectory.

And here we have a number of particles along the periphery of a circle that encompasses Units 3 and 4 and basically what we see is that if you release a particle anywhere along this circle this particle eventually will end up in Mallard Pond which, of course, also demonstrates or proves that if you release a particle anywhere inside that circle, of course, will follow the same trajectory. So in essence this represents the envelope of all possible pathways for the release anywhere in the power block area.

JUDGE TRIKOUROS: These are computer particles, right?

DR. FINDIKAKIS: Right.

JUDGE TRIKOUROS: They don't dilute in the groundwater system.

DR. FINDIKAKIS: The purpose of this was only to estimate, first of all, to find the direction of the pathways and estimate the travel times. Accounting for other processes were done separately and I'm going to address this in the next few slides. If we move to the next slide please.

JUDGE BOLLWERK: Now we're on slide 21.

DR. FINDIKAKIS: Yes. So first before leaving the subject of the groundwater transport pathways, I would like to reiterate that we tried the same analysis with several alternative combinations of groundwater recharges and hydraulic conductivity distribution and the conclusion was that in all cases the direction of the pathways was the same, was to the north.

So here in the next slide, the next slide illustrates the conceptual model for the radionuclide release analysis and basically the assumption that we made was that the major liquid effluent release that would produce the highest concentrations was a release from the auxiliary tank that is located in the basement of the auxiliary building and this is an assumption. This basically comes from the DCD of the AP1000 design.

And we assumed that the effluent that will

be released from that tank will instantaneously be transferred to the water table. Of course, this is quite conservative because we don't take any credit for the six-foot base map at the base of the floor. We assume, of course, that the drain system totally fails and don't take any credit for the membrane and we don't take any credit for travel through the 60 feet of -- I'm sorry. Not 60 feet, the about 25 to 30 feet of vadose zone because the base of the auxiliary is at an elevation of 187. The water table is around in that location 155-160. We have another 25 feet. So basically we ignore all of this and we assume that the effluent instantaneously enters the water table.

Once in the water table, then it has to travel through the backfill material and through different native materials and again since the pathway is to the north it will move to the north and it will discharge in Mallard Pond. And from Mallard Pond and since Mallard Pond overflows into a stream downstream, any effluents will basically follow that stream and, of course, in the course of flowing down the stream will be further diluted with the flow of fresh water flow in the stream. So this was the basic conceptual model that we used. If we can move to the next slide please.

So in our analysis we consider several processes. We consider, of course, advection. We consider radioactive decay and we were very conservative in the way that we treated adsorption and basically what -- Maybe I will cover this in the next slide. I have some more information on adsorption. And finally we accounted for dilution in the surface water.

JUDGE TRIKOUROS: Can I interrupt you for a second?

DR. FINDIKAKIS: Yes.

JUDGE TRIKOUROS: That assumption that the effluent holdup tank all gets immediately into the groundwater, now in reality you'd had mentioned a six foot -- There's a six foot concrete base.

DR. FINDIKAKIS: Yes.

JUDGE TRIKOUROS: Is the auxiliary building the same as the rad waste building? If I understand correctly, in previous applications, I noted that there was an assumption of zero release. There's a permit condition in fact. It was rather surprising so that if there is a break in a tank in the building. Now I'm not sure if it's the rad waste building separate from the auxiliary building that would be zero release. You're just making the

specific assumption that if it breaks in the building that it instantaneously gets into the --

DR. FINDIKAKIS: That's correct. And in fact I should make a small correction. It's not the full contents of the effluent tank. It's 80 percent of the contents which is basically per NRC guidance. So 80 percent of the contents of the tank instantaneously are transferred to the water table.

JUDGE TRIKOUROS: There is a holdup of 20 percent of the tank.

DR. FINDIKAKIS: That's correct.

To give you the conclusion of this analysis and I'll go back in the next slide and discuss a little more the conservatism of the analysis but the conclusion of this analysis was that basically we looked at two criteria, first whether the concentrations of all the nuclides are lower than the effluent concentration limits defined or described in 10 CFR 20 and the answer is yes, they are all much smaller.

But in addition to that the 10 CFR 20 requires that the sum of the ratios of all nuclides concentrations over the respective effluent concentration levels, the sum of these ratios is less than one and in this particular case the estimated sum

of these ratios is 0.058, so much smaller than that, and by the way this estimate is for the point where water leaves the controlled area, basically leaves Southern's property line.

JUDGE JACKSON: What's the point of that last sum of the ratios? What's that trying to get at?

DR. FINDIKAKIS: I think it accounts for the fact that there is a mix of different nuclides. So you're not dealing with individual nuclides. So it accounts for the composite effects. I believe that's what it is, but this is in the regulations. So I'm not familiar with the full rationale as to why the regulations. But my understanding again is this applies to the cases that the effluent is a mix of different nuclides.

JUDGE TRIKOUROS: Just a quick question. I understand decay, adsorption and dilution. What is advection?

DR. FINDIKAKIS: Well, advection is just transport by the movement of groundwater and let me go to the next slide and I'll talk a little more about this process and why this analysis is conservative.

JUDGE JACKSON: Excuse me. Maybe before we go on, we could just ask the staff why that last point is in there, the sum of all ratios must be much

smaller than one. What physical concern are you trying to address there?

DR. KINCAID: This is Charles Kincaid. I like Angelos am a hydrologist. This question you're asking is more of a health physics question.

JUDGE JACKSON: It is.

DR. KINCAID: As to what's the idea here of summing these up and it being less than one.

(Off the record comments.)

MR. SMITH: Your Honor, this is referring to the sum of fractions rule.

JUDGE BOLLWERK: Can you identify yourself?

MR. SMITH: Yes. My name is Michael Smith.

JUDGE BOLLWERK: Thank you.

MR. SMITH: This is referring to the sum of fractions rule whereby each radionuclide has a specific limit set to it.

JUDGE JACKSON: Right.

MR. SMITH: And if you only had the one radionuclide in the environment at that limit you would reach some threshold dose limit and if you had two or more radionuclides each at their individual limits you would go above the overall dose threshold.

So you take the fraction of each radionuclide against its individual limit and sum those and that sum of fractions if it's below one allows you to meet the overall dose threshold.

JUDGE JACKSON: Okay. That makes sense. I just wanted to see if that was it. Sorry to interrupt you.

JUDGE BOLLWERK: We're on slide 24.

DR. FINDIKAKIS: The next slide please. We're on slide 24.

I would like to go over some again and reiterate some points on the conservatism of this analysis. We talked about the fact that we have instantaneous release and zero travel to the saturated zone. One other process that occurs in the subsurface is the dispersion of nuclides as they move through the groundwater and in this case we took no credit for dispersion.

Also regarding adsorption, we did not take credit for adsorption for basically all nuclides involved except for three, cobalt-60, strontium-90 and cesium-134. And for these three, we used distribution coefficients that were determined from laboratory testing of several samples from both the backfill material and the native material, the Barnwell sands.

These samples were sent to the Savannah River Site lab and they were analyzed there using special methods and based on the results of these tests we had an estimate of the Kd or distribution coefficient which defines rate of adsorption and to be more conservative we used the lowest estimate for each nuclide that basically came from all the samples.

For example, if we had like six tests from different samples for cobalt we used the lowest value, the one that would give us the least adsorption. In that sense, the analysis was very, very conservative.

JUDGE TRIKOUROS: The obvious question, of course, is what if you hadn't taken credit for adsorption of those three radionuclides. Was that a problem with the dose?

DR. FINDIKAKIS: Yes. Because if we didn't take credit we wouldn't be compliant and the reason, of course, that as I said, in this case it's important to take into account adsorption is that adsorption slows down the movement which allows more time for radioactive decay of these three nuclides.

So basically our approach was that first to do the most conservative, so take credit for as little as possible and then if we could meet, if we would be in compliance, then we would stop there and

where we were not in compliance we reverted to a more realistic approach based on site specific data.

JUDGE TRIKOUROS: So instead of starting with a realistic approach, you started with an overly conservative approach and then wherever you had a problem you then moved in the direction of realism.

DR. FINDIKAKIS: That's correct.

JUDGE JACKSON: Did you just do the adsorption then once you reached the groundwater? You instantaneously delivered it there. But did you take credit for adsorption?

DR. FINDIKAKIS: In the zone above the water table, no.

JUDGE JACKSON: So you really didn't -- You could have done that as well I assume.

DR. FINDIKAKIS: Right. Yes. So we assumed that nothing is retained in the soil in the 25 or 30 feet of soil between the base of the building and the water table.

In addition, of course, once the stream that drains Mallard Pond flows into Savannah River, there is an additional dilution factor that we didn't factor in this which is of the order of more than 1,000 basically.

JUDGE TRIKOUROS: I'm sorry. One more

question. The effluent holdup tank assumption, was there a reason that you used the effluent holdup tank? Was that the largest tank or did it have the highest activity?

DR. FINDIKAKIS: Yes. In combination of volume and concentration, I think this is the -- that gives the highest concentration basically.

JUDGE JACKSON: Could you say a word about how you arrive at the dilution factor once the liquid reaches the Savannah River?

DR. FINDIKAKIS: There are two dilution factors here. One is the dilution into the stream before the stream goes in the Savannah River and for this we had estimates of the stream flow in that stream. So basically we took the volume of the release and divided by the volume of the stream flow. Okay. We took the volume of the release and based on the rate of groundwater flow under the site this release moves at a certain rate. So this gives us basically a flow rate that the release is contained in.

JUDGE TRIKOUROS: Okay.

DR. FINDIKAKIS: So then we took the ratio of this flow rate over the stream flow in the stream and the ratio of these two defines the dilution

factor.

JUDGE JACKSON: Okay. That seems reasonable to the stream. When you get into something very wide like the Savannah River?

DR. FINDIKAKIS: So then for the Savannah River we used the 100 year drought minimum flow and basically divided the stream flow by that very low flow.

JUDGE JACKSON: Basically the same approach in both.

DR. FINDIKAKIS: Same approach, right. So it's the ratio flow rates in both cases.

JUDGE JACKSON: Okay. I see.

DR. KINCAID: I have a comment. This is Charles Kincaid. I just wanted to actually correct something that Angelos has mentioned. As he talked about retardation adsorption, he mentioned that cesium, retardation was applied to cesium-134. It actually is applied to the entire suite. So it's also 137.

JUDGE JACKSON: Okay.

JUDGE TRIKOUROS: Yes, I was surprised when I heard 134.

JUDGE JACKSON: That would make sense to have it be 137.

DR. FINDIKAKIS: The same, of course, is true for the other nuclides, for cobalt and strontium. But these specific isotopes are the ones that are of concern.

JUDGE JACKSON: Okay.

DR. FINDIKAKIS: Because the other ones have very low concentrations anyway. So they're not a factor. If we move to the next slide please. This will be slide 25.

This slide sort of summarizes the parameters that impact transport and this is because this is a response to the specific request in the letter prepared by the Board. I think that I've already covered that I believe. So we can move to the next slide.

The next slide again goes through the different parameters like the groundwater recharge, distribution coefficients and again states that they were based on the site specific data. We can move to the next slide.

Now I said at the beginning of this presentation that the water table aquifer is separated from the tertiary aquifer by a fairly thick layer of low permeability material. So it's highly unlikely that any nuclides will end up in the next aquifer

down, the tertiary aquifer.

However to be conservative we did analyze this case too and here we made the assumption that the 80 percent of the contents of the effluent tank instantaneously move to the tertiary aquifer. So basically besides the other barriers that I mentioned earlier that are neglected here, we neglect also the 60 feet of the very low permeability Blue Bluff Marl, or Lisbon formation and we assume that the contents get instantaneously transported to the tertiary aquifer.

If we do that and we use again as groundwater velocity based, estimated based on measured hydraulic conductivity in this aquifer and based on the measured hydraulic gradient, what we get is that we get a fairly long transport time from the location underneath the site and the Savannah River. And by the way this is the main pathway now. The pathway in the tertiary aquifer is towards the Savannah River. So this will be the first discharge point. And we have a travel time of the order of 1,000 years. And in this case we didn't take credit for any other processes other than the active decay.

And doing that if we move to the next slide please -- Let's move one slide more. Yes, what

we see is that now again all the nuclides have concentrations by the time they arrive at the Savannah River. They have concentrations which are much smaller than their respective effluent concentration limits and in addition the sum of the ratios of all nuclides concentrations over the respective concentration effluent concentration limits is 0.0036 which is much smaller than one.

I think that this leads me to the next slide which is basically the conclusion that --

JUDGE TRIKOUROS: Before you get to there, just a quick question. What kind of a time frame are we talking about from the entrance to the aquifer to the Savannah River? Do you remember how much time we're talking about?

DR. FINDIKAKIS: Yes. The time is in the order of 1,000 years.

JUDGE TRIKOUROS: Sorry. You had mentioned that.

DR. FINDIKAKIS: Yes, it's the distance. The distance is about a mile and the groundwater transport velocity is of the order of about a little less than five feet per year. So it moves very slowly.

JUDGE TRIKOUROS: Thank you.

DR. FINDIKAKIS: So the last slide basically summarizes the point that we looked at all potential pathways and through an exhaustive exercise we convinced ourselves that we had identified all the plausible pathways and follow all the pathways, basically the transport analysis showed that we meet the requirements of 10 CFR 20. Thank you.

