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NUCLEAR REGULATORY COMMISSION

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ASLBP No. 07-850-01-ESP-01-BD01

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UNITED STATES OF AMERICA

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	:	
SOUTHERN NUCLEAR	:	Docket No. 52-011-ESP
OPERATING COMPANY	:	ASLBP No. 07-850-01-
(Early Site Permit for	:	ESP-BD01
Vogtle ESP Site	:	

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Tuesday, March 17, 2009

ASLBP Hearing Room

Doubletree Hotel Augusta &

Convention Center

2651 Perimeter Parkway

Augusta, Georgia

The above-entitled matter came on for hearing at 8:30 a.m.

BEFORE:

G. PAUL BOLLWERK, Chair, Administrative Judge

NICHOLAS G. TRIKOUROS, Administrative Judge

DR. JAMES F. JACKSON, Administrative Judge

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T A B L E   O F   C O N T E N T S

EXHIBIT NO.	DESCRIPTION	MARK	RECD
SNC000021-00-BD01	Redhorse Conservation Strategy Report	954	954
SNC000022-00-BD01	8/11 Letter, Roy Crabtree	954	954
SNC000023-00-BD01	James Cuchens CV	958	964
SNCR00024-00-BD01	Feasibility of Air-Cooled Condenser Cooling System for the Standardized AP-1000	958	964
SNC000025-00-BD01	Christopher Lazenby Curriculum Vitae	959	964
SNCR00026-00-BD01	Dry Cooling Presentation by James W. Cuchens	959	964
SNC000027-00-BD01	AP-100 Design Control Document Rev. 17, Section 10.1	959	964
SNC000028-00-BD01	AP-100 Design Control Document Rev. 17, Section 10.2	960	964
SNC000029-00-BD01	GE Steam Turbine Product Brochure	960	964
SNC000030-00-BD01	GE Single Exhaust Dual Flow Turbine Design for Medium Fossil Applications	960	964

EXHIBIT NO.	DESCRIPTION	MARK	RECD
SNC000062-00-BD01	Position Paper on Standardization	973	974
SNC000063-00-BD01	Statement by NRC Chairman Ivan Selin	973	974
SNC000064-00-BD01	Conduct of New Reactor Licensing Proceedings	974	974
SNC000065-00-BD01	AP-1000 DCD 10.4	974	974
SNC000095-00-BD01	North Anna Final EIS	1038	1039
SNC000096-00-BD01	North Anna 3 Combined License Application	1038	1039
JTI000015-00-BD01	previously marked and received		
JTI000032-00-BD01	NUREG 0099	1103	1109
JTI000033-00-BD01	Energy Efficiency of Air-Cooled Condenser	1104	1109
JTI000034-00-BD01	Feasiblity of Air-Cooled Condenser	1104	1109
JTIR00035-00-BD01	Declaration of Powers in Support of JTI Motion	1104	1109
JTI000037-00-BD01	Photgraph	1105	1109
JTIR00038-00-BD01	HELLER System	1105	1109
JTIR00044-00-BD01	William Powers CV	1105	1109
JTIR00049-00-BD01	Thermal Issues in Siting North Anna 3	1106	1109

EXHIBIT NO.	DESCRIPTION	MARK	RECD
JTIR00050-00-BD01	NUREG-1811	1106	1109
JTI000051-00-BD01	26A6642AD Rev 4	1107	1109
JTI000052-00-BD01	ESP No. ESP-003 Excerpts RE North Anna...............	1107	1109

P R O C E E D I N G S

(8:32 a.m.)

JUDGE BOLLWERK: All right. Let's go ahead and go on the record please.

Good morning everyone. We're back this morning to continue our evidentiary hearing in the Vogtle ESP proceeding. We're going to be hearing this morning again from the Joint Intervenor witnesses, Dr. Young and Mr. Sulkin on Contention EC 1.2.

Before we start, I'd just -- a couple of administrative matters. I messed -- I failed in my task as guardian of the record here. Somehow what we had on the board yesterday got erased. And I don't think it is critical.

But just as a -- by way of background, especially next week, I think we're probably going to be using the whiteboard quite a bit more. Make sure whoever is using it checks with the Board before you erase anything so we can make sure if we need to preserve it in any way or if someone else wants to use it, we've got it there.

So, again, with this one, it's not, I don't think, a critical matter. I don't think that anybody had asked to have that marked as an exhibit. We do have it on -- we have the video. We had a description of it as it was put up there.

But again, especially for next week when we've got a lot of witnesses, let's make sure nobody erases it before we've had a discussion with us about it.

The second thing, let's see, and Mr. Sulkin, I think, is -- what time do you need to leave today to get to the airport just so we're --

MR. SULKIN: About four.

JUDGE BOLLWERK: About four? Okay. Then that's our sort of target here as to let you get involved in 1.3 to the degree that you need to and get you out of here by four o'clock. So that's what we will be shooting for.

Anything else administrative that anyone needs to raise with the Board at this time?

(No response.)

JUDGE BOLLWERK: All right. Nope? Okay.

Gentlemen, you both remain under oath. And I will go back to Judge Jackson.

JUDGE JACKSON: Thank you.

Good morning.

Dr. Young, we were talking yesterday regarding some issues in your direct prefiled testimony. And today I just have a couple of questions on your rebuttal testimony. So let's shift gears and take a quick look at a couple of issues there.

The first question kind of relates to your question and answer two in your rebuttal testimony. And in that question two, it related to impingement and entrainment again.

And the question was that Mr. Moorer, in one of his answers, in his prefiled direct testimony, agreed with the SRS, the Savannah River Staff, who concluded that at intake flows many times larger than those proposed for Vogtle, that impingement and entrainment remains small and do not result in any quantifiable impact to the fishery.

Do you have that or recall that question?

DR. YOUNG: Yes, sir, I have it in front of me.

JUDGE JACKSON: Okay. In your answer, I'd like to try to clarify a few points regarding your answer. You said you didn't agree with that. And you said that that wasn't your opinion but the opinion of leading scientists.

And perhaps if there had been some specific references that I could have looked at, I wouldn't have to ask these questions. But I didn't see a reference to go along with this. So presumably who are the leading scientists you are referring to?

DR. YOUNG: In this case, the authors of the textbook, Fishes of the Middle Savannah River Basin --

JUDGE JACKSON: Okay.

DR. YOUNG: -- which at this time are the leading researchers in South Carolina and Georgia for the most part. And in this case, I specifically point towards Mike Paller who is one of the leading fish biologists for the Savannah River Site. And he is one of the co-authors of that test.

And in that text, which has been admitted into evidence, he and the other authors specifically state the SRS and VEGP, the Vogtle site, had been impacting the fishes of the Middle Savannah River Basin.

JUDGE JACKSON: Okay. Yes, that was admitted. I think that's NRC000006. And, again, there wasn't a page reference to that. And I took a look at it. And the only reference I could see to Vogtle was on page 16. Did I find that correctly?

JUDGE BOLLWERK: Would it be helpful if we put this up? Is that on the screen?

DR. YOUNG: Well, you are correct. It is

page 16.

JUDGE JACKSON: That's -- you didn't have a page reference. So I just took a look and I could see a reference to Vogtle on page 16. And I guess --

JUDGE BOLLWERK: What exhibit number was it? I'm sorry.

JUDGE JACKSON: That's Exhibit 5.

JUDGE BOLLWERK: NRC000005?

JUDGE JACKSON: It is NRC -- oh, excuse me, NRC000006.

JUDGE BOLLWERK: Six, excuse me.

JUDGE JACKSON: Exhibit 6. And we're just taking a look at page 16. And I could get to my question.

Basically I had trouble finding this statement of -- that it was negatively impacting the fisheries. Now I saw a statement there that said that they were a source of entrainment. But I didn't see a conclusion that said it was negatively impacting the fisheries.

And so since, again, I didn't have a reference, did I miss something? Is there another reference in that report that I didn't see?

DR. YOUNG: No. Well, here's the quoted passage from the textbook, historically the largest sources of entrainment in the Middle Savannah River Basin have been the reactor cooling water intakes for SRS (9.8 percent of the Savannah River flow) and the plant Vogtle Nuclear Power Station (4.2 percent of river flow). And there's a reference to Wiltz 1981 in a DOE report 1990.

JUDGE JACKSON: Okay. I did see that.

DR. YOUNG: So -- correct.

JUDGE JACKSON: But I didn't see anything in that statement that said those withdrawal rates were such that they were negatively impacting the fisheries, which, to me, means pretty significant impact when you start talking about the fisheries.

DR. YOUNG: Well, it is scientifically reasonable to -- when you see sources of entrainment that entrainment will negatively impact a fish population.

JUDGE JACKSON: So that -- is that your -- do you believe that is stated in this reference? Or you are just giving your opinion on that now?

DR. YOUNG: Well, I do believe that. That is inferred here in this particular passage. That they state that they are the largest sources of entrainment and entrainment is negatively impacting fisheries.

JUDGE JACKSON: And -- okay, it just doesn't -- it doesn't say that. You're just saying that you believe that it implies that, correct?

DR. YOUNG: Well, again, scientifically reasonable extrapolation that when you have entrainment, you are going to negatively impact the fisheries. And they also state -- well, it is listed in industrial activities, which, in this case, is on a subheading under Human Influences on the Fish/Fauna of the Savannah River and Associated Swamps, which begins on page 14.

So it is a discussion on which human activities have had an effect on the fishes of the Middle Savannah River Basin. So when you begin at page 14 and read through the discussion, it would lead anyone to believe that they are discussing how human activity has negatively impacted the fisheries of the Middle Savannah River Basin.

JUDGE JACKSON: Okay. I guess -- I think I understand now what your intent was. I didn't know if a fishery was a term of art in your business. I was thinking that the implication it was something beyond that it impacted some fish. Fishery, to me, meant the population in some long-term and major sense. And I guess you're not implying that.

DR. YOUNG: Not necessarily. Just to clarify, typically when a fish population is referred to as a fishery, that means it is being fished. Humans are, you know, taking individuals from the population.

If there is no fishing going on, it should be properly referred to as the fish population. In this case, quite a few of the species in the Middle Savannah River Basin are not actual fisheries. They are just part of the fish community.

So they are discussing all species -- the fish assemblage as a whole which does include species that are fisheries. So the Savannah darter is just a fish species that isn't fished. So it is a population.

Say the striped bass is another fish species but it has a fishery. So that is the difference.

JUDGE JACKSON: Okay. I guess I understand. If you took one fish, it would be a negative impact on the fishery then I guess. But I was thinking that the implication was something --

DR. YOUNG: Well --

JUDGE JACKSON: -- more broad than that.

DR. YOUNG: -- in this case, it is more

broad.

JUDGE JACKSON: Okay.

DR. YOUNG: Basically they discuss the human influences on the fish assemblage as a whole --

JUDGE JACKSON: Okay.

DR. YOUNG: -- all the species in the particular portion of the river.

JUDGE JACKSON: I just didn't see in that sense any strong statement about the negative impacts. I read on down and it almost seemed to be -- for example, it said the overall rates of impingement at the SRS intakes were low relative to those of other cooling water intake facilities. It didn't seem like a major implication that that had been strongly impacting the fishery. But I just wanted to clarify if I had seen the right reference. Okay.

My last question relates to your nine on page five. And I think we can shorten this.

It has to do with the use of these ANSP reports and -- as a basis that the staff used in making their evaluation. And you were responding to something related to that.

And you said in answer nine, in your opinion, it is incorrect to presume that a single survey performed in the fall of 2001 at sites at least ten miles distant from the Vogtle site are representative of conditions at the site.

And you go on to say down later in your answer nine, second, the ANSP study provides only a snapshot of conditions in the fall of 2001 that tells us nothing about other seasons of the year.

Maybe just to summarize this and get it down to something simpler, we entered several exhibits from the staff, different reports by ANSP. And they were entered yesterday. I've looked at some of those and I've looked at the data tables and presentations in them.

And I could see that there were a number of different sites where sampling was conducted, some of them really much closer than ten miles. Some of them had data that was over decades.

I just simply can't understand how you can -- you infer that it is almost a single report that's over ten miles away at one time. And yet as I look at the totality of what the staff had entered into evidence, it seems to be much more broad.

Now were you just -- to make this simple, were you just referring to one report and not all of the reports they looked at or what in making these conclusions?

DR. YOUNG: I was referring to the 2005, 2003, 2001 because that is what they had referred to in the FEIS. So that's what I reviewed in its entirety. And put some effort into those three reports.

And if we could, could we please bring up the Exhibit NRC000004? And that's the 2005 report so that I could try to --

JUDGE BOLLWERK: Could you go ahead and display that please?

DR. YOUNG: -- show you where I'm coming from.

JUDGE JACKSON: Yes, we can surely do that. And I would bring up some other exhibits that show other things if you think to make your point, you'd like that.

DR. YOUNG: I would need that to be brought up to clarify what I'm referring to in my testimony. And if we could, could we please begin with the Table of Contents, which, I believe, would be the second page.

JUDGE JACKSON: So, let's see, which one is this now? This is --

DR. YOUNG: This is the 2005 report, which is supposed to summarize the 2003 field sampling.

JUDGE BOLLWERK: What is the exhibit number on this one? Is this one --

DR. YOUNG: It is four, NRC000004.

JUDGE BOLLWERK: We picked up four, okay.

DR. YOUNG: So within the Table of Contents, it states page two, Study Design. So that's an important aspect to understand exactly what they are doing during these studies.

And so on page two, the last paragraph, you will see that it states, almost at the bottom of the page, that -- and I'm paraphrasing here -- I believe it is the fourth line from the bottom. In fish studies in late summer consisting of boat electrofishing at Stations One, Five, and Six and seining at Stations One and Six, only the results -- and then -- well, we'll move on to the next sentence.

So that right there details their study design. That their fish studies are conducted only in late summer. And they electrofish at only three stations and seine only two stations.

JUDGE BOLLWERK: Could you explain what seining is just briefly?

DR. YOUNG: Seining is when you pull a small net with -- two folks grab each end and you walk along a beach and you try to capture all the critters in a shallow habitat.

JUDGE BOLLWERK: All right. Thank you.

DR. YOUNG: And then moving on to the second important aspect of this result is that if we go back to the Table of Contents, you will notice that even though they conducted some fish surveys, they have zero results concerning the fish populations in this report.

And that is where my concern came in and led to the testimony that I have provided previously. And that's fairly indicative of these ANSP reports is that they've cited the 2005 report as providing the information to come up with potential or foreseeable impacts on the fisheries yet, as you can see in this document, there is no results of their fish surveys.

JUDGE JACKSON: Well, I mean I can't see that from the Table of Contents but --

DR. YOUNG: Well, can we please scroll -- in the Table of Contents, you'll see that they only list the diatometer studies and aquatic insects. So just to review that there aren't any results concerning --

JUDGE JACKSON: Well, I guess maybe --

DR. YOUNG: -- fisheries, could we please just scroll through the document to show that there's no information concerning the fisheries.

JUDGE JACKSON: Did you go through all of their reports though and similar data?

DR. YOUNG: The 2005, 2003, and 2001, which was all that was introduced in the FEIS and here in these hearings.

JUDGE JACKSON: Well --

DR. YOUNG: We can bring up the other two and those --

JUDGE JACKSON: -- you could bring up --

DR. YOUNG: -- to see what information is included there.

JUDGE JACKSON: -- I don't want to get bogged down. We could bring up NRC000002 exhibit. Are you -- while we're waiting, are you aware of any sampling stations that are closer than ten miles that report data in any of these reports? I thought I saw one.

DR. YOUNG: Savannah River Site studies could be within ten miles.

JUDGE JACKSON: I think I -- in looking at one of the tables and trying to chase down one of the sites, it was right very close to the edge of the Vogtle site, within a couple of tenths of a mile.

DR. YOUNG: But --

JUDGE JACKSON: Did I miss --

DR. YOUNG: -- but it has not been recent. As far as I know from my review, they haven't been recent studies within that area.

JUDGE JACKSON: Well, I don't know about recent. But I thought in the staff approach, they believed that it was appropriate to take a longer view. And that you did not have to focus only on recent information, for example.

Even looking at the Waynesboro Flow Gauge, they felt that because that had only started a few years ago, that didn't give a long enough history. So I thought that they were trying to look at the totality of these reports, some recent, some historical, some that had gone on for decades.

And are you saying that that doesn't count in your view?

DR. YOUNG: Why no, sir, I think it definitely counts in my view.

JUDGE JACKSON: Well, I saw --

DR. YOUNG: So I guess for my testimony, if you look at the current state of the fish population in the Savannah River, even going back over the last say 30 years since the Vogtle plant comes into operation, it is known that the striped bass fishery was in severe decline.

Only recently, after decommissioning of the Savannah River Site, after a prolonged period of no dredging or no modification to the estuary, and after we finally have come up with a flow management strategy at Thurmond -- Thurmond Dam -- you now start to see some of these populations start to rebound, which was a point yesterday in testimony by I believe Mr. Dodd with the Go Fish Georgia showing that the fisheries or the fish populations in this area seem to be rebounding somewhat.

JUDGE JACKSON: Well, that's -- excuse me -- that's -- I agree. I was really asking about location. Did they have data taken at stations closer than ten miles? I wasn't necessarily trying to talk about the results of the fish population.

I was trying to say -- I was trying to focus in on your answer there, which kind of implied data was only taken at one time and it was only at places not close. And I'm just saying in trying to peruse these, I found some collection stations that were much closer than ten miles.

They may not have been 2005 or 2003. And I found data collection that went over, in some cases, decades. I was trying to understand did you -- you weren't --

MR. SANDERS: Your Honor, could I object?

JUDGE JACKSON: -- really looking at the totality.

MR. SANDERS: Could I object to this?

JUDGE BOLLWERK: Well, sir, no, well you can object.

MR. SANDERS: I don't know the rules per se but if Judge Jackson would just read the question, he would know what the answer was. I'm sorry.

JUDGE BOLLWERK: Take a deep breath.

MR. SANDERS: Okay. The question -- the question -- the line of questions in the colloquy is going far beyond the actual question and testimony. Mr. Young or Dr. Young was asked something specific about testimony in the staff's direct. Specifically -- I'm quoting now -- specifically the surveys occurred at River Mile 122 and 161.

Mr. Young -- or Dr. Young was testifying in response to the staff's discussion of the studies where the surveys occurred more than ten miles away. That's what he was talking about.

JUDGE JACKSON: Thank you. Let me ask the specific questions then.

Okay, you did state that staff relied on a single survey performed at least ten miles away. We have agreed to that.

Do you agree that the 2000 ANSP study at Table E-11 shows relative abundances of fish at four different stations? There's the first specific question. Is that fair enough, Counselor?

MR. SANDERS: Yes, sir.

JUDGE JACKSON: Okay.

DR. YOUNG: And that was the ANSP 2000?

JUDGE JACKSON: Yes. That's exhibit --

DR. YOUNG: Is that in the evidence?

JUDGE JACKSON: -- that's Exhibit 2.

DR. YOUNG: Could we please bring that up to review that?

JUDGE BOLLWERK: What particular page do you need?

JUDGE JACKSON: I believe that that is page 239, Exhibit 2.

DR. YOUNG: So yes, it's -- well, it was up there briefly.

JUDGE BOLLWERK: Is that it? That should be 239 there, I believe.

DR. YOUNG: Yes. So yes.

JUDGE JACKSON: Okay, you agree with that.

DR. YOUNG: I do acknowledge that there is data within this particular report. However, what I'm referring to in my testimony is if you look in depth at the data supplied to you by these reports, you will not find most of the species of concern in the Savannah River Basin.

You will not find any data concerning the sturgeon populations. They happen to catch minuscule numbers of American shad. As you'll see, they captured minuscule numbers of Catostomids, including no information about robust redhorse.

They don't capture -- if they do capture striped bass, it is of minuscule amounts. And the rationale -- the reason they did not capture those species is, again, because they only sampled once a year in September.

And by doing that, they miss those important species in the Middle Savannah River Basin. And they miss out on those migratory fisheries and fish populations. Species by species, they miss American shad spawning. They miss the sturgeon migrations. They miss Catostomid migrations. They miss several other clupeid or herring-shad migrations.

And they also don't capture the Ichthyoplankton drift or the downward migration of those early life history stages because they only sample once a year in September.

So what they do capture are predominantly the resident species that are less affected by human activities in that area. And that was the crux of my argument in my testimony is that they do supply some data in some years.

As you've seen in 2005 report, there was no fisheries data whatsoever from that year. So this report does have some data but it is grossly incomplete if you are going to try to characterize the fish assemblage in the Middle Savannah River Basin.

JUDGE JACKSON: You are referring to this particular report we have up?

DR. YOUNG: Yes, I'm referring --

JUDGE JACKSON: And my question had to do with the totality of what the staff had used.

DR. YOUNG: Yes. And then referring --

JUDGE JACKSON: Were there data --

DR. YOUNG: -- to that second question --

JUDGE JACKSON: -- were there data taken at any stations closer than ten miles in any of these reports?

DR. YOUNG: As I said before, in these reports, as far as I could tell, that would be no. And not in recent years. And as the reports in totality, I was not supplied or they did not discuss any of the ANSP reports going back to, I guess, potentially 1951. I reviewed what they listed in the FEIS.

JUDGE JACKSON: I guess if you could bring up one more, then if you could bring up NRC000002 -- Exhibit 2 -- page 92. We'll take a quick look at that and then we'll let this go.

I was trying to find a way so that we didn't have to take the time to bring up each one but it was difficult to generalize apparently. And apparently I angered Mr. Sanders with my approach.

MR. SANDERS: Oh, no, no. I'm sorry if I appeared angry.

JUDGE JACKSON: I was trying not to nitpick each -- you know, bring up ten tables and look at them.

MR. SANDERS: Again, it was only the line --

JUDGE BOLLWERK: You were direct, let's put it that way.

MR. SANDERS: -- the line of questioning. I'm sorry.

JUDGE BOLLWERK: Okay. No problem.

JUDGE JACKSON: Okay. Did we find --

JUDGE BOLLWERK: You got our attention.

MR. SANDERS: Thank you.

JUDGE BOLLWERK: Okay, page -- page -- I'm sorry. We have the exhibit up. Which page, I'm sorry?

JUDGE JACKSON: It was Exhibit 2, page 92, Table C-4.

JUDGE BOLLWERK: I'm sorry. What was the page number again?

JUDGE JACKSON: I thought it was 92. I mean it's been a few days since I looked at this. And I made a note to myself that --

JUDGE BOLLWERK: Oops, hold on a second there. There we go.