JUDGE JACKSON: I guess assuming that it penetrates the Blue Bluff Marl is a conservative way of covering the case where there's a fracture or perhaps a well or some other path gets punched in there that would be abnormal.

DR. FINDIKAKIS: Yes. That's correct. We believe that this is highly unlikely but this covers this case, too.

DR. FINDIKAKIS: Okay.

JUDGE TRIKOUROS: So the reason you can get away with such an extremely conservative assumption of instantaneous addition to the aquifer was this really long decay.

DR. FINDIKAKIS: Correct.

JUDGE TRIKOUROS: Was that really the bottom line?

DR. FINDIKAKIS: That's correct.

JUDGE BOLLWERK: Any other questions that

you have at this point?

(No verbal response.)

Let me just see if there's any comments that any members of the staff has relative to anything you've heard in the last hour or so.

DR. KINCAID: I have one comment, this is Charles Kincaid, about this last slide. The inclusion of a tertiary aquifer pathway really arose out of staff's concerns and review of hydrology data that was available on the site. We looked at the water table aquifer data available on some wells and discovered that it didn't make a whole lot of sense.

We had the Applicant go back and look at that and they determined that at a well location the data was indeed flawed. One well that was installed did not respond as other wells in the aquifer were responding and it was assumed that it was poorly completed, perhaps even mudded in around the screen. A replacement well was put in place and all the observations taken from that well showed water levels at or below, they were all below actually, the bottom of the screen.

So it really argued that -- I should mention. The water level was in the cup at the bottom of the well. So it was actually registering bottom of

well type measurements and it was apparent that it wasn't responding. So those two wells were taken out of the dataset by the Applicant.

What we did was argued that this data could, not being replaced by another well and competent data, could argue for a point in the environment where there was communication between the water table aquifer and the tertiary aquifer below. Low hydraulic heads in the water table aquifer could argue that you have a gradient now that's moving water down at a specific point in some way.

We think as the Applicant does that it's highly unlikely. The Blue Bluff Marl at this location is some 90 feet thick I believe. The average is 63. We believe it to be competent. It's just the dataset didn't provide us enough assurance that it absolutely was. So this is actually an example of an alternative conceptual model of the site that brings about a second pathway in the analysis and assures us of the safety of the site.

JUDGE BOLLWERK: Thank you. Any response from you all? I'm sorry.

DR. FINDIKAKIS: No.

JUDGE BOLLWERK: All right. At this point, I think we're ready for our lunch break. When

we return we'll have the NRC staff panel and obviously you all will have an opportunity to anything you may need to comment on with respect to anything they say would be appropriate at that point as well.

I think since we have to offsite do you think we're going to need a whole one and a half or do you think we can do it in an hour and 15 minutes? An hour and a half?

(Off the record comment.)

All right. Right now, it's a little after 12:30 p.m. Is 1:45 p.m. too quick? Can we make a shot to try at 1:45 p.m.? All right. Why don't we try to reconvene at 1:45 p.m. if we could? Thank you very much. Off the record.

(Whereupon, at 12:35 p.m., the above-entitled matter recessed to reconvene at 1:45 p.m. the same day.)

A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

1:47 p.m.

JUDGE BOLLWERK: Good afternoon. We're here after our lunch break to continue with the presentations on radiological impacts, Presentation Number 2. Let me just go back one second, to the panel, either to the Applicant's witnesses or to the staff. Does anybody have anything they want to add based on what we heard this morning? Everybody's satisfied? All right. Either of the Judges? All right.

One thing I was about to mention. I was told over the break is perhaps, it will help. I was told if you keep the mike about four inches from your mouth, you'll probably get the optimum use of it. These are not -- these mikes were sort of bought on the fly when our main system failed yesterday, so they're not the greatest in the world, but we appreciate your patience with us here. We're trying to sort of work this through.

All right, let's go then to the staff

panel on this particular presentation and I think we need Exhibit -- hold on one second. Oh, I've got it right here, 73. I'm sorry, NRC 60, I'm sorry, 000060, if I've got it.

MR. MOULDING: Your Honor, I'll just note that the staff presentation begins with the safety portion and goes into the environmental portion. Would you prefer that we continue with that order or follow the same environmental then safety discussion that --

JUDGE BOLLWERK: It's really up to you all, however you think is --

MR. MOULDING: Why don't we just start with the safety review and go in order through the presentation?

JUDGE BOLLWERK: All right. Do you want to go back the other way? No big deal, either way.

DR. KINCAID: Okay, we'll go ahead with the safety review portion. Next slide, please. I'm Charles Kincaid with PNNL and second slide, please. I'm Charles Kincaid with PNNL. As I mentioned earlier, PhD out of Utah State in Engineering, about 30 years of experience at the laboratory in earth sciences, particularly Vadose zone and groundwater transport studies.

JUDGE BOLLWERK: Let me stop you one second. Can you check and make sure, it's supposed to be NRCR00060. That's it, okay. All right, thank you.

DR. AHN: My name is Hosung Ahn, Hydrologist with that NRC. I am working on the safety side of the hydrology safety NRC.

JUDGE BOLLWERK: Okay.

DR. KINCAID: Next slide. This is Slide 3. It overviews the purpose of the presentation. It's to review the staff's analysis of release and transport of radioactive liquid effluent under postulated accident conditions. It focuses on how the staff assured results were conservative in this analysis. We'll include remarks on the sequence of our review, relevant site hydrology. We'll touch on site characteristics that impact transport at several times in the presentation.

We'll talk about transport paths, post-construction, effluent release points, plausible pathways, compliance points and finally wrap up with slides on the analysis and assurance of conservative results. Slide 4, please. The sequence of our review that we undertook began, of course, with the site audit and various RAIs. I think a key point is that the staff challenged the Applicant's concept of a

single pathway to Mallard Pond draining to the Savannah River from the onset. We also sought information on the use and presence of chelating agents.

A primary aspect of our review after reviewing data and making comparisons to other data sets, USGS data and so on, in terms of hydraulic conductivities and porosities and so on, a primary aspect is our review of plausible alternative conceptual models. This basically began with the -- our review of a groundwater model that the Applicant brought forward in response to open items 2.4-2, 2.4-3 and the various RAIs. We received three versions of this model. In January of `08, we received the first and responded to that with public comments or comments at a public meeting at NRC headquarters in April of 2008.

We received a second version of the model in June of `08 and sent RAIs in July of `08. We received a final version in August of `08 and used that as the basis for our review. To do that from the various model files that were submitted by the Applicant, we selected a case that most closely measured -- represented the measured water table and we used that for our independent confirmation work.

That primarily evolved around or as we performed sensitivity analysis using that model and these were based on post-construction recharge distributions that had to be varied, and we'll talk about that as we get through it.

Slide 5, please.

JUDGE JACKSON: Excuse me, before you leave that, what was the basis for the modifications that you made that you said slightly modified a couple of things?

DR. KINCAID: What we did, during our review of the model and I'll get into that a bit, but just in summary, we looked at the top of model elevations and how that was brought into boundary conditions because the drain boundary conditions that Dr. Findikakis talked about that are about half of the boundary of the site, those rely on specifying a boundary and what we call a conductance. So we were checking to see what the elevation was in these drains, what they were specified at and how that -- how the model behaved with that, and also looking at how the conductance influenced the model.

So we, in our review of it, initially made some adjustment to those drain elevations and the conductance, particularly in Daniel's Branch. So

that's -- and I should add, our model, and you'll see in our results change their model results very little.

JUDGE TRIKOUROS: So the staff purchased their own version of the same computer code that was used by the Applicant.

DR. KINCAID: Exactly. We have the same version of Visual MODFLOW and executed it using the input files initially provided by the Applicant in the second study.

Slide five. I'll go through these items in more detail in subsequent slides but I thought it would be good to list the kinds of things we reviewed. The --

JUDGE BOLLWERK: Check and make sure your mike is on.

DR. KINCAID: I'm just not close enough. Okay, the items that we looked at, the surface, land surface. We reviewed that to insure that the most current LIDAR and the DEM data sets were being employed in the top of model. LIDAR is Light Detection and Ranging. It's a data set that's acquired by aircraft with laser instruments on board. It's gathered by low-flying aircraft and has a relative accuracy of about one foot in the horizontal and about one foot in the vertical. So it's fairly

highly resolved.

The DEM data sets we looked at are older data sets available from the US Geological Survey and you might think of those as your common maps that you can acquire from the survey to tell you the topography of a site.

JUDGE JACKSON: Is the LIDAR information, is it -- was it specifically done for this site or is that a data base that you can access for many locations?

DR. KINCAID: The LIDAR data set was generated by Southern Nuclear Company and provided to both their consultant, Bechtel, and to ourselves.

JUDGE JACKSON: Okay.

DR. KINCAID: I'll say more about it, too, in subsequent slides, but it's a local data set. We also looked at the aquifer base, we reviewed the top of Blue Buff Mall. That is the base of the model. We reviewed boundary conditions, drain boundary conditions in particular that I've already mentioned both for the outcrops and for stream beds. We looked at and reviewed the constant head boundary condition, also the hydraulic conductivity distributions and magnitude, particularly for their influence of Utley limestone and engineered backfill and the recharge

distributions and magnitudes that were applied by the Applicant.

And this involved the surface, its slope, its structures, the vegetation and look at the variability in that. The bottom line, we basically reviewed Southern's combinations of hydraulic conductivity and recharge in space and magnitude that they used in their representative model, their pre-construction, if you will, model.

JUDGE TRIKOUROS: Were you handed the model input deck or were you handed some sort of a calc file that described how the inputs were determined and all of that?

DR. KINCAID: We were handed input files and output files. The -- one way to convey how -- and Dr. Findikakis explained in great detail because there probably wasn't time, but I'll mention that in putting together the model, one begins with -- and certainly they did in this example, began with a very simple model. They assumed that a 100 series set of runs that you had a single hydraulic conductivity for the entire site and a single recharge rate and then sequentially in a 200 series, 300 series and so on, up to a 700 series set of runs we looked -- they looked at and we reviewed sequentially more complex

depictions of the site that took into account the zonation of the hydraulic conductivity and its magnitude and the zonation of the recharge rates and their magnitudes.

So we weren't handed, you know, "This is how we got to that number", but we could see in the results that we were provided a sequence that really showed us how the model got from kind of a base really crude, you know, single value for the entire region to a model that has the kinds of distribution of conductivities and distributions of recharges that you'll see in my subsequent slides.

Next slide, number 6, please. In terms of site characteristics important to transport, this slide overviews in words some of the things we looked at again. We looked at the topography, again, the LIDAR, the DEM data sets. We looked at the top of Blue Bluff Marl here I've summarized the hydraulic conductivity ranges, if you will, that we looked at. Dr. Findikakis already mentioned these. We break them much in a similar way into Barnwell Group, sands, silts and clays, that were obtained, measurements obtained during Unit 1 and 2 site investigations and values obtained during the Unit 3 and 4 site investigations.

You can see that they overlap. The Utley limestone data set was from the Unit 1 and 2 site investigations and ranged up to 340 feet per day. The backfill values of 1.3 to 3.3 feet per day you can see that's a pretty narrow range. It's engineered backfill, so you might expect that. These were taken post construction at Units 1 and 2 after their fill was in place. They placed four what they call LT wells. It's LT and various numbering after that. But these wells were tested to determine these values.

The hydraulic conductivity that was applied as I mentioned in various zonations and in magnitudes in the models, again, I could describe those in terms of the regional breakout and there's a graphic later on we'll see that demonstrates this, these breakouts. The Barnwell Zone, to the northwest and southeast of the ridge on which the plants are placed, were assigned lower values. They tested the ranges between 12 and 34 feet per day in various runs that were made. The Barnwell Zone to the south of the proposed Units 3 and 4 were assigned the lowest values and these ranged as low as five feet per day.

The ridge top where the Utley limestone causes higher values, was tested up to 65 feet per day and there's an area just south of Mallard Pond that

we'll see in the graphics that was tested at values up to 400 feet per day. The backfill was run at the measured values from the field of 1.3 and 3.3 feet per day.

JUDGE JACKSON: What's the role of the Utley limestone? I thought that that occurred down near the base of the Barnwell.

DR. KINCAID: It is near the base of the Barnwell and what we see is an influence of it. In a two-dimensional model you're really integrating the conductivity over that entire thickness to get transmissivity. So when you have a potentially high conductivity lower zone within it, you end up with it dominating perhaps the conductivity that you're using or the transmissivity that the model sees.

JUDGE JACKSON: Above there, where you have the hydraulic conductivity from .3 to 343, is a pretty good range.

DR. KINCAID: Yes.

JUDGE JACKSON: How does that work? It's almost zero to --

DR. KINCAID: Oh, yes, well, hydraulic conductivity can range over several orders of magnitude within a site, easily. And admittedly, we conceptualized this as a two-dimensional model, the

Applicant and ourselves, and have used values that are considerably different than say the measured values which might be quite small.

A couple things about that, you know, we only measure at finite points, so we don't know the complete story on the full range, perhaps. And we do have model scale-up. We are simulating on the scale of 100 by 100 feet and not on the scale of a bore hole. So there's some scale-up that comes into it as well to make the match.