JUDGE JACKSON: Okay. I think -- I believe that in trying to chase down these stations, I believe the Station 2B is a station that is within maybe a couple of tenths of a mile from the edge of Vogtle if you take the Vogtle site boundary and project the boundary.

DR. YOUNG: Yes, sir. But might I add, this is for their mussel surveys.

JUDGE JACKSON: Right, it was.

DR. YOUNG: And they do not survey fish at 2B.

JUDGE JACKSON: I guess I understood your testimony to be more general than you meant. You meant to focus it just on -- not on mussels and not on the whole population but just certain fish or fish and not mussels.

DR. YOUNG: Well, in terms of the entrainment, the water intake, and the thermal discharge in Contention 1.2, we were concentrating on the fish species.

JUDGE JACKSON: Okay.

DR. YOUNG: This would probably be more relevant to Contention 6.0, this particular table.

JUDGE JACKSON: Okay. But I thought the mussels were also of an issue as part of the aquatic population that we were worried about the baseline and the impacts. So --

DR. YOUNG: Well, I would --

JUDGE JACKSON: -- maybe I was wrong in that.

DR. YOUNG: -- no, I would agree. They are important in the baseline. And it would have been more appropriate for them to survey all of the organisms at each of these stations. However, they did not.

JUDGE JACKSON: Okay.

DR. YOUNG: So there is no data for fish at Station 2B.

JUDGE JACKSON: Yes, we can let this go. I think we wouldn't have been having this conversation if you had given me a good reference on that that said here are the leading experts. They are the authors of this paper.

Here's the reference for the paper. And if you go to page 120, you'll see what I'm saying but you kind of left me to my own devices in terms of understanding, you know, where you were coming from in drawing your conclusions.

So sorry that we got a little afield there. Okay. I think that that would be it --

JUDGE BOLLWERK: All right.

JUDGE JACKSON: -- on my questions for Dr. Young.

JUDGE BOLLWERK: Do you have any for Mr. Sulkin? Do you want to move on to that? Or do you want us --

JUDGE JACKSON: If it's time, let's move on to Mr. Sulkin.

JUDGE BOLLWERK: Just, of course, if there is anything further on these -- why don't you talk with Mr. Sulkin and I do have a question about Exhibit

97. We can put that off until you are finished.

JUDGE JACKSON: Okay.

Mr. Sulkin, let me find your direct prefiled testimony here so we can refer to that. I'd like to start by just asking a little bit about your answer 12. Question 12 said what do you mean when you say that there are no scientific or regulatory basis -- there is no scientific or regulatory basis for the five percent threshold.

And you see where I am?

MR. SULKIN: Yes.

JUDGE JACKSON: And you went on and said I do not know if it is reasonable for the staff to assume that impacts from withdrawing less than five percent would be small. There are no data or site-specific information to justify setting the threshold at that.

I think if we turn the page, and then in answer 13, you say in fact, according to EPA, the EPA reg that you list there, the five percent threshold reflects a policy judgment that a greater degree of entrainment reflects an inappropriately located facility.

I guess just how about a question in referring then to that rule. I took a look at that rule. Is it clear that that rule refers to the annual average flow? In other words, the denominator in that fraction is the annual average flow?

MR. SULKIN: I understand your question. I don't think it is a rule at all. I looked for the source of that. If you look in 316, it's not there or I couldn't find it. I found it -- and I was responding to what was in the Final EIS, in their citation.

And then I searched it back to a Federal Register where it discusses the five percent. And what it says is if you are going to take in more than five percent of the flow, and in one place it calls it the annual mean flow or the mean annual, it is an inappropriate location.

It never says that if it is less than five percent, it is small or good. It just means you can't build it if it is more than five percent. And if it is less than five percent, you might still need to do something about it or not.

So it has been mischaracterized. And if I could show you where I got this from, if we could pull up the page, it is Exhibit 1 -- a bunch of zeros and a one.

JUDGE BOLLWERK: Whose exhibit, I'm sorry?

MR. SULKIN: It's 000001.

JUDGE BOLLWERK: Is it the FEIS?

MR. SULKIN: NRC, yes.

JUDGE BOLLWERK: Which section? It has five different sections.

MR. SULKIN: It is page 5-30.

JUDGE BOLLWERK: That would be Section B please.

JUDGE JACKSON: Well, my question is pretty specific. And we'll see if it is covered in what you're talking about. My question was we don't have to call it a rule. I mean I would be happy to call it whatever you would like.

But the five percent threshold that the EPA spoke of, that was five percent --

JUDGE BOLLWERK: I think that may be C. I think it is B.

JUDGE JACKSON: -- of what? Was it the average annual flow?

MR. SULKIN: In the Federal Register, it describes it as the water body mean annual flow.

JUDGE JACKSON: Mean annual flow, that's what I think I saw. So the mean annual flow, that means average annual flow, right?

MR. SULKIN: Right.

JUDGE JACKSON: Okay. Thank you.

MR. SULKIN: But what I wanted to explain was my responding to it came out of the FEIS. And if you look on that bottom of page 5-30 --

JUDGE JACKSON: Okay.

MR. SULKIN: -- I was looking at how the staff used this five percent to comment on.

JUDGE BOLLWERK: Do we have the right page up?

MR. SULKIN: That's right. That last paragraph.

JUDGE BOLLWERK: That's it, another factor?

MR. SULKIN: Excuse me?

JUDGE BOLLWERK: That's it another factor, is the paragraph?

MR. SULKIN: That's it.

JUDGE BOLLWERK: Okay.

JUDGE JACKSON: Okay.

MR. SULKIN: and they go on to talk about the drought flow as well. So they're using it for more than just the annual average. They are comparing it to also drought level three where you see the line on the side, the next to the bottom one. See where it says compared to average to drought level three.

So they were comparing it to a range of flows because obviously at the lower flows, you'd have more of an impact. And the point of this was they are good at any range within average down to the drought three.

So I was responding to that presentation in the EIS.

JUDGE JACKSON: Okay. If we just jump ahead then to say your answer 20, which I think is on page 11 of your prefiled, you also were, I think, referring back to this five percent down in sort of the bottom of that first paragraph in your answer 20.

It says as you can see, all four units operating in normal mode would exceed the five percent threshold of significance at current flow rates. And then 3,100 cubic feet per second and would exceed 18 percent at the theoretical minimum flow.

I guess my question is the following. Is 3,100 CFS the average annual flow at Vogtle?

MR. SULKIN: No.

JUDGE JACKSON: It is not?

MR. SULKIN: No, it's -- the 3,800 is used by -- again, this report, if we can switch to page 7-4, they give a table showing the percentages. And I was, again, responding to the presentation.

JUDGE JACKSON: Yes.

JUDGE BOLLWERK: 7-4 of Exhibit 1?

MR. SULKIN: 7-4 of this same exhibit. And it is Table 7-1. So I didn't come up with how it was used. I was simply commenting on it.

JUDGE JACKSON: Okay.

MR. SULKIN: And it was used against the drought level flows to show there would be no impact.

JUDGE JACKSON: So you would believe -- I guess my question is, my specific question is then using the five percent number as a reference against anything except the mean annual flow would not be really scientifically sound. Is that -- in other words, the mean annual flow is how you get -- is what the five percent refers to.

So if you take something that is not mean annual flow, maybe it is a very low case like -- a low case like 3,100, which isn't the annual flow, then that would be an apples and oranges comparison, would you agree?

MR. SULKIN: I think there might be some scientific validity to looking at the percent of water taken in at any flow. The regulation, and it doesn't explain the scientific basis for it, it is just that it is technologically feasible and inappropriate if it exceeds that.

It is worthy to look at at any flows. And that is what was done in the EIS. So I support looking at it.

You then have to -- you have to understand what you're looking at. What is that flow? Where is it measured? Five percent of what? And unfortunately when you start averaging things and blending things, the science gets lost because is it five percent of a single canal? Or is it -- because this rule anticipates a single structure, a new facility.

In fact, in this case, that is not what is going on. We have an existing facility. One across the river, I understand you could throw a baseball to reach. And some others in the area.

So you start adding it up, it's not five percent that you are really looking at. You have to look at it in totality.

JUDGE JACKSON: Yes, okay. I guess the question is then comparing -- if you take a very low flow number that is not the mean flow that doesn't really compare -- that would not be a proper way to reference the five percent.

MR. SULKIN: That's right. So in the FEIS, they mischaracterized the source of that information. And I was responding to what was presented there.

JUDGE JACKSON: Okay. Thank you for that clarification.

I think I only have one other question. Let me just take a quick look. All right. I think that that probably encompassed -- we kind of went over two or three sections here. And I think that I have I've asked you the main question that I wanted to on your direct testimony. Okay.

JUDGE JACKSON: Are there any other questions on the direct testimony?

JUDGE TRIKOUROS: I have a question. So would you agree that with respect to NEPA, it would not be necessary to look at maximum mode flows but sort of average flows from the point of view -- from a NEPA point of view?

In other words, one would not need to look at theoretical minimums or plants operating in their max mode for any length of time. Would you agree with that?

MR. SULKIN: No, I would not agree with that.

JUDGE TRIKOUROS: And you would believe that worst case assumption should be used in NEPA?

MR. SULKIN: Yes.

JUDGE TRIKOUROS: Okay. And what is your basis for saying that?

MR. SULKIN: That's when your maximum impact occurs. And if you look at only averages, and my background is in dissolved oxygen in river flows, if you only look at averages of dissolved oxygen, then you miss the impacts because in a river with dirurnal, it goes high at day and low at night. And the average is unimportant.

So when you have a drought, particularly an extended drought, you will be maximizing your damage at that end of the scale. And the average means little -- you can have a great flood or two during the year that really bumps your average up but misses the primary impact.

JUDGE TRIKOUROS: What if the NEPA rule itself used words like not using the worst case assumptions?

MR. SULKIN: If the NEPA rules says not to do it, then that's what the NEPA rule says. But I don't believe that that is the case.

JUDGE TRIKOUROS: All right. Thank you.

JUDGE JACKSON: Okay. In your rebuttal testimony, I had a question if we could look at that.

Question eight, answer eight, question eight says do you agree with the staff's conclusion in answer 33 of their prefiled direct testimony that the timing of the striped bass and American shad spawn relates to seasonal periods of higher river flow when the fraction of the water used by the proposed units three and four is smaller.

And in your answer you say no. This is not the case when the Corps's drought contingency plan is in effect. The drought contingency plan does not provide for higher discharge.

If you look at something like the Waynesboro Gauge, does it tend to show higher flows in the spring?

MR. SULKIN: I don't know.

JUDGE JACKSON: Well, I looked at it and in my view, it does tend to show higher flows in the spring. So I guess I was having trouble seeing why, if this spawning takes places in the spring, right --

MR. SULKIN: I presume so.

JUDGE JACKSON: -- so if the Waynesboro Gauge consistently shows higher flows in the spring, then I guess this statement that you were refuting would, in general, be true, wouldn't it?

MR. SULKIN: It may or it may not. I

didn't examine the Waynesboro Gauge for that question. I was looking at what was used as the basis for the EIS, which was the Thurmond releases because that is described as the controlling flow of the river, how much is let out from above.

And it might be more appropriate to switch to a different gauge, particularly after some years of data. But that's not what has been done historically in this case.

And when you have a flow-controlled river by dams, the natural fluctuation doesn't take place. You can have days with river flows of zero in the spring because it is artificially regulated. So I was using the source that was given to me, which was the Thurmond Dam Releases, in my answer.

JUDGE JACKSON: Okay. I'm not sure what -- I guess the chart I was looking at was probably in Exhibit SNC000016. It was just the Waynesboro Gauge data. And it does tend to show higher in the spring.

And is it not true that you should really look at the flow at the site?

MR. SULKIN: You should look at the flow at the site. And that's not happened throughout this report. At some point during this process, someone -- some group of people switched to other points of measurement.

But at the beginning, it was all about the Thurmond Release. And the percentages were based on what comes out of Thurmond. So it would be better to look at a flow closer to the site and that should be done for all aspects of this.

JUDGE JACKSON: Okay. Why would the flow be higher in the spring than other times?

MR. SULKIN: It rains more and there's less evaporation. There's snow melt in the higher elevations if there is snow. And typically in the eastern United States, probably the whole country, spring flows are higher.

JUDGE JACKSON: Right. And that appears to be the case.

MR. SULKIN: It should be the case except in flow-controlled systems where you can turn on and off rivers artificially. Then you can actually have low flows any time of the year, particularly during a drought.

JUDGE JACKSON: But the situation where the Thurmond dam is a number of miles upstream and basically tributaries and other sources could build that flow up even if it is controlled at the dam, is that correct?

MR. SULKIN: That's correct.

JUDGE JACKSON: Okay. That seems to be what is happening in the spring. So I was just trying to understand why you said no, that that didn't occur. And that was because you weren't answering with respect to the actual flow at the site. You were answering based on the release at the dam.

MR. SULKIN: Correct.

JUDGE JACKSON: Okay. Thank you. That's my question.

JUDGE BOLLWERK: All right.

Judge Trikouros?

JUDGE TRIKOUROS: Nothing.

JUDGE BOLLWERK: I then have a question. And either of you can respond, depending on which of you feels is appropriate or both of you can.

There was an exhibit introduced yesterday, which was SNC000097, which was a page or several pages from a website that deals with fishing prospects, it is maintained by the State of Georgia, as well as some discussions I had with Mr. Dodd, I believe, about electrofishing. And I just wondered if you all had any comments about -- if you heard that discussion and had any comments about what Mr. Dodd told me.

DR. YOUNG: Well, I -- Young for the

intervenors -- I feel competent answering questions concerning that report. Are you specifically just asking in response to the electrofishing questions? Or the questioning in general?

JUDGE BOLLWERK: Electrofishing in particular but anything else you want to mention at this point about the discussion that we had.

DR. YOUNG: Okay. The electrofishing in general I have actually assisted some of these Georgia DNR surveys. On several occasions I helped them tag the striped bass for their Middle Savannah River studies. I assisted Ed Betross out of the local office.

And also I've been down there on numerous times, probably dozens of times, to try to capture catostomids for the robust redhorse research at Clemson University. And electrofishing is an accepted and one of our more popular methods of capturing fish in fisheries. However, it does have its shortcomings in a large river environment.

It can effectively capture most fish when they are in shallow spawning habitats. So we were able to capture say the robust redhorse with pretty good results. But that was only when they are on the shallow gravel bars near New Savannah Bluff lock and dam if they are in their other historic spawning ground, about River Mile 186, below the lock and dam.

However, when those fish redistribute to their deep-water habitats, we rarely captured any robust redhorse using our electrofishing. And so thus we would concentrate on capturing them during the spawning and reduced our efforts when they moved to deep-water habitats.

And that holds true also when you are trying to capture striped bass. If they are in a shallow habitat, you capture them with regularity. If they are in deep water, you are going to have poor results.

Electrofishing rarely captures sturgeon unless they are in very shallow spawning habitats. So unless you understand as a fisheries biologist what the shortcomings of your gear are, you can get some varied results. And you can actually come up with some improper conclusions.

If you shock over 50 feet of water and capture no organisms and conclude well, I didn't capture them so they're not there, that would be an improper conclusion because your electrofishing gear can't reach down to the deeper water where those fish are. Thus you actually dismiss those fish.

And so there are shortcomings. We use it frequently but you have to understand the shortcomings and how it affects your results, especially if it is an annual survey. And if you have an annual survey and you resample the same transects year after year, you also need to understand the level of flow, what that does to your sampling.

If I go to a transect at 4,000 CFS and I effectively capture a great number of fish, it is likely because the river was a lower level, more shallow habitat. Thus your gear worked more effectively.

If you go back to that same habitat at 15,000, 20,000, 30,000 CFS, you are likely not going to catch those organisms because now the habitat is deeper and your gear doesn't work as effectively. So you have to just understand the pros and cons of any gear type that you use in fisheries.

JUDGE BOLLWERK: But it is used to some degree to establish a baseline in terms of the fish that are in the particular habitat?

DR. YOUNG: Yes. And usually it is used when you try to have some similarity from year to year. It is one of the more effective gears in controlling bias through effort and also through your personnel.

Typically in fisheries you hire technicians from year to year and there's a lot of turn over in these entry-level jobs. So electrofishing is pretty standard practice that is easily learned. So it helps keep your protocols and your standard operating procedures consistent from year to year so -- as opposed to some other gears that personnel could bias your results by their inexperience.

JUDGE BOLLWERK: All right. Anything you want to say about the website page that was put into evidence?

DR. YOUNG: Yes. I agree that, you know, with the prospectus looking good, that is an indicator that these fish populations in the Middle and Lower Savannah River Basin are likely having some rebound from these declines they had been experiencing over the last few decades.

And I believe that it is more than coincidental that SRS has been decommissioned. We now better -- we have the Flow Management Program from the releases at Thurmond Dam, which has reduced human variation. And at the same times, we've reduced fishing.

So we have reduced a lot of the human impact on that Middle and Lower Savannah River Basin. And I believe that the prospectus looking good or improving is a direct result of our lessening our impact on these fish populations, which I believe provides some evidence that expanding energy production or nuclear production in the this Middle Savannah River Basin might be counterproductive to, you know, encouraging the continued rebounding of these fish populations.

And so that's what I gather from, you know, these improved fish, you know, prospectuses for the Savannah River.

JUDGE BOLLWERK: All right.

Anything you wanted to say Mr. Sulkin on this?

MR. SULKIN: Only that I, too, have done electrofishing and only in shallow wadeable streams.

JUDGE BOLLWERK: All right.

All right, any questions the other Board members have at this point?

(No response.)

JUDGE BOLLWERK: All right. Thank you, gentlemen, with one caveat, which is we need to take -- I take it you all have some questions probably you'd like us to consider.

MR. BLANTON: I think we'd at least like to confer about it, Your Honor.

JUDGE BOLLWERK: Okay. How long do you think you need?

MR. BLANTON: Ten minutes.

JUDGE BOLLWERK: Ten minutes? All right. Why don't we go ahead and then take a ten-minute break. And we'll come back. We'll receive your questions. We may need to take another couple of minutes after that to look at them. But we'll be back in ten in any event to get your questions. Thank you.

(Whereupon, the foregoing matter went off the record at 9:28 a.m. and went back on the record at 9:47 a.m.)

JUDGE BOLLWERK: We're back after a brief break. We had at least some questions. I take it the staff didn't have anything.

MR. MOULDING: No, Your Honor.

JUDGE BOLLWERK: All right.

And we had some questions posed by the intervenors and Judge Jackson is going to ask several of them here.

JUDGE JACKSON: The question is directed toward Mr. Sulkin. And has to do with flow of a selection of flows to consider in this 1.2 evaluation.

Did you calculate a worst case scenario in your analysis?

MR. SULKIN: I found the flows from the gauging station or the record for Thurmond Dam so I suppose you could say I calculated them. I mean I didn't go out and measure flows myself if that is what you are asking.

JUDGE JACKSON: No, I'm just asking if you calculated a worst case scenario in terms of flow.

MR. SULKIN: Let me explain the use of that term. I think that might be part of the confusion. I come from the Clean Water Act world of NPDES permits. And they are based on what we refer to as worst case scenario which is the more critical flow, which is below flow. For a non-regulated stream, it's called 7Q10 in most cases, the most likely ten-year one week drought recurrence.

For dam-controlled streams, in my home state, it's the lowest day of the year, which can be zero.

So I don't mean zero in this case. I mean the most likely, reasonable, foreseeable, event for this river. So I didn't calculate it but I found what that flow was.

JUDGE JACKSON: So does the theoretical low flow represent a worst case scenario?

MR. SULKIN: The theoretical low flow, you mean the 957, I presume, which is what is --

JUDGE JACKSON: I presume that's right. And to add another question, why did you include that in the theoretical low flow, which I believe is the 937.

MR. SULKIN: 957.

JUDGE JACKSON: 957.

MR. SULKIN: I found it in some of the documents related to this case presented by -- in this case, this is the NRC report of this river. And it says that the hypothetical minimum flow volume in the river during the most extreme drought is projected to be 957. So I just took it out of this report.

JUDGE JACKSON: Okay. Let's see, did you answer that you believe that this is a worst case?

MR. SULKIN: No, a worst case would be zero.

JUDGE JACKSON: Okay.

JUDGE BOLLWERK: That's just what the two of us were talking about it beforehand. No flow would be the worst case, right?

MR. SULKIN: Right. And they do have days when they can turn off around the dam. But I'm not talking about that.

JUDGE BOLLWERK: All right.

JUDGE TRIKOUROS: Wait a minute, the worst case would be zero?

MR. SULKIN: If you wanted to take it an extreme and you had an extreme drought and they held all the water back everywhere they could, theoretically it's zero.

JUDGE TRIKOUROS: I don't think that that was what was envisioned in the thinking when they -- the NEPA thinking when they talked about not necessarily doing a worst case analysis. I don't think in a river it would be zero. It would be the worst that one could envision that would likely occur. I mean I don't think zero is -- would likely occur.

MR. SULKIN: I think you missed my answer earlier. What I said was my use of the term, before we took the break, I was talking about the most likely to occur or reasonable, as you would in NPDES permitting, the critical low flow.

I didn't mean the term worst in, you know, hypothetically worst case if the world stopped turning. I mean within reason.

And before this all started, it was

thought it would never drop below 3,800 at Thurmond. Well, in fact, it did. So you have to go a little bit beyond a comfort zone to capture what is reasonably likely. So I'm not talking about zero.

JUDGE TRIKOUROS: Thank you.

JUDGE BOLLWERK: All right. You all had a proposed question, I believe, from the Applicant?

MR. MOORE: Yes, Your Honor. I'll try to tear it neatly.

JUDGE BOLLWERK: And, again, just a reminder to the parties as they propose these, at some point I would like to get a copy e-mailed to me so I can put it in the appropriate place. And then we'll put them on the record after we issue our initial decision.

All right. Thank you. Okay, we'll let you know.

Why don't we take a couple of minutes here. We're going to step out to the back and take a look at this. And we'll be right back. So let's go off -- take a brief recess. Thank you.

(Whereupon, the foregoing matter went off the record at 9:52 a.m. and went back on the record at 9:54 a.m.)

JUDGE BOLLWERK: All right. I think there is one more question. Judge Jackson is going to propose it.

JUDGE JACKSON: Dr. Young, you stated that the FEIS doesn't reference reports assessing the shad, shortnose sturgeon, or striped bass. Don't the lists in the FEIS beginning on pages 2-124, and perhaps we could bring up FEIS 2-124.

JUDGE BOLLWERK: It's going to be 1A, NRC 1A.

JUDGE JACKSON: And to continue the question, and 5-97, identifying the various reports referenced in the FEIS, include reports addressing these species. So the question is don't these lists of references have reports that address these species? That's the question.

And so he's going to try to bring up at least the first one.

JUDGE BOLLWERK: We need to bring up Exhibit NRC00001A.

JUDGE JACKSON: Now the second exhibit is 5-97. And then the follow-on question says, for example, page 5-104 --

JUDGE BOLLWERK: That will be Exhibit 1B.

JUDGE JACKSON: -- final recovery plan for the shortnose sturgeon would be an example of, I guess, addressing the shortnose sturgeon. I think that's -- is the question clear?

DR. YOUNG: Yes.

JUDGE JACKSON: Okay. Thank you.

JUDGE BOLLWERK: and what was -- I'm sorry, what was the reference page in --

JUDGE JACKSON: The second reference page was 5 --

JUDGE BOLLWERK: What was the reference page in the first one.

JUDGE JACKSON: Oh, it was 2-124.

JUDGE BOLLWERK: 2-124.

JUDGE JACKSON: It said lists beginning on that page in the FEIS and 5-97.

You keep scrolling perhaps and let's see how far that list goes. Because the reference was that the list begins there. Keep -- okay -- keep scrolling if you could, scrolling --

JUDGE BOLLWERK: That's pretty general. I think --

JUDGE JACKSON: That's everything.

JUDGE BOLLWERK: -- let's go to 5 --

JUDGE JACKSON: Let's go to 5-97 if you can find that.

JUDGE BOLLWERK: That's going to be in 1B.

JUDGE JACKSON: And then we can look at a specific -- okay. That begins some references. Let's just scroll -- okay -- how about 5-104? Just keep scrolling. Scroll down to page 104 if you could please. Okay.

Final recovery plan for the shortnose sturgeon. Let's see, what page are you on now -- 104? Okay. I'm looking for that. Okay, scroll back up to the top of the page then. At the top of 104.

PARTICIPANT: Can I see the question?

JUDGE JACKSON: Do you see it? We're looking for a report -- a recovery plan for the shortnose sturgeon.

JUDGE BOLLWERK: It looks like it is about the sixth item on that page that I'm seeing on your screen.

JUDGE JACKSON: One, two, three, oh, final recovery plan for the shortnose sturgeon. Got it. Okay. I guess the question then is given this and given this list of reports and the totality of that, doesn't it cover these species that you mentioned it didn't? I ask the question.

DR. YOUNG: This list of reference does provide part of the picture for these species. But at the same time as looking at what they have in the reference list, if you would also scroll through, you would notice what isn't listed in the reference list.

There are some very valuable pieces of literature that were readily available that would provide some more facts that would be able to, in my opinion, more properly try to conclude the foreseeable impacts of, you know, expansion of and construction of, operation of units three and four.

So if you'll notice -- could we scroll through the list beginning at the beginning of the reference list?

JUDGE JACKSON: Yes, on this page? Or back on the previous?

DR. YOUNG: Yes, could you please scroll to 98? Continue please. Can you just continue to page 99? Continue please. If you could please continue to page 100? And continue -- just continue to scroll -- just speed things up.

All right. Thank you. So my point being is that there are some important references here but, for example, in terms of just the discussion of striped bass and potential impacts to that species, there's no list of any of the habitat suitability indices of which one has been introduced into evidence. And I believe it is JTI-000015 by the intervenors.

But within that document, there is a section where they discuss human impacts on striped bass, including their susceptibility to thermal discharge. But yet that document doesn't show up in their discussion. And it is widely used in any discussion for striped bass. And there is actually a second habitat suitability indices for striped bass.

Also there is a habitat suitability indices for the American shad that is readily available. And these are provided by the U.S. Fish and Wildlife Service for species of concern or of importance. And I don't recollect seeing that on their list of references.

Within that document, it discusses, in detail, the life history of shad, including detailed information on portions of their life history that make them susceptible to the types of activities, power generation, that would include potential for entrainment.

And what I'm saying is that there are other documents of very high importance that they omit. And those documents hold some very important pieces of information that would have provided a better analysis, would have provided a thorough analysis for foreseeable impacts. And they don't include them.

JUDGE JACKSON: So I guess just to get back to the question, I'm trying to ask a specific question in Mr. Sander's preferred approach, don't the lists -- here's the question -- don't the lists include reports that address the species? Is that -- there is kind of a yes or no answer to that, I guess.

DR. YOUNG: Yes, there are some reports that address the species.

JUDGE JACKSON: But you are saying there are additional reports that would have good information that you didn't find in the list.

DR. YOUNG: Correct.

JUDGE JACKSON: Thank you.

JUDGE BOLLWERK: All right. Anything further from any of the Board members?

(No response.)

JUDGE BOLLWERK: Nothing from the parties I take it at this point?

(No response.)

JUDGE BOLLWERK: All right then.

Gentlemen, we thank you for your testimony on this Contention 1.2. And I think we'll see both of you on 1.3. So, again, thank you very much for speaking with us and your service to the Board.

All right. At this point I think we're ready then to move to Contention 1.3. And I believe the Applicant has -- well, has several individuals. Hang on one second here. Let me --

MR. BLANTON: Your Honor, could I ask a question?

JUDGE BOLLWERK: Surely.

MR. BLANTON: Does the Board anticipate calling any of these specifically 1.2 witnesses back for any reason? Or are they released at this point?

JUDGE BOLLWERK: Let's see. I think at this point if they -- let me just turn to my colleagues but I think if they don't have obviously other testimony on another issue, yes, they could be released then.

MR. BLANTON: All right, sir. Thank you.

JUDGE BOLLWERK: All right.

MR. BLANTON: We got a lawyer to turn over here.

JUDGE BOLLWERK: Okay. All right.

Gentlemen, you can go ahead and take a seat wherever you had a seat in the audience. And we'll bring up the Applicant panel.

MR. BLANTON: Your Honor, our 1.3 panel

will be Mr. -- or Dr. Coutant, Mr. Moorer, and Mr. Cuchens. Excuse me -- and Chuck Pierce.

JUDGE BOLLWERK: All right.

MR. BLANTON: How could I forget you, Chuck?

JUDGE BOLLWERK: Okay. Let me just check and make sure as an administrative matter, I just -- I know Mr. Sulkin has a problem. Does anyone else have a problem today in terms of being here through whenever we need to finish? All right?

MR. BLANTON: No, sir.

And, Your Honor, I've been joined at counsel table by my partner, Peter LeJeune, who is going to introduce these witnesses.

JUDGE BOLLWERK: All right. All right, whenever you are ready, Mr. LeJeune.

MR. LeJEUNE: Good morning, Your Honor. My name is Peter LeJeune. Last name is spelled L-E-capital J-E-U-N-E, counsel for the Applicant here to present the testimony and exhibits for Environmental Contention 1.3.

The witnesses we have are Dr. Coutant -- starting on our right, Dr. Coutant, next to him is Mr. James Cuchens, next to him is Mr. Thomas Moorer, and then Mr. Charles Pierce.

Dr. Coutant and Mr. Moorer were introduced on EC 1.3 so I'll introduce the other two. I mean, I'm sorry, on 1.2. I'll introduce the other two on 1.3.

JUDGE BOLLWERK: All right. Let's go ahead then and Mr. Moorer and Dr. Coutant are already under oath and you remain under oath.

Let's have the other two gentlemen, if you would, raise your right hand. And, again, I need a verbal response from each of you to the question I'm going to ask.

Do you swear or affirm that the testimony you will give in this proceeding is the truth, the whole truth, and nothing but the truth?

MR. PIERCE: I do.

MR. CUCHENS: I do.

JUDGE BOLLWERK: All right. Then we need to move to the testimony or whatever other introduction you want to do.

MR. LeJEUNE: Sir, if we could load Dr. Coutant's 1.3 prefiled direct testimony please?

Dr. Coutant, do you recognize this document that is on the screen as your prefiled direct testimony concerning Environmental Contention 1.3?

DR. COUTANT: Yes, I do.

MR. LeJEUNE: Thank you. Could you please verbally affirm the following? That the testimony entitled Testimony of Dr. Charles Coutant on Behalf of Southern Nuclear Operating Company Concerning Environmental Contention 1.3 and dated January 9th, 2009, which has been provided to the Court Reporter in electronic format under file name Coutant 1.3 testimony was prepared by you or under your supervision and direction and is true and correct to the best of your knowledge and belief?

DR. COUTANT: Yes.

MR. LeJEUNE: Thank you.

Your Honor, I understand that we changed the method of entering the exhibits.

JUDGE BOLLWERK: Right. Let's get the testimony first.

MR. LeJEUNE: I'm sorry. I move to admit Dr. Coutant's testimony as if read.

JUDGE BOLLWERK: All right. Any objections?

(No response.)

JUDGE BOLLWERK: Hearing none, then the direct testimony of Dr. Charles Coutant on Contention EC 1.3 will be entered into the record as if read at this point as DDMS Item ID 58867.

(Coutant, et al. Direct Testimony (DDMS-58867) to be inserted at this point)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	**Docket No. 52-011-ESP**
Southern Nuclear Operating Company	)	**ASLBP No. 07-850-01-ESP-BD01**
(Early Site Permit for Vogtle ESP Site)	)	**January 9, 2009**

TESTIMONY OF DR. CHARLES C. COUTANT
ON BEHALF OF
SOUTHERN NUCLEAR OPERATING COMPANY
CONCERNING ENVIRONMENTAL CONTENTION 1.3

Q1: Please state your name, address and current occupation.

A1: My name is Charles Coe Coutant. I am a retired Distinguished Research Staff Member of the Oak Ridge National Laboratory, Oak Ridge, Tennessee. My combined business and home address is 120 Miramar Circle, Oak Ridge, TN 37830-8220. I now serve as a private consultant on matters of aquatic ecology and fisheries biology.

Q2: Please summarize your educational and professional qualifications.

A2: My professional and educational experience is summarized in the curriculum vitae (CV) (*see* Exhibit SNC000012). I received a Ph.D. in Biology (focus on ecology) from Lehigh University in 1965. I have conducted thermal effects and other cooling water studies since 1959. For five years post doctorate, I studied thermal effects on aquatic life of the Columbia River, Washington.

While at the Oak Ridge National Laboratory since 1970, I conducted individual research on thermal effects, entrainment and impingement on aquatic life, led a team of scientists studying these power plant cooling issues (for which I have numerous publications listed in my CV), and participated in the preparation of NEPA Environmental Impact Statements for nuclear power plants for the U.S. Atomic Energy Commission, and later the Nuclear Regulatory Commission (NRC), in which thermal, entrainment and impingement issues were analyzed (Palisades, Shoreham, Indian Point). I also participated in the preparation of NEPA analyses for several hydropower facilities (for the Federal Energy Regulatory Commission, (FERC)), and participated in the development of national water quality criteria for temperature (National Academies and the Environmental Protection Agency (EPA)) as well as the interagency (NRC and EPA) implementation document for the thermal effects of Section 316(a) of the Clean Water Act. I have assisted numerous electricity generators with aquatic environmental licensing issues, including Virginia Power (now Dominion) with its North Anna Nuclear Power Plant. I have served on several task forces to develop biological criteria for environmentally benign siting, design and operation of power station cooling-water facilities.

Q3: Please describe your professional activities.

A3: My professional activities have included active participation in the American Fisheries Society, the dominant professional society for fisheries scientists and managers in North America. I served as President of the Society in 1996-1997 after several years of membership on the Governing Board. I also have served as President of the Water Quality Section, the Tennessee Chapter, and the Southern Division. For many years, I was an active participant in the literature review committee of the Water Pollution Control Federation (now Water Environment Federation), producing annual reviews of thermal effects literature. I have served on panels of the American National Standards Institute and the American Nuclear Society developing environmental standards for cold shock and entrainment, and of the American Society of Testing and Materials for contaminant transport models. I am also a member of the

Ecological Society of America, in which I was an officer of the Applied Ecology Section. I have served as an advisor to international agencies with respect to power station cooling-water impacts (Germany, Sweden, Canada, New Zealand, International Atomic Energy Agency (IAEA), and Unesco). The IAEA and Unesco activities resulted in reference manuals for siting, design and operation of steam power stations to minimize detrimental aquatic environmental impacts.

Q4: Please state the purpose of your testimony.

A4: The purpose of my testimony is to assure the Board that the middle Savannah River in the vicinity of the proposed Vogtle Units 3 and 4 does not have "extremely sensitive biological resources" that are necessary for the maintenance of the shortnose sturgeon and robust redhorse. First, I examine the meaning of the term "extremely sensitive biological resources" and the alleged presence of the same in the vicinity of the Vogtle site. Second, I discuss my evaluation of published research and administrative documents regarding the shortnose sturgeon and robust redhorse. Next, I discuss the portions of the Final Environmental Impact Statement (FEIS) that relate to the shortnose sturgeon and robust redhorse. Finally, I discuss the letter issued by the U.S. National Marine Fisheries Service (NMFS) that confirms the FEIS findings regarding the shortnose sturgeon and robust redhorse.

I also note that I have submitted testimony on behalf of SNC regarding Environmental Contention – EC 1.2. In that testimony, I testify regarding the general purpose of an EIS and the sufficiency and adequacy of the Vogtle FEIS, among other issues.

Q5: Are you familiar with the term "extremely sensitive biological resources"?

A5: Yes. Environmental Contention 1.3 in this proceeding is based on Joint Intervenors' assertion that there are "extremely sensitive biological resources" present in the

Savannah River in the vicinity of the Vogtle site. Specifically, Joint Intervenors allege the presence of the shortnose sturgeon and the robust redhorse.

Q6: What is an "extremely sensitive biological resource"?

A6: The term "extremely sensitive biological resources" is drawn from the Preamble of the final rule for Section 316(b) of the Clean Water Act (CWA). Section 316(b) governs cooling water intake structures at new electricity generation facilities. In the Preamble of the final rule, the EPA rejected dry cooling as the best available technology for power generation cooling systems. However, the EPA stated that it "does not intend to restrict the use of dry cooling or to dispute that dry cooling may be the appropriate cooling technology for some facilities . . . in areas with limited water available for cooling or waterbodies with extremely sensitive biological resources (e.g., endangered species, specially protected areas)." In my opinion, extremely sensitive biological resources means more than that endangered species such as the shortnose sturgeon or non-listed but sensitive species such as the robust redhorse are present in the Savannah River watershed (which they are) but that they are sensitive to alterations of the environment in the vicinity of the proposed cooling system. That is, the new cooling system would have to pose significant risks to these species.

Q7: In your opinion, does the area of the Savannah River near the Vogtle power plant site have "extremely sensitive biological resources" necessary for maintenance of the shortnose sturgeon or robust redhorse?

A7: It is my opinion that it does not. Very briefly, in the case of the shortnose sturgeon, the Savannah River at the Vogtle site is a migration corridor for this estuarine and coastal species, which spawns in gravel habitats in the vicinity of Augusta, but there is no indication that the cooling system would diminish the ability of either adults to migrate upstream (and return downstream) or juveniles to migrate downstream past the site. In the case of the robust redhorse, this species also has been found to spawn in limited gravel habitats near Augusta and is merely presumed to be distributed elsewhere in the Savannah River (none have been collected near Vogtle).

Q8: Have you personally conducted an evaluation of the shortnose sturgeon in the Savannah River and come to an opinion about it?

A8: Yes, I have. At the request of SNC, I surveyed the literature on shortnose sturgeon, including scientific studies and agency status reports and management plans and provided a summary and document list to SNC. The studies I relied on for my opinion are listed on Exhibit SNC000019, each with a short summary of the relevant information for the question of whether the river reach near Vogtle is an extremely sensitive biological resource for the shortnose sturgeon. In addition, my opinion is based on the impingement and entrainment studies conducted by SNC, which studies started in March 2008. To date in these studies, SNC has not collected any shortnose sturgeon or robust redhorse. *See* Exhibits SNC000004 and SNC000005.

Q9: Please summarize your findings and opinion.

A9: I located relatively recent articles that would contribute to understanding the distribution of shortnose sturgeon in the Savannah River and possible importance of the Vogtle reach to the population. In aggregate, the studies and analyses support the belief that the Savannah River at the Vogtle location is not an extremely sensitive habitat for shortnose sturgeon and that the cooling system poses minimal risk to the species. The river at Vogtle serves mainly as a migration corridor for adults and juveniles going to and from upstream spawning grounds (RM 171-173 according to Hall et al. 1991). Specifically, adults migrate upstream to spawn from mid-February to mid-March, and return downriver mid-March to early May according to telemetry studies by Hall, et al. (1991). Migration rates were rapid, up to 33 km per day, and thus passage through the Vogtle reach would be brief. The very fact that successful spawning occurs consistently many miles upstream of the Vogtle Units 1 & 2 intake and discharge indicates that there is an effective zone of passage for pre-spawning adults moving upstream, spawned adults moving downstream, and juveniles moving downstream. The Vogtle 1 & 2 intake and discharge are thus not in critical zones of passage and do not compromise any extremely sensitive biological resources needed by the shortnose sturgeon. The similarly designed intake and discharge for Units 3 & 4 would likely also not be in critical zones of passage and would not compromise any extremely sensitive biological resources. While thirteen larval shortnose sturgeon were captured in ichthyoplankton surveys in the Savannah River for the SRS (Paller, et al. (1986)), none were collected in SNC's impingement and entrainment study this spring. Larval and juvenile shortnose sturgeon, like most sturgeon species, occupy the river bottom, where they are unlikely to encounter the Vogtle intake canal or thermal discharge.

Q10: Are you familiar with the robust redhorse?

A10: Yes. I have studied the scientific and administrative literature regarding this species that are listed on Exhibit SNC000020.

Q11: What is your understanding of its status?

A11: The robust redhorse, *Moxostoma robustum*, is an imperiled, large, river sucker with wild populations found in three Atlantic slope drainages: (Ocmulgee and Oconee Rivers (Georgia), Pee Dee River (North Carolina and South Carolina), and Savannah River (South Carolina and Georgia). It is found in small numbers in the lower 300 km (186 miles) of the Savannah River. Small, stocked populations have been established by introducing fish in the

Ocmulgee, Ogeechee, and Broad Rivers in Georgia. It was essentially lost to science until "rediscovered" in 1991 in the Oconee River. It is not listed under the federal Endangered Species Act (ESA), but its recovery is under supervision of an interagency Robust Redhorse Conservation Committee formed by Memorandum of Agreement in accordance with Section 4(b)(1)(A) of the ESA (web site for the Robust Redhorse Conservation Committee, www.robustredhorse.com). A conservation strategy has been adopted (Nichols 2003). *See* Exhibit SNC000021.

Q12: Is there critical habitat for the robust redhorse near the Vogtle site?

A12: No. Other than scattered individuals that may occur in the lower river, the only critical habitat is the spawning location considerably upriver of the Vogtle site.

Q13: Would you explain the location of this spawning in relation to Vogtle?

A13: Spawning (in May) in the Savannah River is known to occur only on small, mid-channel gravel bars near Augusta, Georgia, in the tailwaters of the New Savannah Bluff Lock and Dam between river kilometers (rkm 300 and 280) (river miles 186 and 184). The Vogtle site is more than 30 river miles downstream. The gravel bars are unique in the lower Savannah River (Freeman and Freeman 2001; Grabowski and Isely 2006, 2007b). The fish aggregate in large clusters of individuals (80-85) for spawning, and eggs are deposited in the gravel (Grabowski and Isely 2008). After 10-15 days in the gravel, larvae disperse downstream. The gravel bars are susceptible to dewatering (Grabowski and Isely 2007a) and pulsed, high-velocity flow (Wyers et al. 2003), which appears to be the dominant threat to the species in the Savannah River.

Q14: Does the conservation strategy for the robust redhorse identify any impacts from the Vogtle power plant as problems facing the species?

A14: No. The principal problems facing the species are identified as sedimentation from watershed development and dams that restrict spawning movements and access to probable spawning sites, both of which appear to have limited the amount of suitable spawning habitat (Nichols 2003). Historically, unrestricted harvest likely reduced populations to isolated remnants.

Q15: Have you reviewed the FEIS analysis with regard to the shortnose sturgeon and robust redhorse?

A15: Yes.

Q16: In your opinion, does the FEIS demonstrate that NRC Staff conducted an adequate analysis of potential impacts of the proposed project on the shortnose sturgeon and robust redhorse?

A16: Yes. The FEIS describes an analysis that is thorough, uses standard methods, and is consistent with the level of detail that the estimated impacts warrant. In the FEIS, the NRC Staff analyzed SNC's proposed closed-cycle wet cooling system and determined that the impact of such system on the shortnose sturgeon and robust redhorse would be SMALL. FEIS, Section 9.3.2. With regard to the shortnose sturgeon, the FEIS finds that (i) there is no designated "critical habitat" in or near the Vogtle site; (ii) there are no spawning areas for the shortnose sturgeon or robust redhorse in the vicinity of the Vogtle site; and (iii) that the design of the intake structure inhibits entrainment and impingement. FEIS, Sections 2.7.2.1-2, 5.4.2.2, and 9.3.2. The FEIS concludes that the "overall impact on aquatic resources of operating the proposed VEGP Units 3 and 4 . . . would be SMALL[.]" FEIS, Section 5.4.2.9. In addition, the NRC

Staff determined that design and operation of the proposed cooling water intake system are not likely to adversely impact shortnose sturgeon because the area affected by thermal discharge is small in comparison to the width of the Savannah River at the Vogtle site. FEIS, Section 5.4.3.2.

The potential impacts of the closed-cycle cooling system on the robust redhorse are also addressed by the FEIS. NRC Staff found that the robust redhorse spawning areas are 25 miles upstream of the Vogtle site and the adults stay primarily within the main channel as they move up and down the river. As a result, the FEIS states that "the potential for impact to the State Listed robust redhorse from entrainment, impingement, and thermal or chemical discharges would be minor." FEIS, Section 5.4.2.6.

Accordingly, given the absence of significant impacts, the NRC Staff's analysis of dry cooling as an alternative is adequate. Moreover, notwithstanding the contents of the FEIS, the further analysis that I and SNC have conducted and the additional evidence I describe in this testimony establish that the proposed project will have no effect on the shortnose sturgeon and robust redhorse.

Q17: Are you familiar with the letter of August 11, 2008 from Roy E. Crabtree, Regional Administrator of the Southeast Regional Office of the U.S. National Marine Fisheries Service to William Burton of the NRC?