JUDGE JACKSON: Okay, thanks.

DR. KINCAID: Slide 7, please. This shows the site topography and boundaries. You've already seen very similar graphics from Dr. Findikakis. Let's go onto the next slide. It's a blow-up of the LIDAR depiction you just saw. What's in color here is the region of the site that -- for which LIDAR data are available and were used in the modeling.

In the grayish areas, that's where the DEM data were utilized and it includes Units 1 and 2 as well as some outlier areas within the model domain. Units 1 and 2 are shown here, their position on the ridge top as well as Units 3 and 4. One thing I would note is that during the construction of Units 1 and 2, the lands that are now proposed for Units 3 and 4 were

basically prepared for construction at that time. It was an original -- originally, the plan was to build four units, so that landscape was basically largely flattened.

And you can see that in the image here in terms of contours that are pretty widely spaced indicating a pretty flat hilltop and that's, indeed, the case at the site. Next slide, please.

Slide 9 is a view of the site topography with the boundaries described. This is the model's top elevation contours as they appear in the model that we independently tested. So this shows you the resolution within the LIDAR regions, if you can recall those, surrounding Units 1 and 2 and it shows you the lighter gray areas that are DEM data sets. This also shows you and the proper color is cayenne. You might think of it as kind of a brightish blue. That's the streams and the ponds or lakes on site. We show Mallard Pond, the upper and lower Debris Basin 2, the Met Pond and Debris Basin 1. These are all ponds on site. The -- as was described earlier, the yellow you see here on this plot are the outcrops of the Blue Bluff Marl. They represent the extent of the model along that boundary, basically from the center top of this figure all the way around to the upper and lower

Debris Basin 2.

The other model boundaries as was described by Dr. Findikakis are no-flow boundaries where your watershed is ending. The Savannah River is along the northeast of this model, below the outcrop of the Blue Bluff Marl and the river itself doesn't play in terms of a boundary condition like a hydraulic head boundary condition in this model. We allow the flow of groundwater to move out of the outcrop of the Blue Bluff Marl.

Next slide, please. This is a depiction of the hydraulic conductivity of the case that we selected for independent evaluation. The figure is drawn from Run Number 721. That simply indicates that this was part of the 700 series models. The PC here stands for post-construction so one other way of thinking or seeing that in the figure is that if you note there's a blue area that is Units 1 and 2's excavation and fill and it's assigned to 3.3 feet per day conductivity. There's some olive green areas for Units 3 and 4 and they are also assigned a 3.3 feet per day conductivity. So this is a post-construction depiction of those sites for 3 and 4.

The 65 feet per day value in this model is in a region where we know the Utley limestone to be

more dominant, thicker and with greater conductivity. The five and 25-feet per day values are in areas where we know the Utley to be not as present and not as connected. I show on the left here the measured values again, just to give you a perspective of the kind of measurements we have in that Barnwell sands, silts and clays, the Utley limestone and the engineered backfill.

Next slide, please. In this -- I'm just going to overview this pretty quickly, number 11. You've seen a lot of this already. Basically, we checked the recharge rates and it's an important site characteristic in terms of the modeling, as you can now appreciate and we looked in the USGS data and found -- documents, and found a regional model published in `97, there were also publications in `98 and in 2002, I believe, that provide an estimate of the recharge in the region and the long-term average recharge in the region is 14.5 inches per year and that associated with the local aquifer is 6.8 inches per year.

The recharge rates that we looked at in terms of the zonations and their magnitudes in the model as it was -- as it matured through the seven series that the Applicant tested, shows that, you

know, we've got open areas with minimal vegetation and mild slopes and in the testing it ranged from six to 12 inches per year. We looked at forested areas, 6 to 8 inches per year. So there's these different descriptors of the surface and their treatment and their slope and these ranges of recharge were examined in the sequence of models.

JUDGE JACKSON: You inferred this recharge rate, it looks like from basically measuring the flow in the river, is that --

DR. KINCAID: Yes.

JUDGE JACKSON: Is that correct?

DR. KINCAID: Yes. It's a -- go ahead.

JUDGE JACKSON: No, I just wondered how accurate those measurements are in order to be able to take a difference like that, that may not be very large.

DR. KINCAID: Well, it is an average number. It derives from work that was done examining the flow in the river, again, at Augusta and the flow in the river below the plant at Millhaven. And it was an average year. They came up and they corrected for the tributary flows, and they came up with the contribution to flow the river from the aquifer system. They did divide that and this was divided by

the region, the modeling region to come up with 14.5. So you know, it does find its foundations in an examination of the river flows in an average year. It does take into account the regional model size, scope, scale. And that's where the fourteen and a half comes from.

JUDGE JACKSON: You're convinced that's a pretty accurate number then?

DR. KINCAID: I believe it's representative. You can see also that recharge rates that we've tested look at a variety of values, a range of values and anywhere from zero, where you've got buildings and paved areas, all the way up to 40 where we have a pond that we modeled -- that was modeled with a infiltration rate. Of course, the vast majority of these are looking at forested areas, grasslands, open gravels and whatnot and those are infiltrating less than precipitation, so there's a range of values here.

Slide 12, please. This depiction shows again on the left the USGS data, points of fourteen and a half, 6.8 inches per year. It does note here also that local conditions will cause a variation on the recharge. Ponds can be greater than precip. Forest to grassland, soils and sloped areas, less than

precip and you might find zero where you have structures, asphalt, roadways, provided those waters are routed away and not allowed to infiltrate.

So on the map, on the right this is drawn from Run Number 721's base case, and it shows the pre-construction configuration used by the Applicant. You can see here the variety -- and Dr. Findikakis showed this earlier in the zoom-in, if you might recall, the gray area and the building areas of Units 1 and 2. On this portrait, the white area are eight inches per year and those are forested areas with mild slopes. The green are forested areas with steep slopes and the blue areas are grasslands.

Often times you can see here an outline of where transmission power lines are on the land surface. So you can see a variety here. You can see also the structures of Unit 1 and 2. The reddish brown areas are denoted with the zero.

JUDGE JACKSON: So the detail in this, the slopes and forest versus grassland and so on, that was put together by the Applicant, the map and --

DR. KINCAID: Yes.

JUDGE JACKSON: -- did the staff check any of that by going out in the field there and seeing if the forest and the slopes were roughly correct?

DR. KINCAID: Well, we have visited the site and we appreciate where there are slopes and where there are not and where there are grasslands and where there are forest. So to that extent, we're familiar enough with the site and know that this represents where there's a bluff along the river, to the Savannah River and where there is a steep ravine in the vicinity of Mallard Pond and so on. So, yeah, we know that.

We had not gone to the site and made measurements of infiltration rate. Next slide. This is the pre-construction hydraulic head portrait here. We're comparing the model versus the measured values. On the left are the pre-construction model results. This is our Run 721 with our corrected drains. On the right are the observed March 2006 hydraulic heads which were used for the calibration by the Applicant. And you can see I've highlighted three wells in the portrait here for the March `06 and Well OW-1013 is the well onsite with the highest measurements routinely. It's on the order of 165, 165.31 for this time period.

The Well OW-1009 is just north of the cooling towers and has a 163. Well OW-1003 is the well that is placed within the footprint of Reactor 3,

proposed Reactor 3, and its value is 156.43. So those are points of comparison. The model on the left we've been looking at what is the maximum value of the hydraulic head within the cooling tower area. We found 166.8. The Applicant found 166.9, so very similar results.

Within the power block, the maximum value is 162.8. The Applicant 162.9. So again, very similar values. I would note that in the plot on the left showing the model results, you can see some red dots and you can see some blue dots. The significance of those are that a red dot indicates that the model is predicting high and the blue dots, they're significance is that they are predicting low. The two red dots that you can see in the vicinity of Units 1 and 2 are respectively little in excess of three feet and two feet off. We don't view that as being tremendously off, by the way. That's actually a pretty good match given that other points are smaller in their residuals. These are the same residuals, just colorized here and shown with dots that you saw in Dr. Findikakis' plot of the residuals.

Next slide, please. In the post-construction testing that we did, we looked at a matrix of recharge rates. We did this because in the

future, of course, the landscape will change a bit. There will be buildings built. There will be roads, there will be parking lots. There will be graveled areas. There will be cooling towers with basins beneath them. So things are going to change. And so our fundamental test here is one of testing how recharge might change in the future and influence both the position of the hydraulic high in the system which will tell us what direction groundwater will go and also what is the level of groundwater beneath the site which we'll touch upon in Presentation Number 3.

For the purposes of this presentation, I'll focus on the high, high case. And in this case, we selected half of annual precip and we applied it to both the power block and the cooling tower. I should mention that you see some blacked out areas here on this matrix and the reason that they're blacked out is that it is only plausible that the cooling tower area would have higher recharge rates than the power block. The power block is dominated by a greater number of buildings, structures, roads and so on. It's sloped to take that water away in rainfall events, so it's much more likely and plausible that the power block will have lower recharge rates than the cooling tower and that leads to the blacked out region in here on

this matrix.

JUDGE JACKSON: I can see why you would choose the power block. Did you just choose the cooling tower location, was it because of the large structure and interest in groundwater at the location basically?

DR. KINCAID: In terms of these areas, and maybe if we have the next slide, we can see what we did. In this slide, you can see that we've blocked out the entire power block area and the entire cooling tower area and we're applying, when we take that matrix of values, we're applying those to these areas in their entirety. We're doing so without taking into account structures that have zero inside there. That case was exempt by the Applicant. So we got a little more conservative, if you will, in our application by not considering the buildings.

JUDGE BOLLWERK: And for record purposes, this is Slide 15.

DR. KINCAID: Yes, Slide 15. The reason we were interested in assigning recharge rates to these areas are these are the areas that are going to be modified by the construction, impacted by the construction. And we were interested in applying recharge to the current tower area both because the

water table high exists in their vicinity now and because it is not uncommon that surrounding cooling towers you will have a lot of gravel, and you'll have a vegetation-free gravel surface. So we wanted to look at what combination of recharge rates might shift this groundwater high and in our next presentation, what might give rise to a higher water table.

But these are the areas that are going to be most impacted by construction, so these are the areas that we wanted to focus on.

JUDGE JACKSON: Okay, thanks, that was helpful.

DR. KINCAID: That really sums up this slide as well. I would mention that we basically just super-imposed in these two areas, the blue and the green area for the power block and the cooling towers, we just put on there the recharge rates that we've talked about in the previous slide. Everything else we left the same, so it's the pre-construction, but now with this change, it becomes the post-construction case.

Slide 16, please. On Slide 16 you see results of the high, high recharge case and there's a couple things to go over here. On the left of the slide, I've made some remarks about the effluent

release points and where the release occurs. The effluent release points that we look at in the -- at the ESP stage in this analysis, we looked at the perimeter of the power block area.

So if you now look at the graphic from the 721 post-construction case, the -- on rose colored travel paths, meeting the Units 3 and 4 region, they all begin at the perimeter of the power block area and move outward from there. So that's one thing to be clear, you know. The Applicant has shown a circular area focused on the reactor -- proposed reactor locations themselves. We've taken a little bit farther outlook at the problem by looking at the perimeter. The second set of thoughts here, in terms of the release, Dr. Findikakis described how there's a tank rupture. There are floor drains that communicate that liquid to other rooms within the building. Sump pumps are assumed to fail.

It gets through a three-foot exterior wall. It gets through a six-foot basemat. It goes through 20 feet of vadose zone, all of this instantaneously and finds itself in the pore structure of the aquifer. It's clearly a conservatism. Much of it prescribed in terms of the immediacy of it in Branch Typical Position Paper 11-6.

The plausible pathways that we find out of this analysis is, you know, one is that the Mallard Pond pathway is more likely. We also identify out of this and we'll have to explain the logic of it, that the Daniels Branch is still plausible but less likely. Before I get to that, I would like to make a note that you do see some pathways go directly from the Units 3 and 4 power block and move towards the Savannah River directly.

I want to comment that these are an artifact of having placed higher infiltration rates on 3 and 4 than are at 1 and 2. It would only be logical to place very similar recharge rates on 1 and 2 and 3 and 4 and model that, and we do in the plausible, plausible case and the Applicant has in their post-construction case. And those results show us that nothing goes towards the Savannah River in those instances. So this is an artifact of the simulation here. And they are not a plausible pathway.

JUDGE JACKSON: The Savannah River part.

DR. KINCAID: The Savannah River part.

JUDGE JACKSON: What about the Daniels --

DR. KINCAID: Not the Daniels Branch. The Daniels Branch part, there are several starting points for path lines you know, at the southwest corner of

the power block that move off to the west. They continue, as you can see, past the stream bed. That means the groundwater is actually below the stream bed at this point and these flows were moving underneath the stream bed and then they curl around again to Mallard Pond. The -- having achieved in this simulation pathways the move toward the Daniels Branch and, indeed, go under it at this location, we felt compelled to continue the analysis. Had they not gone that way, we would be looking only at Mallard and only at the tertiary aquifer pathway that the Applicants describe. But because we did get a pathway to move in this direction, albeit below the stream, we felt it compelled us to look farther at the Daniels Branch, primarily because of the uncertainty in the hydraulic conductivities which we've very much simplified by using single values and zones and the uncertainty on recharge in the future.