A17: Yes, I am.

Q18: What is that letter about?

A18: It is a letter that conveys the NMFS' concurrence with the NRC's determination for the "Vogtle ESP Environmental Impact Statement" that the proposed addition of Vogtle 3 and 4 is not likely to adversely affect shortnose sturgeon, a species listed under the ESA, and that there is no designated "critical habitat" in or near the project area. *See* Exhibit SNC000022.

Q19: Why is such a letter important for this proceeding?

A19: Section 7 of the ESA requires that the agency preparing an EIS consult with agencies in charge with protecting listed species ("Section 7 consultation"). The shortnose sturgeon is listed and occurs in the lower and middle Savannah River. The NMFS is the designated authority for the shortnose sturgeon, which is migratory from marine waters into coastal rivers and thus under marine protection (strictly fresh water species would be under the jurisdiction of the U.S. Fish and Wildlife Service).

Q20: What is entailed in obtaining this letter and its concurrence?

A20: The EIS agency (in this case, the NRC) prepares a Biological Assessment of impacts to the listed species and formally requests concurrence from NMFS or FWS. As the letter indicates, NRC did that in January 2008. The NMFS staff reviewed the information in the Draft Environmental Impact Statement (DEIS), which is summarized in the letter to demonstrate that the NMFS understands the scope of the proposed project. The NMFS identified potential impacts to the shortnose sturgeon and conducted its independent analysis of those potential impacts. As the letter states, the NMFS found the impacts insignificant and the Vogtle reach of the river to not contain essential fish habitat. The letter is the formal document providing the legal concurrence by NMFS.

Q21: Why has the NRC Staff not requested a similar letter from NMFS for the robust redhorse?

A21: The robust redhorse is not a species listed under the ESA and thus does not require Section 7 consultation.

Q22: Does your evaluation described above confirm the findings of the NMFS letter?

A22: Yes. My research and analysis are fully consistent with the NMFS determination as well as the FEIS findings.

Q23: Are true, accurate and correct copies of each of the exhibits heretofore referenced in your testimony attached to this pre-filed written testimony, and do they accurately portray the facts they purport to portray?

A23: Yes, except for Exhibit SNC000012, which is attached to my testimony regarding Environmental Contention 1.2, and Exhibits SNC000004 and SNC000005, which are attached to the testimony of Anthony R. Dodd/Matthew T. Montz regarding Environmental Contention 1.2.

Q24: Are the items listed on Exhibits SNC000019 and SNC000020 scholarly or learned journals, articles or treatises commonly relied upon in your profession?

A24: Yes.

Q25: Does this conclude your testimony?

A25: Yes.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	Docket No. 52-011-ESP
	)	
Southern Nuclear Operating Company	)	ASLBP No. 07-850-01-ESP-BD01
	)	
(Early Site Permit for Vogtle ESP Site)	)	January 9, 2009

AFFIDAVIT OF DR. CHARLES C. COUTANT IN SUPPORT OF SOUTHERN NUCLEAR'S PRE-FILED TESTIMONY ON ENVIRONMENTAL CONTENTION 1.3

I, Dr. Charles C. Coutant, do hereby state as follows:

1. I am a retired Distinguished Research Staff Member of the Oak Ridge National Laboratory. A statement of my professional qualifications is attached to the SNC pre-filed testimony to be submitted on January 9, 2009, in response to hearing issues identified by the Board.

2. I have read the foregoing prepared testimony regarding environmental matters at the Plant Vogtle Site.

3. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record of this proceeding. I declare under penalty of perjury that those statements, and my statements in this affidavit, are true and correct to the best of my knowledge, information and belief.

ANGIE GRAY STATE OF TENNESSEE NOTARY PUBLIC ANDERSON COUNTY

Charles C. Coutant
Dr. Charles C. Coutant

Subscribed and sworn to before me this 23 day of December, 2008.

Angie Gray
Notary Public
Comm exp. 08/25/2010

MR. LeJEUNE: Your Honor, do you want to do rebuttal next? Or enter his exhibits for his direct testimony?

JUDGE BOLLWERK: Let's see. He has four exhibits for his direct testimony. We can -- I think we can do it either way. Whatever you -- you want to go ahead and put the --

MR. LeJEUNE: Let's go ahead and do rebuttal.

JUDGE BOLLWERK: All right.

MR. LeJEUNE: Or I'm sorry, he doesn't have any rebuttal.

JUDGE BOLLWERK: I didn't think he did. I was wondering where you were going next because I don't have anything listed.

MR. LeJEUNE: I was about to do that, sorry.

JUDGE BOLLWERK: Okay.

MR. LeJEUNE: Well, then let's go ahead and mark for identification Dr. Coutant's exhibits on Environmental Contention 1.3.

JUDGE BOLLWERK: All right.

MR. LeJEUNE: I understand from my colleague that you would like us just to read --

JUDGE BOLLWERK: Yes, just a brief

description of each one. Then we can -- so we can make sure that the description and what goes in match up. So --

MR. LeJEUNE: The first is SNC000019 entitled Literature Regarding the Shortnose Sturgeon.

JUDGE BOLLWERK: All right. Let the record reflect that Exhibit SNC000019 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000019-00-BD01 for identification.)

MR. LeJEUNE: The next is SNC000020, Literature Regarding the Robust Redhorse.

JUDGE BOLLWERK: All right. Then the record should reflect that Exhibit SNC000020 as identified by Counsel is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000020-00-BD01 for identification.)

MR. LeJEUNE: Next, SNC000021, Robust Redhorse Conservation Strategy Report.

JUDGE BOLLWERK: Let the record reflect that Exhibit SNC000021 as identified by Counsel is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000021-00-BD01 for identification.)

MR. LeJEUNE: And the last is SNC000022, August 11 letter from Roy Crabtree from the National Oceanic and Atmospheric Administration.

JUDGE BOLLWERK: All right. Then the record should reflect that Exhibit SNC000022 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000022-00-BD01 for identification.)

MR. LeJEUNE: Thank you, Your Honor. We'd like to move for admission of these exhibits.

JUDGE BOLLWERK: Any objections?

(No response.)

JUDGE BOLLWERK: Hearing none, then Exhibits SNC000019, 20, 21, and 22 are admitted into evidence.

(Whereupon, the above-referred to documents were received into the record as Exhibit Nos. SNC000019-00-BD01 through SNC000022-00-BD01.)

MR. LeJEUNE: Thank you.

Next if we could load Mr. Cuchens prefiled direct testimony for 1.3?

Mr. Cuchens, do you recognize the document on the screen as your prefiled direct testimony concerning Environmental Contention 1.3?

MR. CUCHENS: Yes, I do.

MR. LeJEUNE: Thank you.

If you could please verbally affirm the following, that the testimony entitled Testimony of James W. Cuchens on behalf of Southern Nuclear Operating Company Concerning Environmental Contention 1.3 and dated January 9, 2009, which has been provided to the Court Reporter in electronic format under file name Cuchens 1.3 Testimony was prepared by you or under your supervision and direction and is true and correct to the best of your knowledge and belief?

MR. CUCHENS: Yes, it is.

MR. LeJEUNE: Thank you.

Your Honor, we move to admit Mr. Cuchens' direct testimony as if read please.

JUDGE BOLLWERK: Any objections?

(No response.)

JUDGE BOLLWERK: Hearing none, then the record should reflect that the entry of the direct testimony of Mr. Cuchens as DDMS Item ID 58872.)

(Cuchens, et al. Direct Testimony (DDMS-58872) to be inserted at this point)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	**Docket No. 52-011-ESP**
Southern Nuclear Operating Company	)	**ASLBP No. 07-850-01-ESP-BD01**
(Early Site Permit for Vogtle ESP Site)	)	**January 9, 2009**

**TESTIMONY OF JAMES W. CUCHENS
ON BEHALF OF
SOUTHERN NUCLEAR OPERATING COMPANY
CONCERNING ENVIRONMENTAL CONTENTION 1.3**

Q1: Please state your name, occupation and business address.

A1: My name is James W. Cuchens. I hold the position of Principal Engineer for Southern Company Generation Engineering and Construction Services (SCG Engineering) in Birmingham, Alabama. SCG Engineering is a division of Southern Company Services, which is a sister company of Southern Nuclear Operating Company (SNC) both of which are subsidiaries of The Southern Company. My business address is: Inverness Office Park, Birmingham, Alabama 35201.

Q2: Please describe your educational and professional background.

A2: I earned a B.S. degree in Mechanical Engineering from Mississippi State University in 1973 and hold professional engineering licenses in Alabama (PE # 13752), Florida (PE # 37700), Georgia (PE # 16164), and Mississippi (PE # 09905).

I have worked as an engineer for The Southern Company for 35 years. My experience encompasses all phases of power plant design and construction: conceptual design studies, equipment design specifications, and equipment bid evaluations. I have designed the thermal cycle equipment, boiler and draft system equipment, and plant cooling system equipment for various types of units, including nuclear, fossil, and co-generation. As relevant to this proceeding, in the area of cooling, I have been involved in the development of equipment technical specifications, bid evaluations, and applied research of systems equipment technologies. I have developed expertise in the design of various types of cooling cycles, including closed loop, once-through, and/or cooling ponds, serving nuclear units, fossil units, and cogeneration units.

My job requires operating knowledge of the optimization of the cooling system equipment (towers, pumps, and condensers) for new and/or existing units, taking into consideration performance, capital cost, and operation and maintenance. I have developed computer programs for selection of cooling cycle equipment design as well as the analysis of equipment and/or plant performance. I have extensive experience with modeling cooling system/cycles and performance analysis for simulation of various cooling system(s), including mechanical and draft, and wet and dry. I have performed feasibility studies for modifying and/or upgrading existing towers for enhancing tower performance and reducing operations and maintenance costs.

I contribute my expertise to various professional engineering organizations including the ASME (formerly, American Society of Mechanical Engineers) and the Cooling Technology Institute ("CTI"). With the ASME, I served on PTC 23, Cooling Tower Test Code Committee, and PTC 30, Air Cooled Condenser Test Code Committee. With CTI, I sat as a member of the Codes and Standards Committee. Besides my committee work for CTI, I had the honor of serving as the organization's President and Chairman of the Board (2000), Vice President

(1999), and a member of the Board of Directors (1995-1997 and 1999-2001). For the past four years, I have served as the Education Program Chairman of CTI. My Curriculum Vitae is attached hereto (*See* Exhibit SNC000023).

Q3: Please state the purpose of your testimony.

A3: My testimony focuses in detail on the feasibility of dry cooling technology for the Vogtle 3 and 4 nuclear units. In two respects, I address the specific topics on which the Joint Intervenors raised factual disputes. First, I sponsor "Feasibility of Air-Cooled Condenser Cooling System for the Standardized AP1000 Nuclear Plant" (the "Revised Report") (Exhibit SNC000024, attached hereto). The Revised Report revises and expands on the report dated June 25, 2007 (the "Initial Report") I attached as Exhibit 1 to my affidavit in support of SNC's Motion for Summary Disposition of contention EC 1.3 (the dry cooling issue) submitted to the Commission on October 17, 2007. Both documents study the feasibility of incorporating a dry cooling system into the design for an AP1000 Nuclear Plant in South Georgia, the location of the proposed Vogtle units. My colleague, Chris Lazenby, helped me research and draft the Revised Report and his Curriculum Vitae is attached (*See* Exhibit SNC000025). Second, I respond to specific assertions in the Declaration of Mr. Bill Powers ("Powers Declaration") which supported the Intervenors' Answer Opposing to SNC's Motion for Summary Disposition.

Q4: Please explain how the closed-cycle wet cooling system of the AP1000 Nuclear Plant and a dry cooling system operate.

A4: In the standard design of the AP1000 Nuclear Plant, steam is passed across a steam turbine and the turbine turns a generator, creating electricity. The steam leaves the turbine and goes to a steam surface condenser, a large heat exchanger filled with tubes that have cold water flowing through them. The cold water in the tubes absorbs the heat from the steam, causing the steam to condense back into liquid form; the condensed liquid is then pumped back to the steam generator and the process begins again. The water circulating through the condenser tubes is then pumped out to a wet cooling tower where it is cooled by discharging its heat to the surrounding air largely by evaporation. Once cool, the water is collected in a basin below the tower and pumped back through the condenser tubes. Both circuits continue in a continuous process (hence the name – "closed loop cooling system").

In contrast to a closed-cycle wet cooling system, which relies on the cooling property of water, a dry cooling system is based on an air-cooled condenser (ACC). In such a system, the steam leaving the turbine is piped through large ducts outside of the turbine building to an ACC where it is cooled by air flowing over large metal-finned tubes. The heat from the cooling water is rejected directly to the air and atmosphere. As the steam loses its heat, it condenses to water and is drained to a large tank from which it is pumped back to the nuclear steam supply system. (*See* Revised Report, Exhibit SNC000024, pp. 3, 10).

Q5: What do you conclude in your Revised Report regarding the feasibility of dry cooling technology for the Vogtle 3 and 4 units?

A5: In the Revised Report I conclude, in greater detail than in the Initial Report, that dry cooling is not feasible for use in the current standard AP1000 design at Vogtle 3 and 4. We originally intended to conceptualize a dry ACC cooling system to match the performance of the AP1000 wet cooling system. However, we quickly realized that our efforts were futile. Simply designing the ACC for the same backpressure (exhaust pressure) as the steam surface condenser of the wet cooling system quickly translated to other design and performance challenges such as: 1) adding miles of large steam ducts to get the steam from the turbine to the ACC; 2) eliminating air-in leakage in miles of steam ducts in order to avoid further degradation of backpressure/performance; and 3) designing an air-removal system (vacuum pumps/jets, etc.)

that would be capable of evacuating the huge steam ducts. The extreme difficulty in resolving these significant design issues makes use of dry cooling, for all practical purposes, impossible. (*See* Revised Report, Exhibit SNC000024, pp. 22-23).

Q6: What is backpressure?

A6: During the cooling process described above, when steam is condensed back to liquid form, it requires a significantly less amount of space and/or volume. When this occurs, it creates a vacuum which is often referred to as backpressure inside a steam condenser and turbine exhaust. Typically, the lower the backpressure (or vacuum), the better turbine performance will be because the lower the pressure, the less restriction is being placed on the turbine exhaust flow. It is similar to an automobile's exhaust system. If you obstruct the exhaust system by placing a tennis ball in the exhaust pipe, the engine's performance will be adversely affected. If that tennis ball is removed, the vehicle's performance will improve. (*See* Exhibit SNC000026, p. 7).

Q7: As part of your analysis regarding the feasibility of dry cooling technology for the Vogtle 3 and 4 units, what specific issues do you discuss in your testimony?

A7: In order to explain why dry cooling technology is not feasible for the Vogtle 3 and 4 units, I will address feasibility as it relates to the four disputes of material fact set forth in the Atomic Safety and Licensing Board's ruling on SNC's Motion for Summary Disposition. These four disputes of material fact are: 1) the types of turbines that can be used with an AP1000 Nuclear Plant; 2) the adequacy of dry cooling system design for use in facilities like the Vogtle 3 and 4 units; 3) the impact of the climate in the vicinity of the Vogtle 3 and 4 units on the efficacy of a wet and dry system cooling; and 4) the potential financial, environmental and performance impacts on the facility design, construction and operation of using a dry rather than wet cooling system. In this testimony, I discuss each of these matters, except for the environmental impacts of installing dry cooling, which will be addressed by Tom Moorer.

Q8: Do you discuss any other issues in your testimony?

A8: Yes. The Intervenors' expert, Mr. Powers, denied that dry cooling impeded the standard design for the NRC-approved AP1000 Nuclear Plant. (Powers Declaration ¶ 10.) I also discuss how dry cooling at the Vogtle 3 and 4 units would be inconsistent with the standard design for the AP1000 Nuclear Plant.

Q9: Please describe the type of turbine that is specified for an AP1000 Nuclear Plant.

A9: For optimum plant efficiency, the turbine-generator design for the AP1000 Nuclear Plant, as specified in the Design Control Document (DCD), Rev. 17, Table 10.1-1 (attached hereto, Exhibit SNC000027), currently pending before the NRC, requires a Toshiba tandem-compound six-flow turbine with a 52-inch last stage blade (LSB). This turbine-generator package consists of a high pressure (HP) element and three low pressure (LP) elements. This means that the turbine exhausts its steam in three distinct sections (the triple exhaust) with each section being physically split so that two distinct steam flows per section are pushed through simultaneously (thus, six flows). For the standard AP1000 Nuclear Plant design as specified in the DCD, the three exhaust sections operate at different design backpressures ranging from 2.37" to 3.57" HgA, giving an average backpressure for all three sections of 2.9" HgA at the design inlet cold water temperature of 91°F. To avoid structural damage caused by operating at a backpressure in excess of what the turbine can withstand, the standard turbine has an alarm point of 5.0" HgA (five inches of mercury) backpressure. This means that, if at any point the backpressure in the turbine rises above 5.0" HgA, the unit heat load must be decreased in order to continue operation.

During normal operations, the AP1000 standard turbine generator experiences backpressure in the range of ~ 1.0" to a maximum of less than 5.0" HgA. The higher the backpressure on the turbine, the less electricity the generator is able to produce, while the lower the backpressure is on the turbine, the more electricity the generator is able to produce (down to choke flow backpressure at ~ 1.0" HgA). Backpressure in excess of 5" HgA exceeds the functional operational limit of the turbine (*See* Revised Report, Exhibit SNC000024, p. 9).

Q10: Could a dry cooling system be used with the AP1000 standard turbine generator?

A10: No, the current limits of technology would likely prevent that. As detailed on p. 11 of the Revised Report, current "state-of-the-art" dry cooling units or ACC's for the utility industry are designed with an Initial Temperature Difference (ITD) of around 40°F, although there have been a few such condensers built in the United States with an ITD of 35°F. ITD refers to the constant difference between the temperature of the outside air and the temperature of the steam condensing within the tube bundles. No manufacturer of ACC's has successfully designed or built an ACC with a lower ITD than 35°F ITD.

For an ACC designed with a certain ITD, the higher the outside ambient temperature, the higher the steam saturation temperature, and therefore the higher the backpressures of the turbine will be. For example, if an ACC was designed for a 35°F ITD, then at an ambient temperature of 75°F the saturation temperature of the steam condensing inside of it would be 110°F (75° + 35° ITD), which would correspond to a backpressure of 2.6" HgA (the saturation pressure of steam at 110°F). If the ambient temperature around the same ACC rose to 100°F, then the saturation temperature of the steam would rise to 135°F (100°F + 35°F ITD) and the unit backpressure would rise to 5.16" HgA. At the design ambient air temperature of 95°F, the lowest turbine backpressure potentially achievable with an ACC based on the current technological limit of a 35°F ITD would be around 4.5" HgA, which is only .5" HgA below the alarm point for the turbine incorporated into the AP1000 design. Additionally, with an ACC, operation at multiple exhaust pressures would no longer be viable. Since 4.5" HgA is the lowest achievable backpressure and any rise above this would put the turbine near or above its alarm point, an AP1000 unit as described in DCD Rev. 17 would not be able operate at full rated power any time the inlet air temperature to the ACC was greater than 95°F.

Q11: Is a triple-exhaust turbine required in the AP1000 Nuclear Plant?

A11: Yes. The AP1000 thermal cycle produces large volumes of exhaust steam and this makes it physically impossible to send exhaust through a single-exhaust or, in most cases, a double-exhaust turbine. Physical limits of the materials and construction of turbine shafts, blades, and casing dictate the maximum amount of steam that can safely pass through a given flow area within a turbine and the maximum safe operating speed of the turbine shaft. Importantly, large, multi-exhaust turbine-generators similar to the Toshiba turbine incorporated in the AP1000 design are standard in the nuclear industry. *See* DCD, Section 10.2.4. (attached as Exhibit SNC000028).[1] Thus, it is accurate to say that an AP1000 unit, regardless of its cooling system design, would have to use at least a triple-exhaust turbine in order to physically be able to pass the steam flow specified in the AP1000 thermal cycle.

[1] *See also* Exhibit SNC000029, p. 13 (G.E. Steam Turbine Product Brochure (an example of a GE "standard" nuclear steam turbine and note that it contains a six-flow LP turbine.) (available at: http://www.gepower.com/prod_serv/ products/steam_turbines/en/ downloads/steam_brochure.pdf).

Q12: Can an AP1000 Nuclear Plant operate with a uniform pressure on all sections?

A12: While not recommended, the turbine could physically operate with all three exhaust sections seeing the same backpressure, even though such operation would drastically deviate from the current thermal cycle design and, more important, change the heat balance performance (performance guarantee) for an AP1000 Nuclear Plant located on the Vogtle site. Operating the turbine as a single-pressure turbine rather than a multi-pressure turbine would have a detrimental impact on turbine/cycle efficiency. In comparison to operating a triple pressure turbine, operating a single pressure turbine restricts the exhaust sufficiently to reduce turbine performance. A simple analogy would be to stick a tennis ball in one of the exhausts of an automobile with a dual exhaust system. While the automobile will still run, it would not be as efficient nor would it be good for the engine since the exhaust pressure on half of the engine will be restricted due to the tennis ball.

Q13: Mr. Powers claims (Power's Declaration, ¶ 13) that the AP1000 Nuclear Plant could use less expensive, higher-backpressure turbines, rated to 8" HgA, to accommodate dry cooling. In fact, he recounts a conversation with a General Electric official who stated that a high-pressure GE D11 system can work with dry cooling. How do you respond?

A13: The current AP1000 standard plant design as specified in DCD Rev. 17 **does not** employ a high backpressure turbine which would be necessary to accommodate an 8" HgA backpressure as suggested by Mr. Powers. I am not aware of any turbine manufacturer that offers a triple-exhaust high-backpressure turbine capable of handling the steam flows that would be associated with the current AP1000 steam cycle if the reactor used dry cooling. As such, while I would not say that a high backpressure turbine and/or an air-cooled system could never theoretically be used with any kind of AP1000 plant design, I would say that it cannot be used with the **current** AP1000 standard plant design, as proposed for the Vogtle site and specified in DCD Rev. 17.

Moreover, in making the assertion that a high-backpressure turbine could be used in conjunction with the AP1000 units at the Vogtle site, the Intervenors and Mr. Powers appear to extrapolate from experience with significantly smaller generating units. (Powers Declaration ¶ 23). Their underlying assumption appears to be that since those smaller units can use high backpressure turbines, then it is true for every power plant in operation. Even if we were to accept the assertion from the General Electric official cited by Mr. Powers at face value, that teaches us nothing about the AP1000 Nuclear Plant. (See Powers Declaration ¶ 13 n.1) The specific turbine Mr. Powers references is a GE single-exhaust, dual-flow turbine designed for "Medium Fossil Applications"[2] and is not comparable to the significantly larger and more complex turbine specified in the DCD for an AP1000 Nuclear Plant located on the Vogtle site. What Mr. Powers asserts is akin to suggesting that the four cylinder engine in your personal automobile is capable of producing the horsepower necessary to compete in a NASCAR race because both your car and a race car are four-wheeled vehicles driven by internal combustion engines. There is a point at which such generalizations become overbroad and that is the case here.

[2] *See* Exhibit SNC000030 (available at: http://www.gepower.com/ prod_serv/products /steam_turbines/en/fossil =/d_series.htm).

Q14: Mr. Powers said that you ignore nuclear plants in the U.S. and abroad that incorporate dry cooling (Powers Declaration ¶¶ 7 and 9). How do you respond?

A14: Mr. Powers does not identify a nuclear power plant that utilizes dry cooling. He suggests that the Palo Verde Nuclear Generating Station uses dry cooling based on a "plant expansion proposed in the late 1970s", but this suggestion is incorrect. A simple search on the Internet, reveals that the Palo Verde reactor actually uses wet cooling. (*See* Exhibit SNC000031, attached hereto (www.pnm.com/systems/pv.htm)) Though located in the desert, the plant uses treated municipal waste water and stores it in a man-made reservoir.

Speaking in a broader context, we have visited and studied numerous large dry cooling installations both in the U.S. and abroad, (including Majuba, Matimba, and Kendal in South Africa)[3] in order to capture their experiences, lessons learned and best practices from design and operational perspectives. As such, our opinions are based on solid experience with applied technology rather than cherry-picking, as suggested by Mr. Powers.

As part of our research regarding the use of dry cooling in Southern Company generating facilities, we have investigated numerous dry cooling technologies in pursuit of water conservation and have spent considerable efforts on optimizing dry cooling systems for potential use on future combined cycle gas plants, where dry cooling proves to be an economically viable technology, in part because of the relatively smaller size of the turbines as compared with the AP1000 turbine. I doubt that anyone else has gone through as extensive an effort in pursuit of applied dry cooling technology as we have at Southern Company. Having gone through these

[3] *See* Exhibit SNC000032, Overview of Kendal Power Station (available at: http://www.eskom.co.za/live/content.php?Item_ID=170&Revision=en/0); Overview of Majuba Power Station (available at http://www.eskom.co.za/live/content.php?Item_ID=181&Revision=en/2); Overview of Matimba Power Station (available at: http://www.eskom.co.za/live/content.php?Item_ID=183&Revision=en/0).

efforts, we are confident in our assertion that dry cooling is not feasible at the Vogtle 3 and 4 units.

Q15: The Intervenors' Answer to the Motion for Summary Disposition (¶ 12) asserts that you did not address the Midlothian coal plant, which uses dry cooling and Intervenors allege is nearly the capacity of either the Vogtle 3 or Vogtle 4 AP1000 units. Is the Midlothian coal plant relevant to assessing the feasibility of dry cooling for the Vogtle site?

A15: No. While the total capacity of the Midlothian plant is 1,650 megawatts, slightly higher than that of Vogtle 3 or Vogtle 4, the 1,650 actually arises from six separate units of 275 megawatts each.[4] Therefore, no relevant comparison can be made between a Midlothian unit and an AP1000 Nuclear Plant at the Vogtle site (*i.e.*, comparing six small high backpressure turbines to a single large standard backpressure turbine is like comparing apples to oranges). The same is true for the Matimba plant in South Africa that Mr. Powers mentions at ¶ 23 of his declaration.[5] To be relevant, the comparison would have to entail dry cooled units of equal size with similar turbine cycles rather than a group of small units to a single large unit. However, since such large dry cooled units don't exist, Mr. Powers' comparison inappropriately attempts to make it appear as though they are technically sound and viable.

Q16: Even if it were possible to construct and install a dry cooling system, is it feasible to use dry cooling at the Vogtle site given the climate of South Georgia location?

A16: No. As I stated earlier, operating an AP1000 Nuclear Plant as currently specified in the DCD with a "state-of-the-art" air-cooled system would likely result in backpressure in

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[4] *See* Exhibit SNC000033, Description of the Midlothian Power Plant, Energy Information Administration Existing Generating Units in the United States by State, Company and Plant, 2006 (p. 188) (available at: http://www.eia.doe.gov/cneaf/electricity/page/capacity/existingunits2006.xls).

[5] Exhibit SNC000032, Overview of Matimba Power Station.

excess of the steam turbine alarm point any time the temperature was at or above the design ambient air temperature of 95°F, which can occur quite a bit in South Georgia. In addition, the 20°-30°F differential in daily temperatures on hot days would harm operation of the plant. (*See* Revised Report, pp. 11-12).

Q17: Mr. Powers contends that the difference in air temperature over the course of a day does not affect the capability of dry cooling systems and that you failed to demonstrate that is does. (Powers Declaration ¶ 14). **Does the difference in air temperature affect dry cooling systems?**

A17: Yes. This opinion is not mine only, but it is shared by industry experts. For example, in a paper presented at the 2002 National Energy Technology Laboratory (NETL) Electric Utilities and Water: Emerging Issues and R&D Needs Conference, John M. Burns, the Chairman of the recent ASME PTC 30.1 committee that wrote an acceptance test code for ACCs, and Wayne Micheletti, an recognized industry consultant in the area of power plant cooling and environmental issues, stated the following:

> For dry cooling systems, sensible heat transfer is the only form of heat rejection, so performance depends upon the ambient air dry-bulb temperature instead of the wet-bulb temperature. Because ambient dry-bulb temperatures are usually higher and tend to *experience more dramatic daily and seasonal fluctuations* than ambient wet-bulb temperatures, *designing and operating dry cooling systems to obtain the consistent and continuous performance historically provided by wet cooling systems is possibly the greatest obstacle to the increased use of dry cooling in power plants*.[6]

Q18: How does the daily fluctuation in temperature affect dry cooling systems?

A18: First, we would need to assume that a "state-of-the-art" ACC could be constructed for an AP1000 Nuclear Plant on the Vogtle site and it could actually maintain a backpressure of

[6] Exhibit SNC000034, "Emerging Issues and Needs in Power Plant Cooling Systems" by Wayne C. Micheletti and John M. Burns, P.E., presented at the 2002 National Energy Technology Laboratory (NETL) Electric Utilities and Water: Emerging Issues and R&D Needs Conference, at p. 5 (emphasis added) (available at http://204.154.137.14/publications/proceedings/02/EUW/Micheletti_JMB.PDF).

4.5" HgA at an ambient temperature of 95°F. On a summer afternoon in South Georgia when the ambient temperature (*e.g.*, 98°F) was already exceeding the design temperature, a breeze could blow the hot air discharge from the top of the ACC back down into the inlet of the ACC, instantaneously raising the inlet temperature by another 5°F. This, in turn, would increase the ITD and the backpressure. The breeze will have caused the unit to operate well above its turbine alarm set point and have placed it, with only another 3°F rise in temperature, in danger of tripping off. The operators, as they must, would begin decreasing the thermal power of the reactor in order to get below the alarm set point. This results in a decrease in the amount of power produced by the unit precisely when it is most needed by the customers dependent on Georgia Power. Then, assume a sudden thunderstorm moved in and cooled the air by 15°F. In that case, the operators would try to increase production from the plant back towards the unit's rated output, and so on as climate conditions changed.

In short, an AP1000 Nuclear Plant operating with an ACC would be in a mode where the operators were constantly "chasing" the weather. This is a very real situation that could, and would, occur due to the sensitivity of a dry-cooled system to changes in the ambient dry bulb temperatures. In addition, due to exposure to winds from all directions, the vast size of the ACC, which the current standard AP1000 Nuclear Plant would entail, enhances the detrimental impact of temperature and/or wind fluctuations. Lastly, though ACC performance can change suddenly from meteorological influences, it does not respond rapidly to sudden changes in thermal loading. Thus, it would be virtually impossible to control and/or modulate a large ACC system (with approximately 300 fans) to react to fluctuating weather influences without impacting unit performance.

By contrast, these climate conditions would pose a less significant risk on a wet cooling system because it relies on wet-bulb temperature, meaning that, in addition to the ambient air temperature, the operation of a wet cooling tower is dependent upon the amount of moisture in the air. In contrast to the temperature, the moisture in the air remains more stable. The only way wet cooling would cause the same fluctuations in electric generation as an ACC is if both the temperature and moisture in the air would change quickly and dramatically. A wet cooling tower would also be significantly smaller and thus we would be able to place it in a more favorable location on the plant site in order to minimize hot plume recirculation effects of sudden winds (or, as a result of the height of a natural draft cooling tower, render them almost entirely moot). (*See* Revised Report, pp. 12, 15).

Q19: Please summarize your conclusions about the impact of the climate at the Vogtle site on the desirability of a possible dry cooling system.

A19: In South Georgia, extreme maximum temperatures recorded in the vicinity of the Vogtle site have ranged from 105°F to 112°F at Louisville IE station. According to climatic data referenced in the Vogtle Environmental Report at section 2.7.4.1.1, the station record high temperature for the Midville Experiment Station (*i.e.*, 105°F) has been reached on four separate occasions. Individual station extreme maximum temperature records were set at multiple locations on the same or adjacent dates. The similarity of the respective extremes suggests that these statistics are reasonably representative of the temperature extremes that might be expected to be observed at the Vogtle site.

The hot South Georgia summers would correspondingly increase steam saturation temperatures and backpressures beyond the operational limits of the turbine, and consequently eliminate the capability of an ACC to provide necessary cooling during times of peak electric load. This creates a practically insurmountable limitation on the technical feasibility of an ACC system in conjunction with the AP1000 steam turbine at the proposed site. Conversely, even if an ACC could be designed and constructed that would deliver backpressures within the AP1000's specification (2.9" HgA), the ITD necessary to deliver such pressures would need to be approximately 20°F, or approximately 50 percent of the minimum ITD achievable with current ACC technology.

Q20: Mr. Powers stated that you exaggerate the extreme climate in South Georgia. He said that "during much of the year" the area experiences maximum temperatures below 70°F and no difference between dry and wet cooling will appear (Powers Declaration ¶ 20). How do you respond to Mr. Powers?

A20: Mr. Powers' assertions mischaracterize the issue. First, with regard to the ambient air design point of 95°F, using a 1 percent temperature value is standard industry practice when designing a cooling system for an electric generating plant. While it is true that these design values are typically only exceeded in 1 percent of the hours during a year (87 hours), there is no way to know if temperatures will be higher than that value for a much greater amount of time. As shown in a study by Michael Kjelgaard in calendar year 2003, the ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) found that 1 percent of summer design dry bulb and/or wet bulb temperatures were exceeded in literally hundreds of hours in a dozen major cities[7]. It may be that an AP1000 Nuclear Plant located on the Vogtle site would not frequently experience temperatures in excess of 95°F, but that does not help much during a summer such as that of 2007 when temperatures exceeded 100°F across the Southeast for days at a time. Moreover, the days when the temperature is the highest tend to be

[7] *See* Exhibit SNC000035, "June 2003: a year in review: ASHRAE design conditions vs. 2002 - weather report," Engineered Systems, August 2003, FindArticles.com, 24 Jul. 2008 (available at: http://findarticles.com/p/articles/mi_m0BPR/is_8_20/ai_107123411/pg_2).

the days of heaviest electricity demand. Reliance on dry cooling for large baseload capacity such as a two unit nuclear power plant would create significant reliability issues for Georgia Power and its customers.

Second, with regard to average temperatures and unit operation, Mr. Powers' assertion that during much of the year the performance of a dry-cooled unit and a wet-cooled unit would be virtually the same is misleading (Powers Declaration ¶ 20). To begin with, the reference cited by Mr. Powers, states that: "Dry cooling saves a lot of water but there is a price to pay for it...*the heat rate may be impacted on all but the coldest days*" (Powers Declaration at Attachment D, p. 9 (emphasis added) (Exhibit SNC000036, attached hereto). A chart in that same document clearly shows that, at dry bulb temperatures down to 60°F, a typical air-cooled system produces a higher turbine backpressure than a typical wet-cooled system. Even accepting that the "typical" values shown on that chart are applicable for an AP1000 Nuclear Plant and that the difference in backpressure produced by the two systems decreases as the ambient air temperature decreases to the point that below 60°F the turbine backpressure could be considered virtually the same, at 70°F there is still approximately a 0.5" HgA difference in turbine backpressure between a wet-cooled unit and a dry-cooled unit. On each AP1000 Nuclear Plant on the Vogtle site, this would equate to around 15 MW[8] of lost generation and that difference is quite significant. Based on historical data, the average temperature in Augusta, Georgia exceeds 60°F over 58 percent of the hours in a year.[9] Based on this, it is correct to say that an AP1000 Nuclear Plant located on the Vogtle site would face significant performance degradation for the majority of every year it is in operation by implementing an air-cooled system as compared to a wet cooling system.

[8] All references in my testimony to "MW" or "megawatts" are MWe.

[9] *See* Exhibit SNC000037, (Ref. TMY-2 data set constructed by the National Renewable Energy Laboratory (NREL) in Golden, CO, as listed in BinMaker PLUS software published by InterEnergy Software Inc., ©1999).

Q21: Do you have an opinion regarding the potential financial, environmental and performance impacts on the design, construction and operation of using dry, rather than wet, cooling?

A21: I will discuss the financial and operational questions. I understand that Tom Moorer will testify on the environmental impacts of installing dry cooling units on the Vogtle site.

Q22: What did you conclude are the financial effects of dry cooling?

A22: As I testified earlier, I am not aware of a triple pressure, 1117 MW turbine available in the marketplace that would operate at the high backpressures produced by a state-of-the-art ACC system. Conversely, as my Revised Report indicates on p. 14, constructing a dry cooling system at the Vogtle site that could replicate the performance of a wet cooling system specified in the DCD is impossible with the current turbine cycle configuration. Current limits of technology do not allow for construction of an ACC that could condense that amount of steam to that low of a backpressure on that warm of a day. However, using ratios of numbers generated from manufacturer curves for much smaller ACCs, I estimated that if such a unit could be designed and built, it would necessitate construction of approximately 324 cooling modules linked with large steam ducts. The estimated cost of construction of this ACC (excluding cost of large steam ducts, condensate tanks/pumps, foundations, and associated vacuum systems) would be approximately $445 million for each of the Vogtle 3 and 4 units, for a total of a minimum $890 million for the entire plant. None of these costs include any additional engineering or construction costs associated with required design changes to the turbine island and the significant losses of electrical output due to the inordinately large number of fans employed with an ACC of this size. In a nutshell, the incremental cost for an ACC for the current standard

AP1000 Nuclear Plant design including unit performance penalty and associated equipment is more than the cost of a single 500 MW combined cycle generating unit.

The ACC design and cost was estimated based on a design backpressure which would presumably still allow use of the steam turbine in the current standard AP1000 Nuclear Plant design. This in itself is a stretch, since the steam duct piping, ambient temperatures, and wind effects may make such a design impossible or the cooling system useless. As such, any ACC design chosen will not provide equitable performance (heat rate or net MW) in comparison with that of the steam surface/wet tower cooling system. I will elaborate on that later.

Q23: Mr. Powers indicated that you admitted that dry cooling would require 230 units in each plant, not the 334 you testified to in the summary disposition phase of this case (Power's Declaration ¶ 14). He also said that the cost in each of the proposed plants would come to $200 million, for a total of $400 million, not the $361 million for each plant, or the total of $722 million you had claimed. Please respond to his assertions.

A23: I did not mention anything about a 230 module ACC in my Initial Report that could operate successfully in conjunction with an AP1000 Nuclear Plant at the Vogtle site or the cost associated with such a unit. Moreover, I cannot find any factual basis or calculations supporting these figures within any of the supplied documentation. I think that the 230 module ACC that Mr. Powers attributes to me is actually his guess as to how large an ACC designed with a 35°F ITD at the Vogtle site would be.

Q24: How did you estimate the loss in electric generation from dry cooling?

A24: In my Revised Report, I calculated the loss in several ways to try and more clearly relate the impact of a dry cooling system on unit output. In one scenario, I assumed that an ACC could be constructed that would replicate the performance of a wet cooling system on an AP1000

Nuclear Plant proposed for the Vogtle site. In theory, the unit would suffer no output degradation with this ACC since it was operating at the same backpressure as with the wet system. However, the size of this unit would increase the consumptive power demand on the unit by anywhere from 27-33 MW over that of a wet cooling system (*See* Revised Report, p. 20).

Q25: Mr. Powers said that the actual operating loss would come to 1.5 percent, or 15-20 MW's, not the much larger volume you contend (Powers Declaration ¶ 15). How do you explain this difference?

A25: Mr. Powers did not provide any support for his measurement of the loss in efficiency from using ACC. However, I infer that the performance penalties Mr. Powers claims are based upon a paper Mr. Powers authored studying the heat rate impacts on "a 515 MW pulverized coal-fired boiler equipped with air-cooled condenser (ACC) at a north central U.S. site location" (*See* Powers Declaration, Attachment C, p.1). In this paper, Mr. Powers estimated that the average annual heat rate penalty for such a unit operating with an ACC designed with a 35°F ITD would be about 1.5 percent when compared to operation with a wet cooling tower system. The Intervenors, in Section I.13 of their opposition to summary disposition, equate this loss in efficiency to a loss of "15-20 MW at peak conditions" for an AP1000 Nuclear Plant operating with an ACC designed with a 35°F ITD at the Vogtle site.

It seems to me that Mr. Powers is using a 515 MW coal plant as an exact model for the much larger AP1000 Nuclear Plant. Such a comparison has no scientific validity.

Q26: Could you elaborate on why the comparison of a 515 MW coal plant to the 1,193 MW AP1000 Nuclear Plant is invalid?

A26: Yes. As has been repeatedly said and demonstrated, comparisons between a 515 MW coal-fired unit, which, given its capacity, would not use a multiple exhaust turbine, and a much larger, triple-turbine 1,193 MW nuclear unit are not at all germane.

The fact that the coal unit Mr. Powers studied was located in Wisconsin adds another layer of incompatibility to the study. The annual temperature distribution for Madison, Wisconsin listed in his study as representative of the plant site is quite different from that of the Vogtle site (Powers Declaration, Attachment C, p. 4). Madison, Wisconsin also has a much colder climate than South Georgia.[10]

Additionally, Mr. Powers' conclusion about the coal unit is based on an assumption that it was going to have an "average annual load (equal to) 2/3 of rated load." (*See* Powers Declaration at Attachment C, p. 5.) An AP1000 Nuclear Plant built on the Vogtle site would be a base-load unit, meaning that it would operate at its rated unit load for the entire year.

I note as well that Mr. Powers misunderstands the concept of loss of efficiency. He asserted in ¶ 15 of the Powers Declaration, "The *estimated annual average efficiency penalty* of using dry cooling at Plant Vogtle is approximately 1.5 percent using a 35°F ITD ACC" (emphasis added). What the 1.5 percent penalty in Attachment C actually refers to is an increase in plant net heat rate, or the amount of heat (in Btu's) necessary to generate one kilowatt-hour of electricity. While heat rate is a common way of expressing thermal cycle effectiveness of a power plant, strictly speaking the thermal efficiency of a power cycle is the constant 3,412 Btu/kWh divided by the plant heat rate. Semantics aside, a point of importance is that a 1.5

[10] *See* Exhibit SNC000038, National Climatic Data Center, Normal Daily Maximum Temperature, Deg F (available at: http://lwf.ncdc.noaa.gov/oa/climate/online/ccd/maxtemp.html).

percent increase in heat rate would typically only equate to around a 0.5 percent drop in thermal cycle efficiency. I do not say that the loss of efficiency at the AP1000 Nuclear Plants in Augusta, Georgia would amount to only 0.5 percent. Rather, this shows that Mr. Powers' calculation of loss of efficiency lacks merit.

Q27: What effect would the use of a dry cooling system with the Vogtle 3 and 4 units have on Georgia Power's customers?

A27: Assuming the turbine technology existed to support it, using dry cooling for the current AP1000 standard plant design would force the citizens of Georgia to pay considerably more money for less electricity and lower reliability. I estimate the capital cost increase alone for an air-cooled system at $890 million and, even according to Mr. Powers, would be at least around $200 million per unit, for a total of $400 million (Powers Declaration ¶ 14), as compared to a wet cooling system. An ACC would also cost significantly more to maintain and operate over the life of the plant than a wet system. As others have noted,

> Both direct and indirect dry cooling systems...are larger and mechanically more complex than corresponding wet cooling systems. . . .[D]ry and hybrid cooling systems will have more fans, meaning more electrical motors, gearboxes and drive shafts. As such, labor requirements for a large ACC can be substantial. At one site with a 60-cell ACC...the maintenance staff was increased by two people for such activities as cleaning fan blades and heat exchanger tube fins, monitoring lube-oil systems, and leak-checking the vacuum system.[11]

In addition to any dedicated maintenance personnel required to maintain a 200 module ACC, let alone a 324 module system, the cost of maintaining such a large number of fans, gearboxes, and motors over the life of the plant would be substantially greater than those for a comparable wet system.

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[11] *See* Micheletti and Burns, at p. 5 (Exhibit SNC000034).

The worst of it is that all of this additional money would buy significantly *less* power than a plant cooled by a wet cooling system could produce for the majority of the year. On hot days, when the temperature can reach 105°F or more, as I testified earlier, this penalty would be even greater because the plant operators would have to lower the thermal output of the reactor in order to avoid exceeding the steam turbine alarm limit. In a worst case scenario, sudden transient conditions could cause the plant to shut down because the turbine backpressure exceeded the trip point and the entire unit output of close 1,200 MW would be unavailable. If this coincided with a system peak, then residents of the area could suffer power outages. At a minimum, Georgia Power would have to buy expensive replacement power from the spot market.

As the very reference that Mr. Powers provided as Attachment D to his Declaration states,

> Since a wet tower has a lower capital cost and has a better performance in hot weather, it will be the best choice if sufficient water is available at reasonable cost...Dry cooling saves a lot of water but there is a price to pay for it; the capital cost is significantly greater and there may be plant limitations on the hottest days (*See* Powers Declaration, Attachment D, p. 9)(Exhibit SNC000036).