So it's largely based on the uncertainty that we -- and having demonstrated this pathway as possible in this extreme case, that we now include it in our suite of pathways.

JUDGE JACKSON: So it occurred or appeared in this calculation because of the higher recharge rates primarily and --

DR. KINCAID: Yes.

JUDGE JACKSON: -- also the zone was made larger.

DR. KINCAID: Yes, at the ESP stage we wanted to look at the entire power block area rather than where the Applicant has proposed to place the reactors in the COLA. So we looked at this larger area to represent the entire perimeter of the power block. That, combined with the high recharge rate, which creates the groundwater's high where it is and how it falls off over space. Those combined, yes.

JUDGE JACKSON: Okay.

DR. KINCAID: Next slide, please. On Slide 17, we wanted to go over the site characteristic information on KD's, the distribution coefficients. Basically, measured KD's for both backfill and aquifer sediments were made for cobalt, strontium and cesium. The -- both the Applicant and the staff applied minimum values of KD in the analysis for both backfill and aquifer sediments. The measurements made in the laboratory by the Applicant and by their contractors, they are sediments from the site and they are groundwater from the site. However, they did not consider the influence of chelating agents in the radioactive liquid released.

We did find, as the Applicant did, that it's necessary to use sorption process with KDs to demonstrate the standard 10 CFR Part 20 is met. And as a result of that, we have placed a COL Action Item 2.4-1 in this section so that Southern can confirm that no chelating agents will be in these wastes or at representative levels, the KD's that would be incumbent with those show that release to still be safe.

The relevance of that, the reason for it, would be first to admit that we're not aware of any data suggesting their presence. We did ask about chelating agents and it was acknowledged that they have been used at Units 1 and 2. They are not routinely used now. There are protocols in place at Units 1 and 2 that would be used in the future at 3 and 4 and that would lead to their potential use in the future.

We also know the chelating agents can influence migration adsorption and result in faster migration. So that's why we have a concern.

JUDGE JACKSON: I wonder if Southern -- representatives of Southern have any comment on the chelating agents and making that an item for the combined license? Comments on that?

DR. FINDIKAKIS: I believe that this is a question for the operation of the plant. So it's beyond my area of expertise so maybe someone from Southern may be in a position to address this issue.

JUDGE JACKSON: Okay, fine.

DR. KINCAID: On the right, I show a matrix and it just reveals for you the backfill and aquifer values. It shows you the range for cobalt, strontium, cesium and, indeed, both the Applicant and ourselves used minimum values. Slide 17 -- 18 rather, next slide, 18.

Another site characteristic in our analysis is the catchment area and the catchment discharge. To estimate the catchment area, we used a standard 10-meter resolution USGS DEM, a Digital Elevation Model. The reason we did that is that, you know, you've seen that we have LIDAR data available but it's not for the entire site, not for these entire catchments and to do an analysis, we needed a single sub-data, so we used the DEM data set even though it's a little less resolved.

We evaluated the flow direction from this DEM and accumulated surface area as it was indicated by the run-off direction. Catchment area is basically the land surface area contributing to surface water

run-off and therefore, contributing to stream discharge at the discharge point of interest, in this case, the compliance points of these two watersheds that we've looked at, the Mallard Pond catchment and the Daniels Branch upper tributary catchment. The catchment discharge, we examined the data available to us to come up with a low discharge year. We used USGS data from five unregulated but monitored streams in the region and then we averaged the five drainage catchments applying scaling to the catchment areas of our site to obtain flow rate for the low discharge year. Next slide, please.

At the Mallard Pond and Daniels Branch catchments, we analyzed them in the following way. We used a streamtube, plug-flow model approach neglecting dispersion in groundwater. Basically what was outlined by the Applicant, we applied the same. The Mallard Pond catchment, we applied those travel times from the groundwater model. We looked at a compliance point of the stream leaving Mallard Pond crossing the site boundary. I've got a graphic showing that next, where that is positioned.

We applied combinations of decay, retardation and dilution in the low flow for Mallard Catchment. That was 279 CFS. And we found that for

all radionuclides in the inventory, the sum of fractions is less than 1. It's .235. Tritium's fraction was greater than one percent of its standard. It basically dominated this number. We found that the standard 10 CFR Part 20 can be met for the Mallard Pond Catchment.

In the Daniels Branch, we applied a very similar logic. We looked at applying travel times assuming a linear movement from the Unit 4 to the Daniels Branch. Our compliance point was the stream leaving debris basin 2 as it crosses the site boundary and again, we looked at combinations of decay, retardation and dilution in the low annual flow and for Daniels Branch that was 267 cfs. For all radionuclides in the inventory, the sum of fractions was again less than one. It's .336 in this case. Both tritium and cesium 137 were greater than one percent of their standard and contribute to this in a major way. The result is that the standard CFR Part 20 can be met for the Daniels Branch Catchment as well.

Next slide, please. This shows the compliance points that we examined. On the Mallard Pond Catchment, you can see that the stream leaving Mallard Pond moves to the north and then to the east

towards the river but it does leave the property and enter public lands at the Hancock Landing. In very short order, it re-enters the site property and then discharges to the Savannah River.

We took the point of view, Staff took the point of view that where it leaves the site property is where we apply the standard. That's for Mallard on Daniels Branch. You can see that the stream leaving the it would be Basin 2 flows to the south and leaves the site before it has its confluence with the Daniels Branch proper. That is the point in space that we chose to apply the standard there.

I show the perimeter block only to give you a point of reference and indeed, that's where the pathlines started in our analysis. Next slide, please. Assurance of conservative results. Several items here. We have reviewed the data and reviewed the construction of this model and we believe it's a relevant pre-construction model of the unconfined aquifer. This model incorporated the topography in the aquifer base that we found in the data sets. It incorporated boundary conditions, specifically drains in an appropriate way. It incorporated distributions of conductivity and recharge. Exhibits correspondence with measured and modeled parameters and achieves

correspondence with measured hydraulic head.

We evaluated post-construction recharge rates and pathways. We established that Mallard Pond drainage has the most plausible of pathways. The staff also defined -- identified Daniels Branch as a plausible, unlikely pathway and we included in our analysis, as to the Applicant the unlikely pathway through the tertiary aquifer.

The Staff's analysis is conservative because we've evaluated alternative conceptual models and multiple pathways. We've neglected dispersion in the groundwater environment. We've applied lowest measure distribution coefficients and we've applied low discharge year catchment flows. In summary, the Staff confirmed the Applicant's conclusion that the standard for 10 CFR Part 20, Appendix B, Table 2 can be met.

JUDGE JACKSON: It looks like you've put quite a bit of effort into making sure this was conservative. I note you have RAIs and you went back and forth several times on this model to convince yourselves that what the Applicant had brought forth was adequate. Would that be fair?

DR. KINCAID: Yes. We went back and forth quite a lot. We wanted to be sure the modeling

exhibited mass balance, that it was converged, that it didn't show extraordinary bias in any way. And we went back and forth quite a lot to achieve that.

JUDGE JACKSON: You said you checked the parameters (inaudible) with the model extensively. You did sensitivity studies. You did a number of calculations yourselves.

DR. KINCAID: Yes.

JUDGE BOLLWERK: Anything? Anything that the Applicant would want to say relative to what you heard the Staff --

DR. FINDIKAKIS: I would like to add something that -- something a little further, something that Dr. Kincaid said. You had a question about the wide range of values that were on the slide for the Utley limestone for the hydraulic conductivity. And I would like to say that, you know, this is what Dr. Kincaid said about, of course, the heterogeneity and the great variability of hydraulic conductivity in natural materials. To some extent this range is also attributable to the different methods that were used.

So basically, these values represent the results from different tests, like, for example, slug test give more localized values and they tend to

capture local heterogeneities because they're representative of a relatively small volume of the material as opposed to pumping tests that tend to draw water from a larger area and they're representative of the hydraulic -- in other words, hydraulic conductivity over a larger area.

In one of the slides that I had, I had listed those separately and you see that within its type of test, the range is somewhat narrower. So the lumping together the data from different tests and to some extent, may explain why you have this range.

Another point that I would like to make is that you had a question about the definition of the different recharge areas and how the Staff determined and I would like to say that what we had, and I believe we provided this to the staff, is that we had high resolution aerial photography that made it possible to quite accurately delineate forest areas, grasslands and other types of land use and this was the recent aerial photographs that Southern specifically took for the support of the license application. And of course, the other feature that went in the position of these zones which was the steepness of the ground surface. This came directly again, from the recent aerial survey that Southern did

as the result of the LIDAR data that Dr. Kincaid mentioned. And this data gave very accurate topography.

So these two sets of data were used to define the zones of areas that are not affected by manmade structures.

JUDGE JACKSON: Thank you. That was helpful.

JUDGE TRIKOUROS: Just a follow-up. Does the Staff take a commercial software package at its face value? Is there any checking into the efficacy of something like that?

DR. KINCAID: When we purchase and use a software package for this type of work, it is installed and tested opposite, you know, standards for you know, installation. So that's routinely done. This is a -- MODFLOW is a USGS model. The visual MODFLOW has an interface developed by a private entity but the foundations of this model are quite solid.

JUDGE TRIKOUROS: So you're comfortable with that no further -- nothing further is needed. No other code check.

DR. KINCAID: I am. Professionally, I am, yes.

JUDGE BOLLWERK: All right. Anything

further from either the Staff or the Applicant at this point on this particular panel?

JUDGE TRIKOUROS: I just wanted to ask the Applicant the same question, that have you worked with any other competing commercial products similar to MODFLOW?

DR. FINDIKAKIS: Yes, in the past, yes.

JUDGE TRIKOUROS: And the -- they give comparable results? You indicated earlier that it was input and assumptions driven, but I we just -- you know, this whole issue of the adequacy of commercial products, it comes up from time to time. But here you're both using the exact same tool. The independence was in the evaluation of the inputs and assumptions, of course, but the tool itself was the same tool. You all seem comfortable with that.

DR. FINDIKAKIS: First of all, I'm -- and the reason being that first of all, in my experience, I don't see this problem another code producing different results. This is just a judgment, but in addition to that, I would like to say that MODFLOW develop -- in development of the USGS and is used very widely by both government agencies and private practitioners. And to my knowledge, I haven't seen any reports of MODFLOW not performing well.

And as I said earlier in my testimony, I think the uncertainty due to the formulation of the problem and the choice of parameters is far greater than any potential numerical inaccuracies. But as far as I know, there have been no reports of any issues with MODFLOW. It's widely and universally accepted as a valid code. In addition to that, I would like to add that in Bechtel, as part of our own QA process, we have subject MODFLOW to several tests and basically comparing its solution again, results from either other codes or from problems with known solutions and we have found it to produce valid solutions.

JUDGE TRIKOUROS: It's always been of interest to me that the staff in almost all of their evaluations, especially when it comes to the NSSS system uses extensive benchmarking requirements against computer codes, even LADTAP and GASPAR are developed by the Staff or the National Labs, it just isn't often that the Staff uses commercial codes for safety analyses and -- but I guess in this particular case, or in such cases you do and it just strikes me as an exception.

JUDGE BOLLWERK: All right, anything further from the Board at this point? All right, at this point, I think we've -- this concludes the safety

part of the review. It's about quarter till. We've been going for about an hour. Why don't we take a 10-minute break and we will reconvene and start with the environmental review of Presentation 2? All right, thank you.

(Whereupon, a short recess was taken.)

JUDGE BOLLWERK: We're back from a brief break and before we begin with the next panel, I understand there's one additional comment that the NRC Staff has.

DR. KINCAID: Yes, this is Charles Kincaid again. The -- at the end of the last session, we were talking about the groundwater model and it being a commercial product. I want to clarify that the commercial product part of that is the visual front-end component. The model itself is MODFLOW-2000 available from the US Geological Survey. So it's not a commercially available product, per se, that is it has been highly tested by the survey and distributed.

JUDGE BOLLWERK: Anything else?

JUDGE TRIKOUROS: Yeah, the radiological part of that, the decay calculations, that part of it, is that built into that MODFLOW or is that a separate tool?

DR. KINCAID: No, that is separate. The -

- we have used the groundwater model as developed by the Applicant and tested by ourselves, to really explore what the alternative pathways could be from Units 3 and 4 to man. And once we determined those pathways, and they were Mallard Pond Catchment, the Daniels Branch Catchment as well as the tertiary aquifer, once we determined that, then we took a very conservative stream tube, plug-flow analysis for groundwater and this -- took into account decay and dilution and adsorption to model that out with a very simple robust approach for each of those three pathways and that did not use the groundwater model itself.

JUDGE TRIKOUROS: Thank you.

JUDGE BOLLWERK: Anything further the Applicant wants to add, the witnesses want to add at this point? All right, thank you very much.

All right, then let's move onto the next portion -- part of the Staff's presentation on radiological impacts. This one will deal with the environmental review side and I think we're going to start with Mr. Ramsdell.

MR. RAMSDELL: Yes, Van Ramsdell, Pacific Northwest Laboratory, contractor for NRC. Move to Slide 3, please. I'd like to take a few minutes as e

get into this to reorient us toward the -- to the environmental review. The ESP Application review actually consists of two parts, a safety review and an environmental review. If you go down to the bottom of this slide, you will see a comparison and contrast of the approaches used in the two reviews. The safety review is pursuant to Atomic Energy Act. It's intended to protect health and safety. It has a very conservative emphasis. It's a continuing review. It will go on beyond this proceedings. It will go on through the COL and through the -- should a plant be built, through the life of the plant, safety review will continue.

And in general, the safety review is an inward look at impacts on the plant with the exception in this case of the accident analysis and the radiological review -- radiological assessment which is an impact of the plant on the environment. On the other hand, the environmental review which we have -- we are re-entering at this point, is -- has its basis in the National Environmental Policy Act. We take care of some other things like the Endangered Species Act, National Historic Preservation Act as we go along. The purpose of our review is to identify and disclose impacts of the construction and operation of

the facility.

Rather than having a conservative emphasis, we have a realistic emphasis. It reduced the burden on us somewhat compared to the safety side. The environmental review is a one-time review. At the point that we conclude this proceedings and you issue -- and the Commission issues its decision, the environmental review ceases.

The environmental review is an outward looking review. We are looking at what the plant does to the environment as opposed to the generally inward looking review of the safety analysis. Now, as we go on into the -- next slide, please, that would be Slide 4. As we go on into the radiological review, we're going to talk about four areas. We're going to talk about normal operations, briefly mention off-normal conditions, then go to design basis accidents and finally severe accidents.

I'm going to now give the microphone to Michael Smith, who will talk about the normal operations and touch on the off-normal conditions and then I'll come back when he's done and talk about design basis and severe accidents.

JUDGE BOLLWERK: All right, thank you. I'd just mention for record purposes, we continue to

be in Exhibit NRCR00060. All right, Mr. Smith.

MR. SMITH: Good afternoon. My name is Michael Smith, and as Mr. Ramsdell mentioned, I'll be discussing radiological impacts of normal operations. A little bit about myself. I've have degrees in nuclear engineering, environmental science. I'm on page 6 now. I'm certified by the American Board of Health Physics and I have 10 years experience doing environmental reviews and performance assessment related to nuclear facilities.

I'm moving to Slide 7 now.

JUDGE BOLLWERK: Right, they're numbered at the bottom as page -- it's numbered at the bottom as page 6.

MR. SMITH: You have the on-screen number here.

JUDGE BOLLWERK: Right, within the PDF document I think it's page 28, but we'll go by the page number on the bottom just for record purposes.

MR. SMITH: Moving onto Slide 7, a brief outline of my presentation. A look at a description of the radiological environment impacts during construction, impacts of normal operation, uranium fuel cycle impacts and cumulative impacts

Moving onto Slide 8, the -- looking at the

regulatory standards and guidance that led my review, primarily at a higher level, 10 CFR Part 51 and our implementation of the National Environmental Policy Act. I also was guided by 10 CFR Part 20, 10 CFR Part 50 and 40 CFR Part 190 in the review. The guidance followed for the review was the Environmental Standard Review Plan, NUREG 1555, specifically Sections 4.5, 5.4 and 5.7. And further guidance came from regulatory guides 1.109, 111, 112 and 113 which deal with doses and transport both gaseous and liquid effluents from nuclear power plants, light water cooled nuclear power plants.

Slide 9, please. The Staff's first look was to look at the current radiological environment to have as a baseline for what the impacts would be if operation of additional two units at the site. We looked at radiological monitoring that had started at the site in 1987 and then 1989 with initiation of operation of Units 1 and 2. We looked at pre-operational monitoring that had occurred from 1981 to 1987 prior to operation of Unit 1. We looked at results of annual environmental operating reports. Those included monitoring of various pathways, including airborne, direct radiation, milk, vegetation, river water, drinking water, fish and

sediments.

And we also looked at annual radioactive effluent release reports. These are reports submitted annually by the Applicant to the NRC to describe normal and abnormal releases from a plant. Moving onto Slide 10, the Staff looked at the radiological impacts during construction, primarily to construction workers on site, that are proposed to be treated as members of the public having doses less than 100 millirem.

We reviewed the Southern estimates for these doses from Units 1 and 2 currently operating on the construction workers that would be building Unit 3 and then we also looked at Southern's estimates for estimates of dose to construction workers on Unit 4, from the existing Units 1 and 2 and adding to that the contribution from the newly operational Unit 3.

The assessment considered direct radiation and doses from liquid and gaseous effluents on the construction workers. The dose estimate was 26.3 millirem per year which was less than the dose threshold for public workers in 10 CFR Part 20 at 100 millirem. And Staff concluded that the impacts would be small.

Moving onto Slide 11, the Staff also

looked at impacts of normal operations. Here we both -- the event --

JUDGE JACKSON: Excuse me, can I interrupt to ask you a question on that last thing before we leave it, the last slide? I realize that's well within standards. It's extremely small. It's even -- but it's a little larger than I would have guessed. What's the -- what's the main source of exposure for the construction workers?

MR. SMITH: Primarily gaseous and direct radiation. Liquid effluents have a minimal impact on the construction workers.

JUDGE JACKSON: So it's primarily routine emissions.

MR. SMITH: Yes, from normal operations, releases from existing units.

JUDGE JACKSON: Okay, thanks. Sorry.

MR. SMITH: No problem. I welcome the questions. Okay, we're on Slide 11. We -- further the evaluation, staff looked at the Applicant's estimate of dose for members of the public and biota and I'll get into a little bit more detail in the following slides what we looked at and also performed independent evaluations.

Slide 12, we can move quickly by, but it's

a depiction of potential pathways that we looked at. Slide 13, for looking at doses from liquid effluents, we used LADTAP II code and similar to the discussion of MODFLOW, LADTAP II is embedded inside of another code called NRCDOSE and the models inside NRCDOSE are the ones that -- they're essentially, LADTAP models. The NRCDOSE part of it, puts a graphical user interface and operating shell around this code, LADTAP, GASPAR and XODOQ.

The source term used was from the AP1000 DCD Rev 15. The Staff reviewed all of the parameter values that were used as input to the code. We received from SNC their LADTAP input and output files for review and we reran those codes to compare the results and as I mentioned, we checked all of the parameters to insure that they were reasonable values for the review.

In the following slide, I'll show the results but we found that the Staff's and Southern's results were similar and both met the regulatory standards, primarily the design objectives in 10 CFR Part 50 Appendix I.

JUDGE TRIKOUROS: When you say "similar", does that mean that you made some modifications to the input text or --

MR. SMITH: For this case, I had to -- for the liquid effluent dose estimates, I had to make very few modifications. Most of the parameter values I thought were reasonable and I agreed with. The only changes that I made were related to the source term values. The Southern inputs, they had rounded some of the values from the DCD and I just took the DCD values directly. It had very little minimal impact on the final results, essentially rounding error differences.

Slide 14, please. Here I compared the results between the Southern and staff calculations and you'll see for the individual results, exposed individual the results are the same. You'll notice for population dose, there's a 20 percent difference and this comes from a choice of the year of population estimates. Southern used the year 2000 and the staff selected the year 2013. This is based on our review guidance that tells us to use a value for the population from a year, five years beyond the licensing action. And at the time of this review, I assumed that that would be year 2008 when the hearing decision would be made.

And obviously, this is 2009 now, but I added five years to 2008 and made an estimate for 2013. And the differences in the populations were

about 20 percent.

JUDGE JACKSON: I guess this is the same question we'd asked before, if you've looked at Revisions 16 and 17 of the DCD and would see that the source terms would change much.

MR. SMITH: I've looked at the Rev 17. I didn't look at Rev 16.

JUDGE JACKSON: That's fine.

MR. SMITH: And I did find that the source terms were modified slightly but not significantly.

JUDGE JACKSON: Okay, thanks.

MR. SMITH: Moving on to Slide 15, here this slide, I'll talk a little bit about LADTAP II code and why we use it. The code is used to estimate radiation exposure through various liquid pathways including potable water, aquatic food sources, shoreline deposits, swimming, boating and irrigated foods. And this code was developed for the NRC specifically for calculating these types of doses, doses from routine releases of liquid reactor effluents and was developed specifically to implement the exposure models described in NRC's Regulatory Guide 1.109.

Additionally, Environmental Standard Review Plan, NUREG 1555, in Sections 4.5 and 5.4,

specifically recommends the use of LADTAP to do these types of codes and to implement Regulatory Guide 1.109. And when site specific parameters are not available, to use the default parameter values included with LADTAP. LADTAP also implements the surface water transport models described in Regulatory Guide 1.113.

Moving on to Slide 16, similar to LADTAP, for the gaseous effluents, we used a code called GASPAR II, and just as for LADTAP, it's embedded within the shell code called NRCDOSE. Again, we used Rev 15 of the AP1000 DCD. We reviewed the input parameter values used by Southern for their appropriateness. And also, obtained Southern's input and output files for our review. And, again, we found that the Staff and Southern results were comparable and both met regulatory standards.

JUDGE JACKSON: All right, in light of the last statement, you're basically saying you also ran the -- your own calculations. You reviewed their input if you will or input parameters but you then used them to run your own calculations.

MR. SMITH: That is correct.

JUDGE JACKSON: Right. That's implied. I just didn't see it explicitly stated there on that

chart.

MR. SMITH: Okay, yes, I did the -- ran my own input files to compare the results.

JUDGE JACKSON: Okay, thank you.

MR. SMITH: Moving to Slide 17, here I compare the various results and this Column 2, with the Southern ER results, these are the same results that were reported earlier in the Southern presentation. Next to it I show the Staff's calculational results and the percent difference. You'll notice there's some minor differences in the individual results and I found that those are entirely attributable to the different source term that I used. I didn't round off values in my source term from the DCD values. And again, the population dose, the same as I explained for the liquid effluent results, I used a different year for the population distribution of year 2013 rather than year 2000, which resulted in about 20 percent increase.

Moving on to Slide 18, very similar as the earlier slide for LADTAP, why did we use GASPAR? And GASPAR is specifically written to estimate radiation exposure from releases of noble gasses and radioiodine in particular emissions from nuclear power plants. As for the LADTAP, the Environmental Standard Review

Plan, Sections 4.5 and 5.4 specifically recommend the use of GASPAR for these types of calculations and was written to implement the air release dose models described in Regulatory Guide 1.09. Slide 19, please.

This is just a depiction of potential pathways that are included in the GASPAR assessment. Slide 20, please. The Staff also reviewed the assessment performed by Southern for exposure to biota other than humans. For this we looked at liquid pathway for terrestrial and aquatic biota and the gaseous pathway for terrestrial biota. Again, we reviewed the parameter values provided by Southern for their analysis and received their input and output files for review and rerunning and we found that the Staff and Southern results were comparable.

Slide 21, please. Here I provide a summary of comparison of results for a single new reactor, comparing the Southern results with the Appendix I design objectives from 10 CFR Part 50. And not to go through all of the results, but you'll find that most are about an order of magnitude or greater below the design objectives. Slide 22, please.

The conclusions for the Staff's review of the radiological impacts of normal operations for public doses, we found -- we found that the doses were

within regulatory design objectives and dose standards. For onsite workers, we found that doses were anticipated to be less than individual doses incurred at current operating reactors, would be in compliance with 10 CFR Part 20 and with ALARA, as low as reasonably achievable.

We found that the dose rate estimates to biota were less than the NCRP, National Council on Radiation Protection and Measurements, and IAEA, International Atomic Energy Agency recommendations and study results. And that the Staff conclusion for all of these areas is that the impacts would be small. Slide 23, please.

For evaluation of uranium fuel cycle impacts, these impacts are described generically, in 10 CFR 51.51(b) and Table S3 and have been evaluated for all light water reactors. To complete the evaluation, Staff scaled the results in Table S3 with the expected power level for the AP1000 and concluded that impacts would be small. Slide 24, please.

Here I describe Staff's review of cumulative radiological impacts. And here Staff considered contributions to local populations from a variety of sources including the existing and proposed units, releases from the Savannah River Site, both

historical and ongoing. By historical, I mean, past releases from the site that have entered the environment and are subsequently being released at a slower rate such as effluents in the past that have entered into sediments or local ponds that are being released from the site and by ongoing I mean, current releases from active facilities at the site.

Other nearby nuclear facilities, we looked as estimates in local population from Chem-Nuclear and from the decommissioning operations at Starmet and we also looked at the contribution from the proposed mixed oxide fuel fabrication facility and that included pit disassembly and conversion, fuel fabrication, and waste solidification facilities proposed for that operation.

JUDGE JACKSON: So you were satisfied with the sources of information from each of those impacts that you looked at such as Chem-Nuclear. I assume that that's all well-cataloged or readily available on annual releases.

MR. SMITH: On primary source of information for the nearby nuclear facilities in the mixed oxide fuel fabrication facility was an Environmental Impact Statement produced by the NRC, NUREG 1767. For the Savannah River Site releases, I

depended on Savannah River Site's annual effluent and operating reports, environmental reports, and of course, for the Vogtle existing and proposed units, the existing units I relied on the annual reports and effluent reports and for the proposed units, the environmental report submitted for this application.