It would not be reasonable to ask the citizens of Georgia to pay substantial amounts of money up front to build air-cooled units that would produce less electricity and be less reliable than wet-cooled units, especially when those units would be located near the banks of a major river.

In addition to cost and performance implications discussed above, the demand for reliable clean power supply is of utmost concern. An ACC for the current standard AP1000 design with a standard backpressure turbine requires a huge land/footprint area due to the large number of fans/modules. As stated previously, such a large ACC will be impacted by fluctuating meteorological conditions which can jeopardize unit reliability. (*See* Revised Report, pp. 22-23).

Q28: Mr. Powers states that you gave no reason "why the dry cooled system must match the performance of the standard wet tower system at peak hot day conditions" (Powers Declaration ¶ 14). Please explain your comparison.

A28: The purpose of my testimony is to compare the feasibility of dry cooling to closed cycle wet cooling. I thought it intuitively obvious that I was trying to make an "apples-to-apples" comparison between wet and dry cooling, which to me implies that the comparison should focus, if possible, on a dry cooling system that performs its cooling function as effectively and efficiently as a closed cycle wet cooling system.

To allay any confusion, my Revised Report also compares a smaller ACC configuration that Mr. Powers and the Intervenors posit would work with an AP1000 Nuclear Plant located on the Vogtle site – a position that I do not share. When differences in unit output and consumptive power demand are taken into account, this option does not compare favorably. Using such an ACC would result in a loss of around 55 MW out of the generator at design conditions and would require an additional 9-15 MW of consumptive power versus the current wet system, making the total reduction in unit net output at design conditions at 64-70 MW (approximately 130 MW total for Vogtle 3 and 4). (*See* Revised Report, pp. 22-23).

Q29: Mr. Powers states that nuclear power plants do not serve peak load on hot days and, therefore, the NRC should not be concerned about the loss of output on hot days (Powers Declaration ¶ 21). How do you respond?

A29: Mr. Powers' assertion is a non-sequitor. Suppliers of electricity must balance generation with load. Specific generation sources do not normally serve specific loads, and that is particularly true of nuclear power plants. As I testified earlier, a nuclear unit, as a base-load plant, operates as much as possible during both peak and non-peak periods. It is nonsense to suggest that nuclear units do not serve peak load on hot days, because on those days *all* generation is serving *all* load. If the nuclear unit were not there, then it would be necessary to bring the smaller, higher cost, units on-line sooner in order to cover the load. Then, it would be necessary to have additional generation capacity, either through additional generation or costly purchases from the spot market, to cover the peak load that would normally be covered by those smaller units. On very hot days, we need to utilize each of our generators to satisfy our customers' demand. As such, the nuclear generation is in the mix of "total load demand" which include peak loads. However, if generation provided from a nuclear unit is not reliable (*i.e.*, due to potential meteorological influences on an ACC), then it may not be considered viable for meeting either base or peaking load demands.

Q30: Mr. Powers says that the increased thermal efficiency of an LM6000 gas-fired unit and the infrequent need to use those units (he claims these units cost $13 million each) would result in almost no impact in the overall cost of electricity (Powers Declaration ¶ 21). Is this as inexpensive an option as Mr. Powers suggests?

A30: No. While it is true that purchasing and building additional gas-fired capacity to offset losses may be an option, Mr. Powers' cost numbers of such generating capacity are a few years old and thus understated. Using a more recent version of the *Gas Turbine World 2007-08 GTW Handbook* that he uses as the basis for the $13 million dollar figure,[12] a more current cost for a 50 MW LM6000 gas turbine is $17.8 million. This increase in cost for the unit, however, is small when compared to the permitting, engineering, real estate, gas pipeline, transmission,

[12] Mr. Powers is using the 2006 version of this annual publication (Powers Declaration ¶ 21 n.2), while I am getting my information from the 2007-2008 version, which is attached (Exhibit SNC000039).

construction, and potential variability in fuel costs associated with putting even a simple-cycle gas turbine generating unit into operation.

A more pertinent point, however, is that, even if one accepts his figures, Mr. Powers is guilty again of comparing "apples-to-oranges." The appropriate comparison in this situation is not the cost of gas-fired generating capacity compared to that of a larger ACC. Instead, Mr. Powers and the Intervenors might offer justification for why it makes sense to spend what they say is an additional $400 million dollars (plus costs for permitting, real estate, etc. as mentioned above) for a smaller ACC and gas turbine to send the same amount of electricity to the grid as a wet-cooled AP1000 Nuclear Plant would at no additional cost.

Q31: Please describe the design changes to the AP1000 Nuclear Plant that would be necessitated by a dry cooling system.

A31: These changes are described in greater detail in my Revised Report, pp. 13-14. In general, if an ACC were to be designed for an AP1000 Nuclear Plant, the current turbine building layout would have to be reworked. In place of the current steam surface condenser, three large ducts would have to be constructed beneath the turbine. Admittedly, I erred in my Initial Report when I suggested that 16'-20' steam ducts would be sufficient to transport the steam from the turbine to the ACC unit. I was basing this on operating experience with smaller, combined-cycle gas generating units and did not account in my analysis for the fact that the exhaust steam flows of those units (typically around 1,300,000 lbs/hr) are small when compared with those of an AP1000 Nuclear Plant (over 8,300,000 lbs/hr total, or around 2,750,000 lbs/hr per duct). After discussing relative steam flows and duct sizes with an ACC manufacturer, it is estimated that the ducts would actually need to be much larger, probably at least 30' in diameter.

Even if they were to fit, an issue which I cannot speak to, these ducts would then have to be run through the walls of the turbine building and outside to a spot a substantial distance away prior to routing the ducts to individual sections of the ACC up to 2000 feet away. This would necessitate changes to the wall of the turbine building and potentially the turbine pedestal. It could also cause layout changes to other equipment in order to provide a path for the steam ducts.

In addition, as shown on Westinghouse preliminary drawings APP-2000-P2-901, -903, and 905, there are six feedwater heaters currently located in the neck of the steam surface condenser on the current AP1000 standard design. Contrary to a condenser, which would have adequate internal bracing and structure to support the heaters, an open duct would not contain the structure necessary to support this equipment. Changing to an air-cooled system would require either an independent support system be constructed within the steam ducts or relocation of all six heaters and their associated piping to a different location within the turbine building (more building space and cost).

Finally, the sheer size of even a "smaller" ACC may dictate a change in the entire plant layout. Trying to fit a dry cooling system that occupies almost ten acres may necessitate moving buildings and/or other equipment external to the turbine building. Indeed, the entire plant site layout may have to be rearranged.

These are all primarily layout issues, but there is a much more significant design issue as well. The DCD Rev. 17 reports in Section 10.2.2.1 that the turbine-generator foundation forms "an integral part of the turbine building structural system...[t]he lateral bracing under the turbine-generator deck also serves to brace the building frame." Modifying the turbine pedestal in any way, whether to accommodate steam ducts or the theoretical "high backpressure" turbine that Mr. Powers purports would work on an AP1000 plant design (Powers Declaration ¶ 13, would impact the structural framework of the entire turbine building and may require literal redesign of the entire building itself.

Ultimately, Mr. Powers fails to realize that a nuclear power unit is composed of numerous sub-systems including the turbine cycle, steam cycle, cooling cycle, condensate and feed-water cycle, which are all designed to optimize performance (heat rate and generation) based on the unit's thermal cycle. All of these systems would face redesign if an ACC were to be used with the AP1000 or if the steam turbine were changed to accommodate an ACC. Redesigning a power plant with the main purpose of accommodating the cooling cycle (either wet or dry) is analogous to designing an automobile engine to primarily accommodate the radiator.

Q32: Mr. Powers claims that the changes to the plant design "are simply design engineering adjustments necessary to accommodate the air-cooled system" (Powers Declaration ¶ 11). Is he correct that the only changes needed to incorporate a dry cooling system are simple design engineering adjustments?

A32: No. Mr. Powers underestimates the extent of the changes that would be needed. I don't think the changes I just described amount to "simple adjustments." It is true that right now all of these issues are only on paper and thus easier to remedy than after construction begins. However, the impacts to the plant layout will necessitate a substantial amount of engineering on the front end, especially since preliminary drawings of the plant layout have already been issued. Relocating the feed-water heaters and rerouting the associated feed-water piping, steam piping, and condensate drain piping will be a significant change to the existing standard plant design which will require substantial costs and redesign efforts, to say nothing of what it would take to redesign the entire turbine building structural support system. This would also incur additional engineering and equipment/material costs to Southern Companies that, while small compared to the cost of the plant, will still be an unnecessary expenditure.

Further, costs would be incurred due to the potential operational and safety analyses that changing to an ACC might necessitate. As noted in Section 10.1.2 of DCD Rev. 17, the current Toshiba turbine design and orientation minimize the probability of missile generation and directs potential missiles away from safety-related equipment and structures. Changing the steam turbine to accommodate an ACC would require a re-working of this analysis. It would also cause a similar effort on Chapter 11 of the DCD, as removing the condensing mechanism from the turbine building and placing it in the open air where a tube leak would vent straight to the atmosphere would most certainly impact the analysis of primary-to-secondary system leakage.

In conclusion, it would appear that Mr. Powers has a rather narrow perspective if he considers these design alterations as simple changes.

Q33: Mr. Powers says that dry cooling does not require steam condensers and that removing them will make room for dry cooling at the Vogtle site (Powers Declaration ¶ 16). Is his assertion correct?

A33: Removing the steam condensers *might* create enough room for the steam ducts necessary to carry the steam to an ACC; but Mr. Powers provided no backup data. Moreover, I cannot say that conclusively based on the information I have seen. Additionally, the feed-water heaters currently located in the neck of the condenser would have to be put somewhere else. These heaters are 5-6 foot diameter cylindrical heaters on the order of 45-55 feet long each. Six would take up 170-330 feet.

As stated previously, plant and/or equipment design changes associated with eliminating the steam surface condenser will require significant changes to the existing standard plant design which will require substantial costs and redesign efforts.

Q34: Mr. Powers contends that you admitted in your Initial Report that a dry cooling system would entail a simpler design (Powers Declaration ¶ 17). Did you make that admission?

A34: No. I was speaking specifically of the thermodynamic process involving an air-cooled system as being simpler than a wet-cooled system due to its lack of an intermediate heat transfer step. I never suggested that mechanical operation of an air-cooled condenser with an AP1000 Nuclear Plant would be simpler than unit operation with a wet tower system. In fact, I detailed multiple operational complexities that would ensue from using dry cooling, as I testify herein. I reiterate from the quote I read before:

> Both direct and indirect dry cooling systems...are larger and mechanically more complex than corresponding wet cooling systems...[D]ry and hybrid cooling systems will have more fans, meaning more electrical motors, gearboxes and drive shafts. As such, labor requirements for a large ACC can be substantial.[13]

While the thermodynamic process may be simpler for an ACC system, it would be erroneous to conclude that it would enable a simpler cooling system. Mr. Powers again suggests interchangeability of wet/dry systems with almost total disregard for basic power plant thermal cycle fundamentals and turbine technology.

Even if operation with an ACC were simpler, in a power plant as in real life, there are often times when simpler is not better.

[13] *See* Micheletti and Burns, at p. 5.

Q35: Mr. Powers claims that the cooling system does not form part of the standard design, but serves only as a point of departure (Powers Declaration ¶¶ 10, 12). Why does replacing the closed-cycle wet cooling system, in fact, alter the standard design?

A35: I testified earlier that using dry cooling would require a different turbine and even Mr. Powers admits that the steam turbine does form part of the standard design. Mr. Powers, in fact, says explicitly that "the standard design accommodates any cooling system, wet or dry, as long as the cooling system maintains the steam turbine backpressure *within the design limitations of the steam turbine established by Westinghouse Nuclear in its standard AP1000 design*" (Powers Declaration ¶ 12 (emphasis added)).

Mr. Powers' Declaration contradicts the AP1000 DCD, since the AP1000's standard design as specified in DCD Rev. 17 currently employs a specific turbine with specific physical characteristics, a specific orientation, and a specific support structure that is integral to that of the entire turbine building. Yet, as we previously discussed here, he suggested use of an ACC with a design backpressure of 8.0" HgA for the new Vogtle units.

Q36: Mr. Powers says that every plant requires modifications from the standard design to suit differences at each site and that he considers dry cooling one such typical modification. Is this a "typical" modification? (Powers Declaration ¶¶ 9, 11)

A36: No. As I have discussed at great length and as detailed in my Revised Report, the modifications to the standard design would not stop there (*See* Revised Report, pp. 16-17, 20-22). Changing the cooling system on an AP1000 Nuclear Plant as specified in DCD Rev. 17 would result in 1) mandating a change in the steam turbine to a design that does not exist or 2) spending exorbitant money both in up front costs and in higher maintenance costs over the life of the plant and potentially changing the entire plant layout only to suffer lower unit output the majority of the year, higher consumptive power demands the entire year, at a minimum, less unit reliability and, at worst, outright shutdowns during times of critical power demand. I would not consider either set of circumstances "typical."

Q37: Are true, accurate and correct copies of each of the exhibits heretofore referenced in your testimony attached to this pre-filed written testimony, and do they accurately portray the facts they purport to portray?

A37: Yes.

Q38: Are Exhibits SNC000033, SNC000034, SNC000035, SNC000036, and SNC000039 scholarly or learned journals, articles or treatises commonly relied upon in your profession?

A38: Yes.

Q39: Does this conclude your testimony?

A39: Yes.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	Docket No. 52-011-ESP
	)	
Southern Nuclear Operating Company	)	ASLBP No. 07-850-01-ESP-BD01
	)	
(Early Site Permit for Vogtle ESP Site)	)	January 9, 2009

AFFIDAVIT OF JAMES W. CUCHENS IN SUPPORT OF SOUTHERN NUCLEAR'S
PRE-FILED TESTIMONY ON ENVIRONMENTAL CONTENTION 1.3

I, James W. Cuchens, do hereby state as follows:

1. I am employed by Southern Company Generation as a Principal Engineer. A statement of my professional qualifications is attached to the SNC pre-filed testimony to be submitted on January 9, 2009, in response to hearing issues identified by the Board.

2. I have read the foregoing prepared testimony regarding environmental matters at the Plant Vogtle Site.

3. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record of this proceeding. I declare under penalty of perjury that those statements, and my statements in this affidavit, are true and correct to the best of my knowledge, information and belief.

James W. Cuchens
James W. Cuchens

Subscribed and sworn to before me
this 7th day of January, 2009.

[signature]
Notary Public

MY COMMISSION EXPIRES 10/11/2012

MR. LeJEUNE: If we could next load Mr. Cuchens' rebuttal testimony on EC 1.3?

Mr. Cuchens do you -- Mr. Cuchens, is this your testimony concerning -- your rebuttal testimony concerning EC 1.3?

MR. CUCHENS: Yes, it is.

MR. LeJEUNE: Thank you.

Could you please verbally affirm the following? That the testimony entitled Rebuttal Testimony of James W. Cuchens on behalf of Southern Nuclear Operating Company Concerning Environmental Contention 1.3 and dated February 6th, 2009, which has been provided to the Court Reporter in electronic format under the file name Cuchens 1.3 Rebuttal Testimony was prepared by you or under your supervision and direction and is true and correct to the best of your knowledge and belief?

MR. CUCHENS: Yes, it is.

MR. LeJEUNE: Thank you.

Your Honor, we move for admission of Mr. Cuchens' rebuttal testimony.

JUDGE BOLLWERK: All right. Any objections?

(No response.)

JUDGE BOLLWERK: Hearing none, then the

rebuttal testimony of James W. Cuchens relating to Contention 1.3 is admitted and should be bound into the record as if read as DDMS Item ID-59113.

(Cuchens, et al. Rebuttal Testimony (DDMS-59113) to be inserted at this point)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	Docket No. 52-011-ESP
Southern Nuclear Operating Company	)	ASLBP No. 07-850-01-ESP-BD01
(Early Site Permit for Vogtle ESP Site)	)	February 6, 2009

REBUTTAL TESTIMONY OF JAMES W. CUCHENS ON BEHALF OF SOUTHERN NUCLEAR OPERATING COMPANY CONCERNING ENVIRONMENTAL CONTENTION 1.3

Q1: Please state your name, occupation and business address.

A1: My name is James W. Cuchens. I hold the position of Principal Engineer for Southern Company Generation Engineering and Construction Services ("SCG Engineering") in Birmingham, Alabama. SCG Engineering is a division of Southern Company Services, which is a sister company of Southern Nuclear Operating Company ("SNC") both of which are subsidiaries of The Southern Company. My business address is: Inverness Office Park, Birmingham, Alabama 35201.

Q2: Have you previously testified in this proceeding?

A2: Yes. I submitted my direct testimony in this proceeding on January 9, 2009, which contains a discussion of my educational background, business experience, and current areas of responsibility.

Q3: Please summarize your direct testimony.

A3: My direct testimony focused on the feasibility of dry cooling technology for the Vogtle 3 and 4 nuclear units and addressed the specific topics on which the Joint Intervenors raised factual disputes. I concluded that a dry cooling system is not feasible for use with the proposed Vogtle 3 and 4 units due to its incompatibility with standard design for the AP1000, the significantly greater expense than a wet cooling system; the high temperatures and temperature fluctuations at the Vogtle site which would create reliability issues; and the lack of availability of a triple-exhaust high backpressure turbine capable of handling the AP1000 steam flow.

Q4: What is the purpose of your Rebuttal Testimony?

A4: The purpose of my Rebuttal Testimony is to address certain new information, assertions, and conclusions set forth in the Prefiled Direct Testimony of William Powers submitted in this proceeding on January 9, 2009 ("Powers Testimony") in support of Joint Intervenors' direct case.

Q5: Please summarize your understanding of Mr. Powers' contentions with regards to whether dry cooling is feasible at Plant Vogtle and identify any flaws in these contentions.

A5: Mr. Powers contends that dry cooling is a viable option for Vogtle Units 3 and 4 based on several erroneous premises.

First, Mr. Powers testifies that dry cooling can be utilized at the Vogtle site based on the notion that standard AP1000 design can accommodate both high and standard backpressure turbines. (Powers Testimony at A13-A18). Mr. Powers fails to understand the definition and purpose of the standard AP1000 design, as well as the optimum operating backpressure for the AP1000. Moreover, Mr. Powers continues to maintain dry cooling is feasible for a 1,117 MW AP1000 unit simply because smaller units utilize dry cooling. In doing so, Mr. Powers misrepresents the capacity of these small power plants by referring to the total capacity of the power plant, rather than the individual unit's capacity.

Second, Mr. Powers asserts that dry cooling is compatible with facilities like Plant Vogtle. (Powers Testimony at A19-A25). This contention, much like his first, continues to reflect a total misunderstanding of standard plant design as well as gross underestimation of the impact of his suggested modifications to the AP1000 standard design.

Third, Mr. Powers claims that the climate at the Vogtle site does not impact the effectiveness of a dry cooling system. (Powers Testimony at A26-A29). Once again, in an attempt to support his position, Mr. Powers cites several electric generating plants as examples of the effectiveness of dry cooling, and misrepresents the capacity of the units of these plants in his attempt to compare then to an AP1000 unit.

Fourth, Mr. Powers maintains that the financial, economic and performance impacts on facility design, construction and operation do not favor wet cooling over dry cooling, but does not provide any support for this position. (Powers Testimony at A30-A35) Instead, Mr. Powers strings together a series of conclusory statements, faulty assumptions, and a single reference to a telephone conversation in 2002 as the basis for his opinion. In fact, as presented in my direct testimony, the use of dry cooling with an AP1000 unit at Vogtle would negatively affect the performance and output of the unit and would cost substantially more than that proposed wet cooling system.

<u>The Standard AP1000 Design Configuration Does Not Accommodate Both High and Standard Backpressure Turbines.</u>

Q6: Do you agree with Mr. Powers' assertion (Powers Testimony at A13-A16) that implementation of dry cooling is compatible with AP1000 standard design?

A6: No. As previously discussed in my direct testimony, the standard design for the AP1000, as specified in the Design Control Document ("DCD"), Rev. 17, Table 10.1-1 (Exhibit SNC000027), utilizes a triple exhaust, six-flow turbine-generator package in conjunction with a three shell steam surface condenser operating an average backpressure of 2.9" HgA at design conditions. Based on information I received from SNC and our general operating experience with similar units across the Southern Company system, I assumed that such a turbine would operate at Vogtle with an alarm level of 5.0" HgA. Mr. Powers ignores these basic requirements of the standard design configuration, and concludes that a high backpressure turbine, which he defines as maintaining the required steam flow at a backpressure of 8.0" HgA or greater, can be used with a standard AP1000 unit (Powers Testimony at A15-A16). Mr. Powers refers to "design limitations" but neither describes these design limits nor cites any authority for his statement. Rather, he concludes that not only is a backpressure of 8" HgA compatible with standard design, but it might be "simpler and less expensive." (Powers Testimony at A16). As my direct testimony and Exhibit SNC000024 state, a high backpressure turbine is not compatible with the current AP1000 standard plant design, and I am not aware of a triple-exhaust high backpressure turbine that could accommodate the AP1000 steam cycle in conjunction with the operating limits of Plant Vogtle if the unit used dry cooling.

Q7: Do you agree with Mr. Powers' assertion (Powers Testimony at A21-A23) that implementation of dry cooling does not interfere with standard design and requires few modifications to the AP1000 design?

A7: No. Mr. Powers' characterization of the standard design is incorrect. I understand that Mr. Chuck Pierce addresses standard design issues in his rebuttal testimony and, thus, I refer the Board to that testimony. Moreover, as I stated in my direct testimony and explain in more detail below, the modifications necessary to accommodate dry cooling with an AP1000 unit would be significant.

Q8: On pages 6 and 7 of his direct testimony (Powers Testimony at A21-A22), Mr. Powers states that the surface condensers necessary with the wet cooling system in the AP1000 design can be removed to create adequate space for ACC steam ducts and that 20-foot diameter openings in the wall of the turbine building are necessary to install these ducts. Mr. Powers also states that these modifications "in no way rise[s] to the level of reworking the entire turbine building" and do not interfere with the standard design for the AP1000. Do you agree?

A8: No. The AP1000 standard plant is designed using a water cooled condenser. The entire turbine building structure as well as surrounding yard structures would likely have to be redesigned to accommodate an ACC. The present design of the AP1000 turbine-generator/condenser support system works together as one mass along with the "table-top" turbine pedestal design. Substituting steam piping for the present condensers along with substantially different reaction loads would likely cause a significant portion of the entire turbine building structure to be redesigned, including but not limited to, main building support steel, spring support foundation system, and turbine building base mat foundation. As described in the DCD, the lateral bracing under the turbine-generator deck also serves to brace the building frame. (Exhibit SNC000028, Section 10.2.2.1). Moreover, this "integrated" design reduces the bracing and number of columns required in the building. The changes necessary to accommodate an ACC and its steam ducts would clearly affect this design and require the reworking of the turbine building.

Current Dry Cooling System Design is Not Compatible with Facilities like Plant Vogtle.

Q9: In support of his testimony that dry cooling is compatible with facilities like Vogtle Units 3 and 4, Mr. Powers references the Midlothian, Wyodak, and Matimba power plants (Powers Testimony at A18, A26). Is Mr. Powers' comparison accurate?

A9: No. Mr. Powers fails to specify that the capacity he cites is total capacity and not the individual unit's capacity. (Exhibits SNC000032 and SNC000033). As shown in the chart below, the Midlothian plant consists of six units of 275 MW each for a total of 1,650 MW. The Wyodak power plant consists of one 330 MW unit and the Matimba power plant consists of six units for a total of 4,000 MW. I have visited the Matimba site. From personal observation, I can testify that the Matimba dry cooling system does comprise one large structure. The structure is divided into six independent units, one for each of the six turbines on the site. Each turbine carries a capacity of 660 megawatts as opposed to the AP1000 turbine that has a capacity of almost 1200 megawatts. Clearly, these are not comparable examples of the dry cooling facilities that would be required for the capacity of the Vogtle units, which are 1,117 MW each.

Plant Name	Unit Capacity	Number of Units	Total Capacity
Midlothian	275 MW	6 units	1650 MW
Wyodak	330 MW	1 unit	330 MW
Matimba	665 MW	6 units	4000 MW

Comparing six, small high backpressure turbines to one large standard backpressure turbine not only provides no viable comparison, but is an attempt to pass-off smaller units as evidence that dry cooling is feasible with the much larger units. Mr. Powers repeated references to these small dry cooled units, always presented in the aggregate, mischaracterizes the applicability of dry cooling to larger units.

Q10: Mr. Powers claims the use of an ACC system and high backpressure turbine for the AP1000 would be simpler and less expensive (Powers Testimony at A30-31). How do you respond?

A10: Mr. Powers reaches the conclusion that a high backpressure turbine would be simpler and less expensive for the AP1000 with no specifics on how such a high backpressure turbine could be used at the Vogtle site, no cost calculations, no diagrams and no data supporting this conclusion. Additionally, Mr. Powers fails to identify any high backpressure turbine compatible with the capacity of the Vogtle units. As I previously stated in my direct testimony and Exhibit SNC000024, not only would a high backpressure turbine prove much more complicated, due to the necessity of using multiple smaller ACC units and the parallel construction to existing buildings and redesign of the units, but these multiple units and construction and relocation costs would be excessive. In fact, simply constructing the necessary ACC units would cost at least $445 million for each of the Vogtle units, which figure does not include increases in ongoing operation and maintenance costs.

Q11: With regard to Exhibit JTI000038, please describe the Heller System.

A11: The Heller System is what is referred to as an "indirect dry cooling system". It operates similarly to a traditional wet cooling system in that the steam being exhausted by the turbine is being condensed inside of a condenser. The condenser has a loop of circulating water that goes out to a tower where it rejects its heat to the atmosphere. However, the condenser utilized with a Heller System in not the same as the condenser utilized with a wet cooling system; it is what is called a "direct contact" condenser. What this means is that the condensed steam from the turbine comes directly into contact with the cooling water being circulated out to the tower. As it condenses, the condensate and the circulating water form one big pool at the bottom of the condenser and some of that pool is pumped out to the tower to cool while the rest is pumped back to the reactor to be turned into steam. Similarly, with an indirect system such as the Heller, the cooling water does not come into direct contact with the air inside the tower. Instead, it is circulated through large, finned tubes similar to those in an ACC, and it rejects its heat via conduction and convection through the tubes into the air. No evaporation takes place with a Heller System.

Q12: Is the Heller System different than the dry cooling systems installed on the units referenced in Mr. Powers' direct testimony (e.g., Midlothian, Matimba, and Wyodak)?

A12: Yes; all of the units Mr. Powers mentions are cooling via air-cooled condensers in which the steam is being exhausted from the turbine through long ducts to be condensed inside of the finned-tube bundles in the ACC.

Q13: Exhibit JTI000038 at p. 9 references "the only dry-cooled nuclear power plant in the world." Are you aware of a nuclear power plant that utilizes dry cooling -- either the Heller System or some other type?

A13: I was not aware of a nuclear power plant that uses dry cooling prior to reading Exhibit JTI000038 and, even then, I was skeptical of the assertion. After conducting some additional research, we found one reference in another GEA presentation that states that the Bilibino nuclear power plant in Russia "is the only dry-cooled nuclear PS in the world." (Exhibit SNC000056). The Bilibino nuclear power plant consists of four 12 MW light-water-cooled, graphite-moderated reactors (48 MW total) and is located above the Arctic Belt. (Exhibit SNC000056). This facility is clearly not comparable to a two unit AP1000 power plant at Vogtle.

Q14: Does Exhibit JTI000038 identify an application of the Heller System with a turbine with a capacity of 1,100 MW or greater?

A14: No. In fact, the capacities of the plants referenced in the Heller materials are similar to the Midlothian, Wyodak, and Matimba plants cited by Mr. Powers. As shown on the attached chart and related materials (Exhibit SNC000057), the units listed in the Heller materials range from 100 MW to 700 MW, which are the size units that generally utilize dry cooling.

Q15: Is the Heller System compatible with the AP1000 standard design?

A15: No, it could not be used with any AP1000 Standard unit constructed in accordance with DCD Rev. 17 because the direct contact condenser employed by the Heller System is not the same as the steam surface condenser utilized in the AP1000 design and, therefore, as with the other dry cooling systems, the installation of the Heller System would require significant redesign of the AP1000 standard plant. As mentioned, in a direct contact condenser, the condensed steam and the cooling water come into direct contact with each other, which means two things: First, it takes a physically different kind of condenser;

you cannot keep half of the water running through tubes and get direct contact and more importantly, because the same water is being sent both back to the reactor to be turned into steam and out to the tower to be cooled, all of the water in the system must be high quality water capable of being passed through the reactor. I could not tell exactly how much from looking at this exhibit, but this would dramatically increase the amount of "clean" water required to operate the plant. In any event, this type of condenser and larger amount of high quality water are not part of the AP1000 Standard plant design. Secondly, a Heller System would present the same operational problems and limitations as a standard dry-cooled system. Although direct comparisons of the Vogtle cooling system to a Heller System are difficult to make because there is no indication in Mr. Powers' testimony regarding the source of the data shown, page 18 of JTI000038 provides the basis for a rough comparison. Page 18 illustrates that with an 800 MW coal unit the turbine backpressure with both a Heller System and an ACC exceeds 5" HgA prior to the ambient temperature reaching 90ºF. While it is uncertain whether a Heller System at Vogtle would perform similarly, in my opinion the 800 MW coal unit provides the basis for a reasonable estimate that as temperatures increased the Heller System would not be able to maintain anywhere near a comparable turbine backpressure of a wet system such as the one specified as part of the AP1000 standard design. In all likelihood, the Heller System would experience the same problems as an ACC in maintaining backpressure below the turbine alarm setpoint of 5" HgA.

The Impact of Climate in the Vicinity of the Vogtle Site.

Q16: Mr. Powers asserts a dry cooling system can be effective despite the impact of climate in the vicinity of the Vogtle site (Powers Testimony at A27-29). How do you respond?

A16: Mr. Powers fails to recognize that when the ambient air temperature rises and peak summer conditions occur, dry cooling is at its most vulnerable and demand for energy is at its highest. As I present in my direct testimony, as the ambient temperature rises, an ACC becomes less efficient and, thus, creates higher backpressures that affect the operation of the turbine. This effect would be most apparent during summer peak conditions when maximum output is needed the most.

Q17: Mr. Powers also states that the ambient temperature at Vogtle is less than 70° F during most of the year and that peak summertime design conditions generally occur less than 200 hours a year. Mr. Powers further states that there would be relatively little differential in the MW output of wet and dry systems under these conditions (Powers Testimony at A27 and A28). How do you respond?

A17: The temperature in Augusta, Georgia exceeds 70° F over 36 percent of the hours in each year (3,215 of 8,760 total hours). (Exhibit SNC000037). On average, the temperature exceeds 90° F for 200 hours a year. (Exhibit SNC000037). As I explain below, this position conveniently ignores those portions of the year when the temperature is greater than 70° F and the demand for electricity is highest. In fact, a "typical" wet cooling system will outperform a commensurate air-cooled system at temperatures above 60° F, which means a wet cooled system will outperform the dry cooled system the majority of the year.

The Financial, Economic, and Performance Impacts of Dry Cooling On the Design, Construction, and Operation of an AP1000 at Vogtle.

Q18: Mr. Powers states that an ACC design system would be simpler than the standard AP1000 design and that simplification generally makes a system more reliable (Powers Testimony at A30-A35). Do you agree with Mr. Powers?

A18: No. As mentioned previously, an ACC would contain vastly more moving parts and pieces, which translates to vastly more time and money spent on maintenance, repair, and replacement of parts over the life of the plant, than would a wet system, especially if it employed a natural draft tower. An ACC is, in a sense, thermodynamically simpler because it involves no evaporative heat transfer, but I would have a hard time saying it is a "simpler" system than a wet system. I would never say it is more reliable.

Q19: With regard to your testimony that a 334 module ACC would be required for operation with an AP1000 unit, Mr. Powers states that "it makes no sense to build a 334 module ACC that costs $361 million and has a 44 MW parasitic fan load when a 230 module ACC with 30 MW parasitic fan load would result in the same annual energy penalty for the dry cooling option. ACC design is a balance between cost, size, and performance." (Powers Testimony at A30-A35). How do you respond?

A19: While sizing any cooling system is a balance between cost and design, to make an equitable comparison one must compare not only the cost and performance of the cooling system itself, but also the differences in unit output. In my initial comparison, I theoretically designed an ACC capable of replicating the wet system's performance because it gave an "apples-to-apples" comparison. I am not sure what the basis for Mr. Powers' statement that a smaller ACC would result in the same annual energy penalty is supposed to mean or where exactly he gets the basis for that statement. Using a smaller

ACC would certainly result in a lower cost for the ACC and lower parasitic power requirement than a larger ACC, but, as my report shows, that would be more than offset by the lower generation out of the steam turbine due to the higher backpressure at which it would be exhausting. Furthermore, Mr. Powers' assertion still fails to address the fundamental point that any realistic ACC design would not be able to duplicate the performance of a wet cooling system and would incur exorbitant cost increases.

Q20: Mr. Powers further states that there would relatively little differential in the MW output of the wet and dry systems during most of the year whenever ambient temperature is less than approximately 70° F (Powers Testimony, A30-A35). How do you respond?

A20: I would argue that Mr. Powers' own submitted evidence seems to contradict his testimony. First, Attachment D that was originally attached to his declaration submitted in opposition to SNC's Motion for Summary Disposition shows that a "typical" wet cooling system will outperform a commensurate air-cooled system at temperatures above 60° F (Exhibit SNC000036, p. 10). His recently submitted Exhibit JTI000038 seems even more contradictory on p.18, where it shows that there is no temperature at which an ACC's performance can approach that of a wet system for the particular 800 MW supercritical coal unit that was being studied. I would also say that even if Mr. Powers' statement were true, and even if the temperature only exceeded 70° F roughly 1/3 of the year, suffering diminished unit performance for even that period of time is a significant cost in lost generation. The fundamental point is that for any given turbine, regardless of the backpressure limits of the turbine, a wet system would enjoy a substantial performance advantage over any of Mr. Powers' proffered dry systems for significant portions of the year.

Q21: Are true, accurate and correct copies of each of the exhibits heretofore referenced in your testimony attached to this pre-filed written rebuttal testimony, and do they accurately portray the facts they purport to portray?

A21: Yes, except for Exhibits SNC000024, SNC000027, SNC000028, SNC000032, SNC000033, SNC000036, and SNC000037, which are attached to the testimony that I submitted in this proceeding on January 9, 2009.

Q22: Does this conclude your testimony?

A22: Yes.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	Docket No. 52-011-ESP
	)	
Southern Nuclear Operating Company	)	ASLBP No. 07-850-01-ESP-BD01
	)	
(Early Site Permit for Vogtle ESP Site)	)	February 6, 2009

AFFIDAVIT OF JAMES W. CUCHENS IN SUPPORT OF SOUTHERN NUCLEAR'S REBUTTAL TESTIMONY ON ENVIRONMENTAL CONTENTION 1.3

I, James W. Cuchens, do hereby state as follows:

1. I have read the foregoing prepared rebuttal testimony regarding environmental matters at the Plant Vogtle Site.

2. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record of this proceeding. I declare under penalty of perjury that those statements, and my statements in this affidavit, are true and correct to the best of my knowledge, information and belief.

James W. Cuchens

Subscribed and sworn to before me
this 2nd day of February, 2009.

Notary Public

MY COMMISSION EXPIRES JUNE 15, 2011

MR. LeJEUNE: Your Honor, Mr. Cuchens has quite a few exhibits.

JUDGE BOLLWERK: All right. Let's move along then there.

MR. LeJEUNE: We'd like to mark for identification the following SNC exhibits sponsored by Mr. Cuchens. The first is SNC000023, the curriculum vitae of James W. Cuchens.

JUDGE BOLLWERK: The record should reflect that Exhibit SNC000023 has been marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000023-00-BD01 for identification.)

MR. LeJEUNE: The next is SNCR00024, Feasibility of Air-Cooled Condenser Cooling System for the Standardized AP-1000 Nuclear Power Plant.

JUDGE BOLLWERK: The record should reflect that Exhibit SNCR00024 has been marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNCR00024-00-BD01 for identification.)

MR. LeJEUNE: SNC000025, Christopher Lazenby curriculum vitae.

JUDGE BOLLWERK: The record should reflect that SNC000025 has been marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000025-00-BD01 for identification.)

MR. LeJEUNE: SNCR00026, Dry Cooling Presentation by James W. Cuchens.

JUDGE BOLLWERK: The record should reflect that Exhibit SNCR00026 has been marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNCR00026-00-BD01 for identification.)

MR. LeJEUNE: SNC000027, AP-1000 Design Control Document Rev. 17, Section 10.1.

JUDGE BOLLWERK: The record should reflect that SNC000027 has been marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000027-00-BD01 for identification.)

MR. LeJEUNE: SNC000028, AP-1000 Design Control Document, Rev. 17, Section 10.2.

JUDGE BOLLWERK: Let the record reflect that SNC Exhibit 000028 has been marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000028-00-BD01 for identification.)

MR. LeJEUNE: SNC000029, GE Steam Turbine Product Brochure.

JUDGE BOLLWERK: Let the record reflect that SNC000029 has been marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000029-00-BD01 for identification.)

MR. LeJEUNE: SNC000030, Overview of GE Single Exhaust Dual Flow Turbine Design for Medium Fossil Applications.

JUDGE BOLLWERK: Record should reflect that SNC Exhibit 000030 has been marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000030-00-BD01 for identification.)

MR. LeJEUNE: SNC000031, Website Description of the Palo Verde Nuclear Power Plant.

JUDGE BOLLWERK: The record should reflect that Exhibit SNC000031 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000031-00-

BD01 for identification.)

MR. LeJEUNE: SNC000032, Overview of the Kendal, Majuba, and Matimba Power Stations.

JUDGE BOLLWERK: The record should reflect that SNC Exhibit 000032 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000032-00-BD01 for identification.)

MR. LeJEUNE: SNC000033, Energy Information Administration Existing Generation Units in the United States by State and Description of the Midlothian Power Plant.

JUDGE BOLLWERK: The record should reflect that Exhibit SNC000033 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000033-00-BD01 for identification.)

MR. LeJEUNE: SNC000034, Article Entitled Emerging Issues and Needs in Power Plant Cooling Systems.

JUDGE BOLLWERK: The record should reflect that SNC Exhibit 000034 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000034-00-BD01 for identification.)

MR. LeJEUNE: SNC000035, Study by Michael Kijard.

JUDGE BOLLWERK: The record should reflect that SNC000035 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000035-00-BD01 for identification.)

MR. LeJEUNE: SNC000036, Cooling Technology Institute, Why Every Air-Cooled Steam Condenser Needs a Cooling Tower.

JUDGE BOLLWERK: The record should reflect that Exhibit SNC000036 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000036-00-BD01 for identification.)

MR. LeJEUNE: SNC000037, TMY2 Dataset.

JUDGE BOLLWERK: The record should reflect that Exhibit SNC000037 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000037-00-BD01 for identification.)

MR. LeJEUNE: SNC000038, National Climatic Data Center, Normal Daily Maximum Temperature.

JUDGE BOLLWERK: The record should reflect that SNC000039 is marked for identification. I'm sorry. That is 38. Let me go back and do that again. SNC000038 is marked for identification. I apologize. I'm getting ahead of myself.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000038-00-BD01 for identification.)

MR. LeJEUNE: SNC000039, Gas Turbine Handbook.

JUDGE BOLLWERK: The record should reflect that SNC Exhibit 000039 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000039-00-BD01 for identification.)

MR. LeJEUNE: He also has two exhibits for his rebuttal testimony.

JUDGE BOLLWERK: All right.

MR. LeJEUNE: The first is SNC000056, Overview of the Bilibino Nuclear Power Plant.

JUDGE BOLLWERK: The record shall reflect that SNC Exhibit 000056 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000056-00-BD01 for identification.)

MR. LeJEUNE: SNC000057, Overview of Units

Referenced in Exhibit JTI000038.

JUDGE BOLLWERK: The record shall reflect that SNC000057 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000057-00-BD01 for identification.)

MR. LeJEUNE: Thank you, Your Honor.

We move for admission of these exhibits.

JUDGE BOLLWERK: All right. Any objection?

(No response.)

JUDGE BOLLWERK: hearing none, then Exhibit SNC000023, Exhibit SNCR00024, Exhibit SNC000025, Exhibit SNCR00026, Exhibit SNC000027, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 56, and 57 are admitted into evidence.

(Whereupon, the above-referred to documents were received into the record as Exhibit Nos. SNC000023-00-BD01, SNCR00024-00-BD01, SNC000025-00-BD01, SNCR00026-00-BD01, SNC000027-00-BD01 through SNC000039-00-BD01, SNC000056-00-BD01 and SNC000057-00-BD01.)

MR. LeJEUNE: Yes, sir. Thank you.

If we could next move to the prefiled

direct testimony of Mr. Thomas Moorer on Environmental Contention 1.3?

Mr. Moorer, do you recognize this as your testimony on Behalf of Southern Nuclear Operating Company on EC 1.3?

MR. MOORER: I do.

MR. LeJEUNE: Thank you. Could you please verbally affirm for me that the testimony entitled Testimony of Thomas C. Moorer on Behalf of Southern Nuclear Operating Company Concerning Environmental Contention 1.3 and dated January 9th, 2009, which has been provided to the Court Reporter in electronic format under the file name Moorer 1.3 testimony was prepared by you or under your supervision and direction and is true and correct to the best of your knowledge and belief?

MR. MOORER: I so affirm.

MR. LeJEUNE: Thank you.

Your Honor, we'd move for admission of Mr. Moorer's testimony.

JUDGE BOLLWERK: All right. Any objections?

(No response.)

JUDGE BOLLWERK: Hearing none, then the direct testimony of Thomas C. Moorer with respect to

Contention 1.3 is admitted and should be bound into the record as if read as DDMS Item ID 59381.

(Moorer, et al. Direct Testimony (DDMS-59381) to be inserted at this point.)

Corrected on: March 11, 2009
Originally Filed on: January 9, 2009

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	**Docket No. 52-011-ESP**
	)	
Southern Nuclear Operating Company	)	**ASLBP No. 07-850-01-ESP-BD01**
	)	
	)	
(Early Site Permit for Vogtle ESP Site)	)	**January 9, 2009**

TESTIMONY OF THOMAS C. MOORER ON BEHALF OF SOUTHERN NUCLEAR OPERATING COMPANY CONCERNING ENVIRONMENTAL CONTENTION 1.3

Q1: Please state your name and address.

A1: My name is Thomas Claibourne Moorer. My business address is: 42 Inverness Center Parkway, Birmingham, AL 35242-4809.

Q2: Please state your employer, position, and current responsibilities.

A2: I am currently employed by Southern Nuclear Operating Company ("SNC") as the Project Manager-Environmental. In that capacity, I am responsible for all environmental support activities for new plant and license renewal work for SNC. I was responsible for developing the Environmental Report filed by SNC as part of the Early Site Permit application for Vogtle Units 3 and 4 and all supporting activities. My Curriculum Vitae is provided as Exhibit SNC000014.

Q3: Please summarize your education and professional qualifications.

A3: I earned a Bachelor of Science degree in Environmental Science from Auburn University and a Bachelor of Science in Civil/Environmental Engineering from the University of

Alabama. I have over 30 years of experience in the environmental field, including 18+ years of experience in environmental engineering, licensing, and regulatory compliance in nuclear power. I have over 15 years of experience working in NEPA matters, including the development of Environmental Reports for Environmental Impact Statements supporting NRC licensing actions. I am heavily involved in the work of various industry groups, including EPRI, EEI, and NEI, and have both authored and co-authored numerous technical publications in the environmental field.

Since 2005, I have been responsible for all environmental support for new plants and license renewals, including development of the Environmental Reports ("ERs") for the Vogtle Early Site Permit ("ESP"), Combined Construction and Operating License ("COL") and License Renewal applications to NRC. I am responsible for interface with NRC for review of the ERs and subsequent EIS development, site audits and public meetings and for coordination with state and Federal agencies regarding ESP, COL, and License Renewal activities. Prior to 2005, I worked as the SNC Environmental Services Supervisor for over 15 years and managed the technical and regulatory support for permitting and environmental compliance in the areas of water, air, solid/hazardous waste, mixed waste, chemistry and hazardous materials for all three SNC plants. I have extensive NEPA experience, including the management of environmental support for the Plant Farley and Plant Hatch license renewals, as well as EPRI and NEI work associated with development of the NEI License Renewal Guideline. I have worked with NRC on the development of the Generic Environmental Impact Statement ("GEIS") for license renewal. I also provided project management for numerous major environmental projects including technical studies to resolve NPDES permitting issues, wetlands and endangered species work, US Army Corps of Engineers permitting, and studies related to license renewal.