JUDGE JACKSON: Okay, thanks.

JUDGE TRIKOUROS: So basically, you repeated the LADTAP and GASPAR calculations using the narrow combined source term of all of these facilities and you came -- and you compared that against Appendix I.

MR. SMITH: For the cumulative radiological impacts assessment, I did not re-run LADTAP and GASPAR. For the existing and proposed units, I relied on my LADTAP and GASPAR runs. For the Savannah River Site releases, I relied on their dose estimates from their environmental-- annual environmental reports. And for the nearby nuclear facilities and the proposed mixed oxide fuel fabrication facility, I relied on NUREG-1767 Environmental Impact Statement. Each of those provided an estimate of dose to maximally exposed individual from each of those sites. And what I've done is made the conservative assumption that there

would be one maximally exposed individual that would receive the maximum dose from each of those facilities. It's not possible but it's a conservative approach for determining what the MEI, Maximum Exposed Individual dose could be, but I did not rerun my own assessments for those other facilities.

JUDGE TRIKOUROS: So you just -- you added the dose. You added the separate doses then.

MR. SMITH: I did. I added them. I summed the maximum exposed individual dose assessments for each of those individual facilities.

JUDGE TRIKOUROS: And the standard that you are comparing it against was Appendix I, not twice Appendix I or three times Appendix I or four times Appendix I for four facilities, but just Appendix I, right?

MR. SMITH: That's correct.

JUDGE TRIKOUROS: Okay. And how close did you come? I noticed you didn't provide any actual numbers here. You provided them for the other cases. You were about a factor of three off at one point. I'm curious how it --

MR. SMITH: The total dose to that MEI is just below three millirem per year.

JUDGE TRIKOUROS: Was what? I'm sorry.

MR. SMITH: Just below three millirem per year, and the total population dose from all of those facilities in the 50 mile region is just above 30 person-rem per year.

JUDGE TRIKOUROS: So you had margin.

MR. SMITH: I'm sorry, I didn't hear you.

JUDGE TRIKOUROS: So there was a margin.

MR. SMITH: Yes.

JUDGE BOLLWERK: All right, anything further from the Board at this point? Let me then go to the Applicant's witnesses and see if they have any comments anything they've heard in the presentation. No, all right. Very good, thank you.

Then we will go back to Mr. Ramsdell. He's going to tell us about radiological impacts accidents and for the record, Exhibit NRCR00060.

MR. RAMSDELL: Thank you. Just a brief background. I've been working -- I have a master's degree in meteorology from Oregon State University many years ago. I've been working in atmospheric transport and exposure at the Pacific Northwest National Laboratory since 1967. I was involved in the licensing of Summer and Maine Yankee, the first time around. I've been doing accident consequence modeling since about 1980 and more recently, I was a project

manager for the update of the Environmental Standard Review Plan in 1995, `96, `97.

I have been, in the -- done the design basis and severe accident assessments for the three previous ESP, EIS's. The design basis accident review guidance is limited to Environmental Standard Review Plan 7.1 Chapter 15 of the Standard Review Plan, this is Slide 29 now, and Regulatory Guide 1.183.

The process that we go through in this review is to evaluate the Applicant's identification of their exclusionary boundary and low population zone boundary. We look at the calculation of atmospheric dispersion factors, their accident selection, and then ultimately the dose estimates. The Southern analysis in the ER adjusted the analysis done for design certification to account for site specific parameters. The AP 1000 is a certified design and therefore, Staff has put a significant weight upon the design certification review done for the AP 1000. So we did a consistency check of the Applicant's analysis and did some confirmatory calculations to check their estimates of dose first from the DCD estimates per dose and secondly, from the DCD source terms, isotopic source terms.

Our calculations confirmed that their

calculations were correct. The review basis is the d- - certified AP 1000 design and the analysis we conducted was with a median estimate of the atmospheric dispersion factor which is different than the safety which is an atmospheric dispersion factor that exceeded no more than five percent of the time. In fact, that's the only difference between the environmental review and the safety review.

With respect to current nuclear power plants the Commission found and it's codified in 10 CFR Part 51 Appendix B, that the environmental impacts of design basis accidents are of small significance for all plants. Further, Standard Review Plan 15.0.3 Table 1 provides criteria for the safety review. These two pieces of information provide a -- provide some sort of guidance or context for the environmental evaluation of the consequences of design basis accidents. In our review and in the Southern review, the dose estimates were generally for all design basis accidents except LOCA were within -- were less than 10 percent of the safety criteria set forth in Standard Review Plan 15.0.3.

The loss of coolant accident, dose estimates were about 15 percent of the safety criteria. On the basis of our review of the Southern

work, the design certification analysis and our independent checks of the calculations, plus the staff's -- or the Commission's assertion that current nuclear power plants, the impact of design basis accidents is small, the Staff concludes that the Vogtle site is suitable for operation of two reactors with parameters following within the parameters of the AP 1000 design or Rev 15 certified design.

JUDGE BOLLWERK: We've just concluded with Slide 32 and moving onto 33 now.

MR. RAMSDELL: I just finished 32, yes. I"m sorry. And moving on to severe accidents, review guidance is found in the Environmental Standard Review Plan 7.2. There was a revision to Standard Review Plan 7.2 in 2007. It was published for comment and I have -- generally, the discussion of severe accidents in the EIS was written to that standard or to that Review Plan. The Review Plan or the review for severe accidents consists of review of the probabilistic risk assessment done for the AP 1000 in design certification, an evaluation or examination of the release categories and core damage frequencies that were determined for the AP 1000, a review of the consequence assessment performed using the MACCS computer code and then a risk assessment which combine

the results of the design certification evaluation of core damage frequencies and release categories with the consequences.

A question may arise, why use MACCS2. It's a code that was published in 1997. To start with the Standard Review Plan suggests that the MACCS2 code is an appropriate code for use. The MACCS code was developed specifically for this purpose as part of a component of severe -- or severe accidents analyses that was prepared for NRC by Sandia National Laboratory. It's maintained by Sandia and updated on occasion, that since the completion of the EIS, there has been a new release of MACCS. It's now called WinMACCS. It has a Windows front end. It's much easier to use than the existing one.

We have compared the atmospheric transport from dispersion portions of MACCS2 against the atmospheric transport and dispersion part of the RASCAL code which is used in the emergency response center at NRC and also against an ADAPT/LODI code that's run by Livermore. The RASCAL code has spatially and time dependent varying meteorology and the -- ADAPT/LODI code is much more robust in terms of physics than either of the other two. And the results are within factors of two of the -- the three codes

are generally within a factor of two of one another.

So within that context, given the uncertainty in the source term, we think that we're close enough.

JUDGE TRIKOUROS: Was MACCS and MACCS2 and RASCAL on the -- were MACCS or RASCAL on the low side or the high side of the --

MR. RAMSDELL: Actually, we ran RASCAL in two versions. The version that has been used for the last five or six years and the coming version and those two versions of RASCAL bracketed the other two codes. Just for a point of reference, the time required to do 600 releases for MACCS was about five minutes. The RASCAL code took about 45 minutes and the ADAPT/LODI code took almost a week of CPU time to run.

JUDGE TRIKOUROS: Was MACCS conservative relative to that?

MR. RAMSDELL: No, MACCS is within that -- MACCS is right in the middle of the group.

JUDGE TRIKOUROS: Oh, MACCS. I thought you -- I'm sorry, I thought you said the RASCAL --

MR. RAMSDELL: The RASCAL is top and bottom. MACCS and ADAPT/LODI are in the middle.

JUDGE TRIKOUROS: Relative to ADAPT/LODI,

this is the first time I've heard of this code, how did MACCS do? Was it high or low?

MR. RAMSDELL: It was comparable.

JUDGE TRIKOUROS: Comparable.

MR. RAMSDELL: Right, five -- it depends on the direction and the particular run, but on the average, it was within a factor of two MACCS in all directions for all 600 runs, on an average.

JUDGE TRIKOUROS: Oh, it bracketed -- oh, it was within a factor of two on those statistical kind of variations.

MR. RAMSDELL: Yes, right.

JUDGE TRIKOUROS: Oh, I see.

MR. RAMSDELL: Anyway and one of the -- the only strong reason for using MACCS2 is it allows us to compare severe accident consequence assessments for the proposed plants with a large number of consequences estimates done at other plants using the same tool.

The Southern analysis, MACCS2 was actually repeated several times. They used input from the Westinghouse design certification analysis. They used -- and they used a good bit of local meteorology, land use, population and economic factors in the Southern calculation. The Staff review first we looked at the

parameter and source -- and input. We did receive the Southern input and output files. We looked at the input decks and as I said, requested several changes and had Southern rerun MACCS two or three times before we got to a run that we accepted. We reran the code using their input, did a comparison, came out with identical results, which at least confirms that the two codes were the same.

JUDGE BOLLWERK: Are we on Slide 37 now?

MR. RAMSDELL: No, I'm still on 35.

JUDGE BOLLWERK: 35, okay, I'm sorry.

MR. RAMSDELL: I think we can go now to 36.

JUDGE BOLLWERK: Right, sorry.

MR. RAMSDELL: Again, the review basis for severe accidents was the AP 1000, Revision 15, source terms and the Vogtle site specific meteorology population land use and economic data. The risk estimates for population dose were 2.8 times 10^{-4} person-sieverts per reactor year. Fatality estimates were -- I think that's 1.9 times 10^{-10} per reactor year. Economic cost was $48.00 per reactor year and the farm land requiring decontamination was 3.6 times 10^{-4} hectares per year, about four square yards per year.

JUDGE TRIKOUROS: So all of these very small numbers are driven by, I'm assuming, the very low probability that came out of the PRA.

MR. RAMSDELL: You're correct. The total core damage frequency is about -- is less than three times 10^{-7} per year for all accidents and about 90 percent of the accidents involve a containment that holds and performs as designed.

Getting down to trying to evaluate a large, moderate or small impact, first we note that the Commission found that the probability weighted consequences of atmospheric releases and so forth for all plants was small for existing plants. We go through our analysis and we find compared to the existing Vogtle plants, that the proposed plants are less than 10 percent of the consequen-- of the risk of the existing plants and finally we find -- we look at the -- and compare the average early fatality and population cancer fatality risks for postulated new reactors with the Commission's safety goals and find that the risks are far below the risks that are set in the safety goals.

JUDGE JACKSON: Excuse me. Can I ask you a question --

MR. RAMSDELL: Yes.

JUDGE JACKSON: -- on this chart? What accounts for the population dose being less than 10 percent of the risk for an existing plant?

MR. RAMSDELL: I believe the core damage frequency, I believe for the proposed units is about two orders of magnitude lower than the core damage frequency for the existing units.

JUDGE JACKSON: That would certainly --

MR. RAMSDELL: I can look that up if you would like, but core damage frequency is a --

JUDGE JACKSON: Considerably less.

MR. RAMSDELL: -- large part. Also, I believe the large release frequency is considerably lower for the proposed plants.

JUDGE JACKSON: Okay.

MR. RAMSDELL: The next slide, 38, the -- looks at the cumulative risks. The cumulative risk of normal operations for Units 1 through 4 is of the order of 2.1 time 10^{-2} person-sieverts per year. Severe accidents for risk for Units 1 and 2 is about twice the normal operation risk and the severe accident risk for Units 3 and 4 is something like, what is that, five percent of the risk of the normal operations with a total risk being almost entirely dominated by normal operations plus the severe

accident risks for Units 1 and 2.

Unit 3 and 4 contribute very little to the total risk of the plant. And if you then compare the risk for the plant against background radiation risk, in terms of population dose, it isn't even on the same number of significant figure. It's just -- it's still 2.4 times -- still the same as background.

Then as a result of our review, we conclude that the probability of weighted consequences are small, small significance for an AP 1000 design reactor at the Vogtle site.

JUDGE BOLLWERK: Do the Board members have questions?

JUDGE TRIKOUROS: No, not right now. We're going to be talking about severe accident mitigation and there may be some --

MR. RAMSDELL: That will be a subject of Topic 8 will be design mitigation alternatives.

JUDGE TRIKOUROS: Right.

JUDGE BOLLWERK: All right, then at this point, then, I think we could finish with this presentation topic on radiological impacts and we thank all the Staff who made presentations to us and appeared before the Board today. Thank you for the information to be of service to the Board. At this

point, let's go ahead and move on to Presentation 3, which is Groundwater Impacts on Safety-Related Structures. Some of you who are already up there can stay in your seats and there will be some other folks that will be leaving. Again, thank you all for your testimony before the Board.

Okay, do we have enough folks and enough microphones here? Everybody all right. Let's take about a one-minute break and maybe we can take that microphone there or just give Dr. Findikakis a stand, right, so he doesn't have to hold the mike.

MR. BLANTON: And your Honor, Dr. Findikakis is Southern Nuclear's witness for this and we will be back to his Exhibit SNCR00073 and we will have another exhibit to introduce.

JUDGE BOLLWERK: All right. All right, why don't we go ahead and start with -- I should mention, all these witnesses have previously been sworn, and obviously, gentlemen, you remain under oath for the purposes of this testimony as well. Let's go to counsel for Southern. I'll go ahead and have you introduce the witness and we'll do the exhibits.

MR. BLANTON: Your Honor, Dr. Findikakis will also be testifying for Southern on the effect of groundwater on safety-related structures and his same

--- that will just be Part 2 of his presentation that's already been marked and admitted as SNCR00073.

JUDGE BOLLWERK: All right, and I believe that's the only exhibit for the doctor.

MR. BLANTON: It is, yes, sir.

JUDGE BOLLWERK: All right, let's turn to the staff then and see if they have any exhibits they need to get admitted. I think just the presentation perhaps.

MR. MOULDING: Yes, your Honor, that is correct.

JUDGE BOLLWERK: Okay, I think it's 61 if I've got the right --

MR. MOULDING: Yes, it is Exhibit NRC000061, Staff Presentation 3, Groundwater Impacts on Safety-Related Structures.

JUDGE BOLLWERK: All right, let the record reflect that NRC -- Exhibit NRC000061 as described by counsel has been identified for the record.

(The document referred to was marked as Exhibit NRC000061-MA-BD01 for identification.)

MR. MOULDING: And we'd like to introduce it into evidence, your Honor.

JUDGE BOLLWERK: All right, the motion's been made. It will be admitted into evidence. Any

objection? Hearing none, then, Exhibit NRC000061 is admitted into evidence.

(The document referred to having been marked as Exhibit NRC000061-MA-BD01 for identification was received in evidence.)

JUDGE BOLLWERK: And at this time I believe both these panels are ready for their presentations and for questions from the Board. Doctor, we'll turn to you first.

DR. FINDIKAKIS: Thank you. Can we first go to Slide 31 in this presentation? And please give me the next slide. In this presentation, I'll address potential groundwater impacts as a result of the construction of Units 3 and 4. And I'll start again by discussing the relevant aspects of the post-construction hydrology and to relate those to site specific data and I'm going also to address the conservatism of the analysis and conclude by discussing how we comply with the federal regulations.

Next slide, please. For the subject of groundwater impacts, the key hydrological activities that are of importance are the site configuration, the site grading and drainage, the introduction of any new materials for the post-construction -- during the construction of the units like the backfill material

and these parameters and characteristics were, again, integrated into the groundwater model at that time, I had described earlier which was the primary tool that was used to predict future conditions.

So, the -- my presentation from here on will rely on the groundwater model that I've described in my presentation on safety topic, Number 2.

JUDGE BOLLWERK: Now on Slide 34, is that correct?

DR. FINDIKAKIS: Slide 34, please. So again, I would like to reiterate that the model was based on site specific parameters and measurements and it was calibrated using site specific data. If we go to side number 2, the model as I explained earlier, was developed using internal conservative parameters and for the key parameters that are of importance for the groundwater impacts, the hydraulic conductivity and rate of recharge. A sensitivity analysis was performed to address the impact of these parameters.

So the next slide, please. So in this slide, we see groundwater level contours for post-construction conditions. These are contours developed by the model and, again, this is the model that incorporates all the changes that will be introduced at the site as a result of the construction. And the

key feature that we need to observe here is that in the area of Units 3 and 4, the groundwater levels are somewhere between 150 and 160 feet above mean sea level. The site grade level is elevation 220 and the base of the lowest structure it's at elevation around 180, 180 plus.

So this means that the depth to groundwater below the base of the building is 20 feet plus. And of course, the water table is at the depth of between 60 and 70 feet and I think we can see this in the next slide if I have the next slide, please. This slide shows contours to -- contours of depth to groundwater, depth from the surface and the surface that was used here, since we're talking about post-construction conditions, is a surface asset, as it will be shaped after the construction of the units.

And again, this shows that we are -- that the water table is at a depth of 60 to 70 feet below the ground surface. As I said earlier, we did the sensitivity analysis to some of the key parameters and what we found that the level of groundwater was not very sensitive. I mean, the change is primarily -- the change is well within the order of about two to five feet at most, depending on the combinations of parameters that was used, that were used.

So if we move to the next slide, I would like to stress that the key conclusion from this evaluation was that the groundwater level will be at an elevation 155 to 160 feet below site grade level which is 60 feet below the site grade level. And therefore, if we'd go to the next slide, there is -- since the entire structure is above the water table, way above the water table, there is no issue of hydrostatic loading on the safety buildings.

And I believe that's all I have.

JUDGE BOLLWERK: All right, let me then see if there's any questions from either members of the Board. Judge Jackson?

JUDGE JACKSON: That seems like a pretty good margin given that you did sensitivity studies and assured yourself that these calculations were quite conservative.

DR. FINDIKAKIS: I would like to add that the predictions for the future groundwater level are fairly close to where the groundwater level is today at that site. So basically, site construction will not alter much the groundwater levels.

JUDGE JACKSON: Okay, thanks.

JUDGE BOLLWERK: Let me check and see if either of -- any of the staff members, the members of

the panel for the staff have any comments on what they've just heard. No, at this point? All right, then let's go ahead and move to the Staff's presentation. Did we -- did I give you an opportunity to introduce these witnesses? I don't remember if I did. I apologize if I didn't.

MR. MOULDING: No, I guess I should just reintroduce them now. From the Board's left again, Mr. Christian Araguas, Dr. Charles Kincaid and Dr. Hosung Ahn.

JUDGE BOLLWERK: All right, thank you, gentlemen. Let's go ahead and move then to -- this would be NRC000061, which is the Staff Presentation on Groundwater Impacts on Safety-Relates Structures. Dr. Kincaid?

DR. KINCAID: Okay, next slide, please. Again, I'll be presenting as the primary and then Dr. Hosung Ahn will be assisting me. Next slide. Okay. The purpose of this presentation is to review the potential groundwater impact on sub-surface portions of safety-related structures, systems, components, the SSCs. Our focus is on how the Staff assured that the evaluation in the SER is conservative. Remarks on the pre-construction site hydrology parameters versus measurements, post-construction site hydrology and our

analysis and assurance of conservatism.

Next slide, please. Slide 4 is on the pre-construction site hydrology, basically the history on this is we issued open item 2.4-2 which required an improved and complete description of the current and future local hydrological conditions, including alternate site models, demonstrate the design basis related to groundwater induced loadings on sub-surface portions of the safety related SSCs would not be exceeded.

In response to that, the Applicant provided the groundwater model that we've discussed previously and we reviewed that to determine alternate conceptual models of the site that would be acceptable for this analysis. From the files we selected a case that most closely represented the water table and we modified that slightly, as I've described before, in terms of drain elevations and conductivity to perform our independent confirmation work. And again, our analysis is based on sensitivity analyses of the post-construction recharge distributions and how they might impact in this case the height of the water table in the vicinity of the reactors.

Next slide, please. Slide 5 --

JUDGE BOLLWERK: Slide 5?

DR. KINCAID: Yes, we're on Slide 5. And actually, I'm not sure, maybe the Board could tell me how you feel about this; there are a number of slides here that I could go through very quickly that are basically duplicates of what we've presented earlier. I could to through them in detail again, or we could hit them very short and move ahead.

JUDGE TRIKOUROS: I think you can move faster through them. You don't need to repeat what you said before.

JUDGE BOLLWERK: I think the point would be relative to the question of the groundwater impacts from the structures. If there's anything in particular about any of those slides that you need to point out, that would be the main -- major point, major item, I think.

DR. KINCAID: The next few slides, I'll just -- on each slide I'll just kind of introduce its topic and then move right to the next one. The next four or five slides, there's nothing specific to this topic and then we'll hit the pre-construction model and we'll talk about that in more detail.

JUDGE BOLLWERK: All right, that will work.

DR. KINCAID: So this Slide Number 5 is an

outline of the things we reviewed and I described those in the earlier presentation Number 2. Slide Number 6. Slide Number 6 is showing the topography and boundaries. It displays the LIDAR, the Light Detection and Ranging data set versus the top of model that eventually was adopted. Next slide.

This is a detail of the LIDAR and again, it just emphasizes that we checked the best data sets we could find against the top of model. Next slide, please. And this slide is just showing the top of model elevations in the model that we adopted for use, the 721 model, and shows the various geography of the site and various outcrops and ponds and so on, as described in the Number 2 presentation. Next slide.

This is Slide Number 9. This is -- this one wasn't in the earlier presentation. It's the base of model, the top of the Blue Bluff model. This is a rendition of this that was developed by Southern and we checked. It incorporates Unit 1 and 2 site characterization data as well as Unit 3 and 4. And, of course, there's far more data available in the vicinity of Units 3 and 4 on this particular edition. Next slide.

Slide 10, just reviews the hydraulic conductivity that was in the Model 721 and again, this

is the post-construction version where we show the conductivities in the vicinity of the Units 1 and 2 and Units 3 and 4. Slide -- next slide, please.

Slide 11 shows the site recharge and there's a summary on the left of what we know. We know from USGS work on the regional model, the 14.5 and the slide -- portrait on the right is from the Run 721. It just shows the distribution of recharge in that model. I would draw your attention to the recharge rates that are applied on Unit 1 and 2. You're looking at zeros in the structures areas, the rust colored if you will. There's a light gray area that surrounds the primary structures within the Unit 1 and 2 complex. That light gray area is assigned four inches per year, so a quite low value relative to others here.

Then there's a 14-inch per year region that surrounds the cooling towers and the switch yard and so on. These areas where you might expect a greater amount of recharge because of graveled surfaces maintained free of vegetation. These are not atypical. I mean, these are typical values that you'd expect in a operating reactor area.

You see in Units 3 and 4, in this pre-construction rendition, you've got higher rates. The

off-green, OD green type color here is 16 inches per year, and then you've got some grassland type areas of blues. This is again this is an area where the -- during construction of Units 1 and 2 the area now proposed for 3 and 4 was leveled and is approximately at the 220 elevation and fairly flat. Has drainage to it, but it's fairly flat. Next slide, please.

What we're showing here is the pre-construction hydraulic heads. And this is the same information you've seen before. So the observation wells 1013 and 1009, 1003 are respectively the highest 1013 is south of the proposed cooling towers, 1009 is just north of it above the cooling towers, and observation well 1003 is in the footprint of the Reactor 3. The proposed -- the model on the left again, shows some high predictions in the Unit 1 and 2 area and some lower values lateral to that both to the north and to the south. This is our best model. We agree with Southern on that. It's the best model.

However, it does over-predict the hydraulic head in the vicinity of Units 1 and 2. This, we believe, is likely because of one of two things. The recharge rates being applied are higher than they ought to be. That's unlikely actually because the buildings are being assigned zero in that

area and the areas around the buildings are assigned four inches per year. The other explanation for why those red dots could be appearing there is the use of the 3.3 foot per year, the measured value, rather than a scaled up value for conductivity. So the model is producing higher values. It's likely because of the conductivity we're applying there is our belief.

It's still best match. I point out again that the model results achieved by the Applicant and by the Staff are virtually the same, a tenth of a foot apart in terms of the max values in the cooling tower area and the power block area and as you can see in Dr. Findikakis' earlier presentation, a good match in terms of the residuals that points within this immediate vicinity. Next slide, please.

Okay, our tests to determine the post-construction possibilities, if you will, we used again this matrix of recharge rates and I've highlighted here the plausible, plausible case. The plausible case in terms of cooling tower, we've assigned it a quarter of the annual average precipitation. This is 12 inches per year. This is based on literature that tells us that if you have gravel and that over time it is in-filled from wind-blown sediments, and you have a moderate level of fines, that you'll have between 60

and 50 percent precip infiltrating. So we adopted this 25 percent.

The range in the literature is that it can range from about 12 percent to 25 percent precip as infiltration and recharge in this case. So that's why they adopted that value. The plausible case for the power block, we've assumed 1/8 of the annual average precipitation and that's a result of looking again at the literature and seeing for gravels again, but for a larger amount of fines up to 25 percent fines, that you'll see a zero to 12 percent of precipitation become recharged, 12 percent, one-eighth. So you know, that's where the one-eighth is coming from.

It's a, perhaps, high end value. It's six inches per year. So the plausible, plausible case is looked at here to reach our conclusions about the height of water table in this vicinity of the reactors. I would note that it is obvious that the higher the recharge rate you apply, the higher the water table will get. We felt that the high, high case was a bit too high to be considering when we're looking at what the water table could be in a more reasonable but bias conservative way. So that's why we've adopted the plausible, plausible case here for this analysis. Next slide, please.

Again, this just shows the areas to which we apply the recharge rate. Again the blue quadrant is highlighting the power block area. The green is highlighting the cooling tower area and these recharge rates we've adopted are applied to the entire area without regard to structure, pavement, parking lots, and so on. So that's a bit of a conservatism in a way. Next slide, please.

JUDGE BOLLWERK: We're now on Slide 15; is that correct?

DR. KINCAID: We're on 15 now. Post-construction hydraulic heads, this is a portrait showing the plausible, plausible recharge case rate -- recharge case results. On the left, I'm showing results from the Applicant's analysis. We mined the Run 721 from the Applicant's file and found that within the cooling tower area, its maximum was 166.1; within the power block area, it's 162.6. In the Staff's simulation found the cooling tower region maximum 166.5 and the power block 162.4. So again, very comparable results, not a great deal of difference.

Now, if one considers that in the prior analysis in the pre-construction mode, which we based this, the elevations in the Unit 1 and 2 region were

higher than observed by three feet in one case, two feet in another and near matches in two others, you've got about a foot and a half conservatism in this at Units 1 and 2. And it's likely that you see that same result in this for Units 3 and 4 because we now have placed Unit 3 and 4 excavation backfill material, we've placed that material in this model at the same conductivity that we used in Units 1 and 2.

Next slide, please. Conservatism, again, we've based our look at the post-construction situation on a pre-construction model that we believe incorporates the topography for base, it incorporates the boundary conditions. It incorporates the distributions of conductivity and recharge and exhibits correspondence with measured and modeled parameters. It achieves correspondence with the measured hydraulic heads. The NRC Staff and Southern Nuclear Company pre-construction models yield conservative or high estimates of water table. Therefore, the post construction results likely also are high and conservative.

We've evaluated the post-construction water levels and the Applicant evaluated recharge rates at pre-construction rates applied to 1 and 2. They applied those same ones to Units 3 and 4 in their

post-construction analysis. We, on the other hand, looked at applying a rate through the entire power block area, the entire cooling tower area, and allowed that these 1/8 and 1/4 rate precipitation recharge rates independently and we have no zero recharge zones within those areas. The results of the analysis, both theirs and ours, show post-construction water table predicted to be below 165 feet mean sea level within this region. Next slide, please.

Thank you. The Staff's analysis, the highest measured pre-construction water table elevation inside the proposed power block is 157.24. This was measured in May of `06. It's at Observation Well 1003 within the proposed region for Reactor 3. The pre-construction groundwater model predicts conservatively high water table of 162.9 inside the power block. The simulated post-construction water table inside the power block by the Applicant 162.6. It used a template of recharge rates as applied at Units 1 and 2. The Staff's value, 162.4 applied recharge rates with consideration -- without consideration for structures and the cooling tower area was 12 inches per year. In the power block area it was six inches per year.

Both simulations suggest post-

construction, less than or equal to pre-construction levels. It's not really a surprise. We see some of that behavior in the existing Units 1 and 2. Therefore, the Applicant's site characteristic for highest groundwater level, 165 feet mean sea level is supported by current observations and post-construction simulations. Furthermore, the lowest elevation of the safety-related SSC for the plant fitting within the bounding parameters in the proposed permit application has a bottom elevation of 180.5 feet mean sea level.

A maximum groundwater level of 165 feet mean sea level inside the power block would present no undue threat to any related SSCs located there.

JUDGE BOLLWERK: All right, that concludes Slide 17.

Now, we'll turn to the Board members.

JUDGE JACKSON: Just the same question and that is that you're convinced that you have looked at enough cases and built enough conservatism into this that it's highly unlikely that the groundwater will make it to the foundation of the major structures.

DR. KINCAID: There's two aspects to that answer. In the work that we've done, we've looked at the entire power block area at the ESP stages. And

we've predicted a value of 162.4. We believe that to be conservative based on the Units 1 and 2 hydraulic heads, perhaps as much as three feet, in all likelihood, certainly, a foot and a half, foot and a quarter.

If we were to subtract that off and look at this number, you're looking at 161, and if you look at the range of observations in the water table aquifer for the last 17 years as shown in the ER, and the FSAR, it's tabulated in the ER in the table, but it's in the detailed tables of the FSAR as well, you're looking at a range of 6.6 feet, 7.6 feet max, if you include some data that I'm not sure is right. But you're less than four feet in terms of the range. So if we're at 61, you add four, you're at 65. This would be on the very edge, the south edge of the power block area.

Certainly, the facilities we're talking about are going to be interior to this. So I feel confident that 165 is going to work fine. The -- at the proposed location, second part of my answer, at the proposed location, the Applicant has measured, as I've shown here, 157.24. The range again, is still plus or minus four feet. At the time of May, 2006, we're about in the middle, mid-range of the hydraulic

heads that have been observed at this site. In the power block 1 and 2 that's true and I assume it would be the same here.

So, you know, you'd add four to 157 and you're what 161, 162. So you're well below it. So I think in both of those cases, we're below the 165.

JUDGE JACKSON: Thanks.

JUDGE BOLLWERK: Judge Trikouros, anything, anything from Judge Jackson? Let me turn then to the Applicant's witness. Do you have anything you'd like to add based on what you heard the staff testify to?

DR. FINDIKAKIS: Maybe in this last point, or question, I would like to add that I believe that the maximum water level fluctuation in any of the wells and some of the wells that were installed at the time of the construction of Units 1 and 2, is less than five feet. So this is over a period of 20, 25 years.

DR. KINCAID: Right. I do not recall the table number but there is a table in the ER that summarizes max, mins and for the LT wells, there were three listed, there were three others, and I believe the maximum shown was 7.6 feet in that table. That covered a 17-year period. I mentioned that if you

accepted a data point that I quarrel with, there was a low measurement, I believe it was in June of `85 and it's -- you know, in water tables you measure one number and then you come back the next month, you measure a number that's considerably lower, and then the next month you come back and it's higher. And you tend to throw away that low because it looks like an anomaly. I have not looked at it in good enough detail to throw it out. If you threw it out, it's like 6.6. If you leave it in, it's a 7.6 number.

DR. FINDIKAKIS: I don't recall this table I was referring to. There is a graph in the SSAR that shows the plots basically ground water levels at these wells at the LT wells, I believe as a function of time and that's the base of my statement it's less than five feet but there may be one point I saw from basically a visual observation.

JUDGE BOLLWERK: Okay, thanks. Anything further from the Board members at this point. The witnesses, I think have given us the information we were hoping to get. I thank you all for your information you provided and for your service to the Board. Thank you very much. All right, let's take about a one-minute recess here. Let me talk with the Board members about scheduling.

(Whereupon, a short recess was taken.)

JUDGE BOLLWERK: Okay, all right, if we can come back to order briefly. Let's go back on the record. I want to again thank all of the witnesses that we heard from today on the first three presentation topics. I think the Board found all of you provided very useful information to the Board and we do again, appreciate their efforts and the information they have given us.

I think the general impression of the Board also is using this presentation process has worked well, as opposed to pre-filed testimony, I think. So that may be something in terms of a lesson learned going forward that may be useful in terms of other mandatory hearings.

In terms of today's scheduling, I think given what we were facing, we couldn't start Presentation 4, that's much too long. We were looking at a couple of the ones that we'd mentioned toward the end, 8, 9, 10 and 11. I think we'd prefer to wait on those. I think those might take a little longer and we wanted to get done a little bit early today because we do have the limited appearances tonight beginning at 7:00 here in this room.

Having said that, I would anticipate

tonight, given the number of pre-registrations we got, we will go till at least 8:30, maybe as late as 9:00. It often depends on the number of folks that show up and want to make presentations. We do have a full day tomorrow, and I guess my question for the parties is, would you prefer to start at 9:00 o'clock tomorrow given we're going to probably be here till at least 8:30 and maybe a little later tonight or do you want to start at 8:30 and press ahead? We will have to finish -- I think to keep on schedule, we will have to finish 4, 5 and 6 tomorrow at a minimum, until -- however long it takes us to get done. So we can start at 9:00. I think the Board is willing to do that but let me see what the parties' preference would be in terms of 8:30.

MR. BLANTON: I think we're fine to start early, your Honor, but I note that you are going to be here till 9:00 o'clock tonight, too, so I would say, it's what the Board wants to do will control that.

JUDGE BOLLWERK: Yes. Does the staff have any preference one way or another?

MR. MOULDING: I think our preference would probably be to start at 8:30 if that's acceptable to the Board.

JUDGE BOLLWERK: All right, if you all are

willing to put your nose to the wheel that way we can certainly do that. So we'll go ahead and at this point, we'll say 8:30. If by some chance we do go later tonight, past 9:00 o'clock, we may want to revisit that. I take it you all have somebody here that could contact your folks and let them know if we decided to move it back a half an hour. I don't anticipate that but again, the limited appearance sessions are for members of the public and if they show up, we will try to go as long as is reasonable to make sure we accommodate everyone that has something to say. So hopefully we will be done by right around 9:00 o'clock. All right, having said that, we will then plan on beginning at 8:30 in the morning. We will move ahead with Presentation Number 4 which is Environmental Impacts of Alternatives.

Tomorrow we would anticipate dealing with at least 4, which I just mentioned, 5 which is the Limited Work Authorization and Site Redress Plan and 6 which is Site Emergency Plan. At that point, depending on the time, we might look again at one of those -- the topics for -- that we have at the end, 8, 9 and -- 8, 9, 10 and 11. I think given seismic is going to be a major one, I suspect that will be Wednesday morning at this point, given the way this is

beginning to look.

One other thing I would ask the staff or the Applicant if they feel comfortable, we've been talking among ourselves, and we did not ask for a presentation on ITAACs. Is there someone that could give us a brief explanation in terms of what you all did with ITAACs that's here as part of one of those other four presentations? And if you feel you want to talk about that tonight, you can tell us in the morning. You don't have to make a commitment tonight.

MR. MOULDING: Your Honor, we'll discuss that and I guess we can report back to you tomorrow if that's acceptable.

JUDGE BOLLWERK: Tomorrow or if you know by limited appearance time, then you can certainly let us know informally and we'll bear that in mind. Again, obviously, we're not expecting a slide presentation. We did not ask you for this, but if you can tell us a little bit about what you did within the ITAAC area, and maybe if the Applicant has a witness, we'll put them on as well if they want to respond to anything the Staff has to say. This, again, we understand we're sort of putting you on the spot, but if you have somebody that knows something about it, and is willing to tell us a little bit about where you

were coming from and the major ITAACs that you put into the -- your planning or proposing to put into the permit, that would be useful to us.

MR. MOULDING: I can mention, I think some of the ITAAC will already be coming up in the presentations on seismic issues and on emergency planning but we can confer with those presenters and see if, perhaps, they can provide a little bit more background on ITAAC as part of those presentations.

JUDGE BOLLWERK: And then again, anything else you feel is a major or an important ITAAC that you're looking at, maybe as part of, for instance, the presentation on permit conditions or that would -- or deferrals to COL either one, maybe we can fit it in there as well. All right, again, we appreciate anything you can give us. I recognize this is sort of last minute, very last minute.

JUDGE TRIKOUROS: Yeah, now if the ITAACs associated with emergency plan and seismic are -- you would consider the most important ones and they're going to be covered, then that's fine.

MR. MOULDING: I believe they are the only ITAAC that have been identified for the application.

JUDGE TRIKOUROS: All right, you can talk that over and just verify that tomorrow morning or

something.

JUDGE BOLLWERK: Thank you very much.

MR. BLANTON: Let me mention one thing, your Honor. We -- it's relevant to the -- this is one of the few times I've ever been accused of not being able to be heard, but we found a misdescription of an exhibit in our exhibit list that we intend to correct and in the LWA. It's an exhibit in the LWA presentation and this description caused us to cite it in the EP presentation. So if the Court or the Board please, we intend to correct that exhibit list reference before tomorrow and file a revised version of the EP presentation that just eliminates that citation from the -- just to avoid confusion as you all take this back.

JUDGE BOLLWERK: All right, can you tell me which one you're referring to?

MR. BLANTON: Yes, sir, I think it's 79.

JUDGE BOLLWERK: All right.

MR. BLANTON: It just cites the wrong RAI.

JUDGE BOLLWERK: All right, so we would need to, perhaps, withdraw the one we have and put another one in? Is that --

MR. BLANTON: Well, no, sir, we're going to -- the actual document that was submitted as

Exhibit 79 is an LWA exhibit and it's cited in the LWA presentation. So what we would propose to do is just re-describe it in the exhibit list to make it match the document that was actually filed and then just eliminate the citation from the EP presentation because it shouldn't have never been in there in the first place.

JUDGE BOLLWERK: So you're going to revise your emergency planning -- your site emergency plan presentation then?

MR. BLANTON: Just to remove that citation.

JUDGE BOLLWERK: All right, so there's going to be -- all right.

MR. BLANTON: It's a little confusing but I was concerned it would be even more confusing if we didn't fix it.

JUDGE BOLLWERK: Right, no, 83 is going to be a revised version, then, if I've got the right. Okay, very good. I think we can handle that. We need to let Mr. Welkie back in Washington know that he may be getting a revised exhibit. All right. He's still there, good for him, I guess, or maybe not.

All right, in any event, I think at this point, this concludes our business for today. Again,

I would invite those of you who are interested and maybe members of the public that may be listening that have not pre-registered for the limited appearances tonight, certainly you can do so by seeing our law clerk, Wen Bu.

Those of you who will be joining us tonight, we will see you back here at 7:00. Those of you who are not joining us tonight, we'll see you tomorrow morning at 8:30. And with that, we stand adjourned for today. Thank you.

(Whereupon, at 4:37 p.m., the above-entitled matter recessed, to reconvene at 8:30 a.m. on March 24, 2009.)

CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of: Southern Nuclear Operating Co

Name of Proceeding: Mandatory Hearing

Docket Number: 52-011-ESP;
ASLB No. 07-850-01-ESP-01

Location: Waynesboro, Georgia

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.

Tobias Walter
Official Reporter
Neal R. Gross & Co., Inc.