Q4: What is the purpose of your testimony?

A4: The purpose of this testimony is to describe the environmental issues and the potential adverse impacts to land and wildlife resources that would arise if a dry cooling system is utilized at Vogtle Units 3 and 4. Moreover, based on these impacts, I testify that dry cooling is not a feasible alternative for Vogtle Units 3 and 4. Finally, I discuss why wet cooling should be used at the Vogtle site.

I also note that I have submitted testimony on behalf of SNC regarding Environmental Contention – EC 1.2. In that testimony, I testify regarding preparation of the ER as part of the ESP application for Vogtle Units 3 and 4.

Q5: Have you reviewed Mr. Jim Cuchens' testimony?

A5: Yes. I have reviewed his testimony and the report entitled, "Feasibility of Air Cooled Condenser Cooling System for the Standardized AP1000 Nuclear Plant." (*See* Exhibit SNC000024).

Q6: What are your determinations after reviewing this testimony?

A6: The use of dry cooling at Plant Vogtle would create problems with engineering, construction feasibility, economic, and other issues cited by Mr. Cuchens in his testimony. In addition, dry cooling would produce a number of significant adverse land use, environmental, ecological, and aesthetic impacts. These factors, in addition to the technical reasons noted in Mr. Cuchens' testimony, demonstrate that dry cooling is not a feasible alternative for the proposed new units at Vogtle.

Q7: What other factors should be considered when determining the feasibility of dry cooling?

A7: There are environmental issues that should be considered as reasons why dry cooling technology is not a feasible alternative for Vogtle Units 3 and 4, including land use, ecological, and aesthetic impacts.

Q8: Are there detrimental impacts that could result from the use of dry cooling?

A8: Yes. Given that the proposed dry cooling tower footprint would require substantial portion of the undeveloped acreage at the Vogtle site, there would be significant land use, environmental, ecological, and aesthetic impacts.

Q9: How much land would dry cooling towers occupy?

A9: In accordance with the testimony provided by Mr. Cuchens, the actual dimensions of an ACC for the AP1000 is estimated as 2700 feet by 300 feet. The ACC must be oriented with the prevailing wind perpendicular to the longitudinal axis of the ACC. Based on discussions with cooling tower vendors, a minimum distance of 600 feet between the unit 3 and unit 4 towers would be required to prevent plume recirculation. In addition, a minimum of 600 feet of clearance would be required on each side of the towers to prevent interference with the wind approach to the towers and to allow for construction access and for maintenance after construction. Moreover, clearance of 500 feet is recommended on the tower ends. These conditions result in a minimum footprint of 7200 feet by 1500 feet. This results in a footprint of 248.9 acres. Exhibit SNC000040 is a depiction of the dry cooling towers on the Vogtle site.

Q10: How would this impact the available land at the Vogtle site?

A10: The Vogtle site contains a total of 3169 acres, with over 800 acres associated with the Unit 1 and Unit 2 power block, cooling towers, intake, switchyard, and ancillary areas and

Plant Wilson. The Vogtle site was originally a four-unit site and much of the area associated with the proposed new units will be located in areas that have already been excavated to plant grade and are currently in planted pine or grasses. This area is not large enough to support the dry cooling option. Therefore, dry cooling towers would have to be constructed in an undeveloped area.

Q11: How does this compare to the wet cooling towers proposed for Vogtle Units 3 and 4?

A11: The proposed natural draft cooling towers for the closed cycle wet cooling system will occupy approximately 70 acres of the 310 acre footprint of the Vogtle Units 3 and 4 site. The dry cooling option would require three times the land area. Therefore, this would require use of undisturbed areas of the site.

Q12: Where are the undeveloped areas on the Vogtle site that would be impacted?

A12: Based on the review of the site for potential dry cooling locations, there is only one area that could be utilized. This area is located in the undeveloped north/northeast portion of the site. This area is wooded, includes Mallard Pond, and is drained by a small unnamed creek.

Q13: Please describe Mallard Pond.

A13: Mallard Pond is a spring-fed pond located in an undeveloped, natural area in the north part of the site that drains through a wetland area to the Savannah River. The ESP for Vogtle was developed with controls in place to continue to protect the Mallard Pond area. This pond and the surrounding area provide important habitat diversity and wetlands support for the site. The pond was present when the site was originally purchased and has been maintained and protected from construction impacts since that time.

Q14: How will these undeveloped areas be affected by the footprint of the dry cooling towers?

A14: The types of impacts that would occur include: clearing and grubbing of land, including removal of a large number of trees; cut and fill to produce a flat area to support construction; re-routing and reconstruction of site drainage features including the Mallard Pond drainage; and the potential removal of Mallard Pond. Significant impacts to this area from construction activities and runoff could have serious impact on wildlife habitat and mitigation would obviously be required in the event the pond was significantly impacted. In addition, the amount of area disturbed from the construction of a dry cooling system would be substantial. *See* Exhibit SNC000040.

Q15: Would these undeveloped areas be impacted by the natural draft (wet) cooling towers?

A15: No. The natural draft towers would be located in an area that was previously disturbed during the construction of Unit 1 and Unit 2.

Q16: Would any sensitive species be affected by the construction and footprint of the dry cooling towers?

A16: Yes. The southeastern pocket gopher is known to reside in upland areas of dry, sandy soil or well-drained, fine-grained gravely soil. Surface mounds indicative of the presence of the pocket gopher have been observed in the property bordering the northern part of the Vogtle site, near Mallard Pond, which includes the area where the dry cooling towers would be constructed. The southeastern pocket gopher is a "state threatened" species in Georgia, and it was added to Georgia's list of protected species in October of 2006. *See* Exhibit SNC000041. In addition, there is currently at least one American alligator resident in Mallard Pond. The

American alligator is a Federal threatened species due to the similarity of its appearance with the American crocodile, which is a Federally-listed endangered species. *See* Exhibit SNC000042.

Q17: Are these species affected by the wet cooling towers?

A17: No. The habitat that supports these species does not occur in the area where the wet cooling towers will be constructed.

Q18: How much power is required to operate the dry cooling towers verses the wet cooling towers?

A18: Approximately 80 MWe would be required for station service to provide power to the dry cooling tower fans and other electrical loads and to compensate for efficiency losses that must be provided by a base load power source.

Q19: What impacts would result from this need for additional power?

A19: The additional station service requirements of a dry cooling system, in comparison to the proposed wet cooling system, would produce significant environmental concerns. Additional base load capacity would be required to offset station service needs, which would create significant impacts to the air, water, land use and ecology. In my judgment, this source of power would be either coal or nuclear. The coal source would result in significant air emissions. Assuming a bituminous coal source, 81 MWe would result in emission of approximately 300 tons of SO_2, 209 tons of NO_x, 7 pounds of Mercury, and 61,000 tons of CO_2 each year.

There would also be thermal and chemical impacts to water, and potentially wetland, ecological and other land use impacts. There would also be consumptive use of water of approximately 40 cfs. Mr. Cuchens' testimony also indicates a significant loss of efficiency associated with turbine back pressure and other engineering issues that could result in additional power losses requiring offset. Additional air emissions would be associated with this additional power need further exacerbating this impact.

Q20: What other factors must be considered?

A20: The National Environmental Policy Act (NEPA) requires analyses of all reasonably foreseeable environmental impacts of new plant construction, which includes aesthetic impacts of major structures such as cooling towers. Due to the extremely large amount of land required, as well as the physical size of the dry cooling towers, the aesthetic impact would be significant.

Q21: Please elaborate on the potential aesthetic impacts?

A21: In the best case, even if Mallard Pond is not physically impacted, the isolated, serene nature of the pond and surrounding area will be severely altered by the view of the large dry cooling towers in the background when looking west. In addition to the visual impacts, there will be an increase in noise levels around Mallard Pond. Although the levels have not been quantified at this time, it is believed that they would be similar to wet mechanical draft cooling towers. Studies would be required to quantify the impact of noise and controls could be required dependent on the levels observed.

Q22: Would the dry cooling towers be visible from outside of the plant site?

A22: Yes. The dry cooling towers necessary to accommodate two AP1000 units would have a very large footprint on the site and would be visible from River Road. It would also be visible from most of the areas bordering the site and from the natural areas in the vicinity of Mallard Pond. In addition, the dry cooling towers would be visible from the Savannah River along much of the area where the river borders the site and from areas where transmission lines intersect the road and/or river. This negative aesthetic impact must also be considered for the dry cooling application.

Q23: What are your conclusions and recommendations?

A23: As I stated previously, the testimony provided by Mr. Cuchens clearly demonstrates that dry cooling is not feasible as an alternative cooling technology for Vogtle Units 3 and 4 based upon engineering, construction feasibility, economic, and experience-based reasons. When considering these factors in addition to the negative environmental impacts discussed above, I agree with Mr. Cuchens that dry cooling is not feasible for use at Vogtle Units 3 and 4. My recommendation is that wet cooling technology should be implemented for Vogtle Units 3 and 4.

Q24: Are true, accurate and correct copies of each of the exhibits heretofore referenced in your testimony attached to this pre-filed written testimony, and do they accurately portray the facts they purport to portray?

A24. Yes, except for Exhibit SNC000014, which is attached to my testimony regarding Environmental Contention 1.2, and Exhibit SNC000024, which is attached to the testimony of James W. Cuchens.

Q25: Does this conclude your testimony?

A25: Yes.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	Docket No. 52-011-ESP
	)	
Southern Nuclear Operating Company	)	ASLBP No. 07-850-01-ESP-BD01
	)	
(Early Site Permit for Vogtle ESP Site)	)	March 11, 2009

AFFIDAVIT OF THOMAS C. MOORER IN SUPPORT OF SOUTHERN NUCLEAR'S REVISED DIRECT TESTIMONY ON ENVIRONMENTAL CONTENTION 1.3

I, Thomas C. Moorer, do hereby state as follows:

1. I have read the foregoing prepared testimony regarding environmental matters at the Plant Vogtle Site.

2. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record of this proceeding. I declare under penalty of perjury that those statements, and my statements in this affidavit, are true and correct to the best of my knowledge, information and belief.

Thomas C. Moorer

Thomas C. Moorer

Subscribed and sworn to before me
this 10 day of March, 2009.

Sharon Hudgins

Notary Public

My commission expires 6-9-09

MR. LeJEUNE: Mr. Moorer also has three exhibits we'd like to mark.

JUDGE BOLLWERK: All right.

MR. LeJEUNE: The first is SNC000040, a photo depicting aerial view of the plant Vogtle site.

JUDGE BOLLWERK: Let the record reflect that SNC000040 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000040-00-BD01 for identification.)

MR. LeJEUNE: SNC000041, Georgia Department of Natural Resources Wildlife Resources Division Protected Species List.

JUDGE BOLLWERK: The record should reflect that SNC000041 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000041-00-BD01 for identification.)

MR. LeJEUNE: SNC000042, Listing of Federal Endangered and Threatened Wildlife.

JUDGE BOLLWERK: And the record should reflect that SNC000042 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000042-00-BD01 for identification.)

MR. LeJEUNE: Thank you, Your Honor. We move for admission of these exhibits.

JUDGE BOLLWERK: Any objections?

(No response.)

JUDGE BOLLWERK: Hearing none, then Exhibits SNC000040, 41, and 42 are admitted into evidence.

(Whereupon, the above-referred to documents were received into the record as Exhibit Nos. SNC000040-00-BD01 through SNC000042-00-BD01.)

MR. LeJEUNE: If we could load the rebuttal testimony of Charles Pierce please concerning Environmental Contention 1.3?

Your Honor, we noticed an error in Mr. Pierce's testimony last night. Basically the reference on page five, answer 10, we reference Appendix N. And it should be Appendix D. I wanted to ask you how you would like to handle that correction -- if we could just do that now or if you'd like revised testimony.

JUDGE BOLLWERK: Let me turn to Mr. Wilke.

MR. WILKE: (Speaking from an unmiked location.)

JUDGE BOLLWERK: Right. What version does the Court Reporter have?

MR. LeJEUNE: The version with Appendix N.

JUDGE BOLLWERK: And that is -- I'm sorry, that's the corrected version or the --

MR. LeJEUNE: No, that's not the corrected version.

JUDGE BOLLWERK: It's not the corrected version. Okay. All right. Let's -- in this instance, let's go ahead then. I don't want to delay this any further. Let's go ahead and we'll have it reflect on the record. Go ahead and give us the change again.

MR. LeJEUNE: The change is on page five of Mr. Pierce's rebuttal testimony concerning Environmental Contention 1.3. In answer 10, the beginning of the second line, there is a reference to Appendix N. It should be a reference to Appendix D.

JUDGE BOLLWERK: All right. And do you want to affirm that change Mr. Moorer?

MR. PIERCE: Mr. Pierce.

JUDGE BOLLWERK: Mr. Pierce, I'm sorry. I apologize.

MR. PIERCE: Yes, sir. I affirm that change.

JUDGE BOLLWERK: All right.

Any objections from anyone relative to the change?

(No response.)

JUDGE BOLLWERK: All right.

MR. LeJEUNE: Could we load it back on please?

Mr. Pierce, do you recognize that as your testimony concerning Environmental Contention 1.3?

MR. PIERCE: Yes, sir. I do.

MR. LeJEUNE: Could you please verbally affirm for me that the testimony entitled Rebuttal Testimony of Charles R. Pierce on Behalf of Southern Nuclear Operating Company Concerning Environmental Contention 1.3 and dated February 6th, 2009, which has been provided to the Court Reporter in electronic format under the file name Pierce 1.3 rebuttal testimony was prepared by you or under your supervision and direction and is true and correct to the best of your knowledge and belief?

MR. PIERCE: I affirm.

MR. LeJEUNE: Thank you.

Your Honor, we move for admission of Mr. Moorer's testimony -- Mr. Pierce's testimony.

JUDGE BOLLWERK: Any objections?

(No response.)

JUDGE BOLLWERK: Hearing none, then the rebuttal testimony of Mr. Pierce relative to Contention 1.3, as corrected on the record this morning, is admitted and bound into the record as if read as DDMS Item ID 59112.

(Pierce, et al. Rebuttal Testimony (DDMS-59112) to be inserted at this point.)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	**Docket No. 52-011-ESP**
Southern Nuclear Operating Company	)	**ASLBP No. 07-850-01-ESP-BD01**
(Early Site Permit for Vogtle ESP Site)	)	**February 6, 2009**

**REBUTTAL TESTIMONY OF CHARLES R. PIERCE
ON BEHALF OF
SOUTHERN NUCLEAR OPERATING COMPANY
CONCERNING ENVIRONMENTAL CONTENTION 1.3**

Q1. Please state your name, occupation and business address.

A1. My name is Charles "Chuck" R. Pierce. I hold the position of Licensing Manager for Southern Nuclear Operating Company ("Southern Nuclear"). My business address is: Inverness Office Park, Birmingham, Alabama 35201.

Q2. Please describe your educational and professional background.

A2. I earned a B.S. degree in Mechanical Engineering from Mississippi State University in 1974 and a M.S. degree in Mechanical Engineering from Mississippi State University in 1980. I have worked as an engineer at Southern Nuclear for twenty-eight years. My experience encompasses nuclear power plant licensing, design engineering and retrofitting. I have managed license renewal projects for various nuclear facilities, including all aspects of the Nuclear Regulatory Commission's ("NRC") new nuclear licensing requirements. I have designed and evaluated safety related systems, changes in licensing to meet regulatory impacts, and site system engineering to solve plant issues.

As relevant to this proceeding, in the area of standard design, I have been involved in the development of standard designs for nuclear power plants with Westinghouse Company ("Westinghouse") and the licensing of Westinghouse's standard design with the NRC.

My job requires knowledge of the licensing practices and procedures for nuclear power plants, including all aspects of site design, installation, environmental qualifications, construction and regulatory interpretations. I have experience with all aspects of licensing of nuclear plants, including the regulatory requirements, policies and practices. I have performed evaluations of design changes in licensing and license renewals. I have developed Early Site Permits and Combined Operating License applications, in compliance with the NRC current standards for nuclear power plants. My curriculum vitae is attached. *See* Exhibit SNC000058.

Q3. Please state the purpose of your rebuttal testimony.

A3. The purpose of my testimony is to rebut the testimony of Joint Intervenors' witness Mr. William Powers with regard to the meaning of the AP1000 standard design and to discuss the importance of retaining the standard nuclear power plant design that has been reviewed and certified by the NRC.

Q4. What is the NRC's policy regarding use of certified nuclear power plant designs?

A4. The NRC has repeatedly expressed its desire that the next generation of nuclear plants be standardized in order to enhance safety by making reactors of the same design more uniform and to reform the licensing process by making it more predictable. Based upon this policy, the NRC has certified four standard plant designs that may be used by applicants seeking a license to construct and operate a nuclear plant. These "standard designs" are approved only after a rulemaking that includes a review of the Design

Control Document ("DCD") for each standard design and after NRC staff issues a final safety evaluation report for each standard design. In addition, the NRC encourages license applicants to standardize the balance of their plants to the extent it is practicable. *See* Exhibits SNC000059, SNC000060, SNC000061, SNC000062, SNC000063, and SNC000064 (Final Statement on Policy of Conduct of New Reactor Licensing Proceedings, 73 Fed. Reg. 20963, at 20971 (April 17, 2008), citing 10 C.F.R. § 52.63 (2006) ("the Commission encourages applicants to standardize the balance of their plants insofar as is practicable.")). *See also* 10 C.F.R Part 52 ("The NRC issued 10 CFR part 52 . . . to reform the NRC's licensing process for future nuclear power plants. . . . The processes in 10 CFR part 52 allow for resolving safety and environmental issues early in licensing proceedings and were intended to enhance the safety and reliability of nuclear power plants through standardization.").

Q5: On page 7 of his direct testimony (Powers Testimony at A23), Mr. Powers states that "a standard design serves as a point of departure for customizing the design for a specific site with specific site constraints." How do you respond?

A5. The statement is misleading. The characterization of the standard design as a point of departure for customization is contrary to the NRC's policy and intent with regard to the meaning of "standard design." As I discussed earlier, the NRC has repeatedly expressed its desire that the next generation of nuclear plants be standardized in order to reform the licensing process by making it more predictable and to enhance safety by making reactors of the same design more uniform. The standard plant design will also facilitate and expedite the licensing, procurement, construction, and commercial operation of all the standardized units. While the new Part 52 licensing regulations do carry a departure process where changes to the standard design can be made, the intent of both the NRC and the industry is that this process will be applied only when absolutely necessary in order to maximize the benefits of the standard design. For example, the current standard design employs a Toshiba turbine. While several of the current five AP1000 applicants have indicated a preference for other turbine manufacturers with which they have had more experience, all have elected to not change that design in order to achieve the benefits of standardization.

Q6. What is the standard plant cooling system design for the AP1000 nuclear power plant design?

A6. The standard AP1000 cooling system design includes a closed loop cooling system with a traditional steam surface condenser to condense steam from the turbine and a wet evaporative cooling tower. *See* Exhibit SNC000065, DCD Section 10.4. The conceptual design for the cooling system for the AP1000 nuclear power plant design was developed by Westinghouse with the objective of achieving a generic standardized design for use at all potential sites and for all potential clients. The standard plant design would facilitate and expedite the licensing, procurement, construction, and commercial operation of all the standardized units.

Q7. What is the standard turbine specified for the AP1000 nuclear power plant design?

A7. Section 10.2.2 of the DCD specifies the turbine-generator as a TC6F 52-inch last-stage blade unit, which is a multi-stage Toshiba turbine. *See* Exhibit SNC000028. More specifically, the TC6F turbine is designed to operate in conjunction with a single pass/multipressure condensing turbine with a design backpressure of 2.9" HgA.

Q8. Is the turbine-generator building part of the standard design?

A8. Yes. The design of the turbine-generator building is also described in Section 10.2.2 of the DCD. *See* Exhibit SNC000028.

Q9. On pages 6 and 7 of his direct testimony (Powers Testimony at A21-A22), Mr. Powers states that the surface condensers necessary with the wet cooling system in the AP1000 design can be removed to create adequate space for ACC steam ducts and that 20-foot diameter openings in the wall of the turbine building are necessary to install these ducts. Mr. Powers also states that these modifications "in no way rise[s] to the level of reworking the entire turbine building" and do not interfere with the standard design for the AP1000. Do you agree?

A9. No. Removal of the condensers and creation of 20-foot diameter holes in the turbine building would be substantial changes to the standard design. These modifications would require changes to the wall of the turbine building, the turbine building structural steel cross bracing, and the main turbine deck support system. Moreover, these changes will cause layout changes to other equipment in order to provide a path for the steam ducts and will require the design of a support system for the steam ducts.

Q10. Would a change to the turbine require a re-evaluation of the final site safety analysis?

A10. Yes. The final site safety analysis submitted in this proceeding in accordance with Appendix N is based upon the site safety analysis and the DCD prepared by Westinghouse as part of the standard AP1000 plant design. As noted in Section 10.1.2 of DCD Rev. 17, the current Toshiba turbine design and orientation minimize the probability of missile generation and directs potential missiles away from safety-related equipment and structures. Changing the steam turbine to accommodate an ACC would require a re-working of this analysis. It would also cause a similar effort on Chapter 11 of the DCD, as removing the condensing mechanism from the turbine building and placing it in the open air where a steam tube leak would vent straight to the atmosphere would most certainly impact the analysis of primary-to-secondary system leakage. Thus, further costs would be incurred due to the potential operational and safety analyses that changing to an ACC might necessitate.

Q11: Are true, accurate and correct copies of each of the exhibits heretofore referenced in your testimony attached to this pre-filed written testimony, and do they accurately portray the facts they purport to portray?

A11. Yes, except for Exhibit SNC000028, which is attached to the pre-filed direct testimony of James W. Cuchens submitted in this proceeding on January 9, 2009.

Q12: Does this conclude your testimony?

A12: Yes.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	Docket No. 52-011-ESP
	)	
Southern Nuclear Operating Company	)	ASLBP No. 07-850-01-ESP-BD01
	)	
(Early Site Permit for Vogtle ESP Site)	)	February 6, 2009

AFFIDAVIT OF CHARLES R. PIERCE CONCERNING SOUTHERN NUCLEAR'S REBUTTAL TESTIMONY ON ENVIRONMENTAL CONTENTION 1.3

I, Charles R. Pierce, do hereby state as follows:

1. I am employed by Southern Nuclear Operating Company as the Licensing Manager for Vogtle Deployment. A statement of my professional qualifications is attached to the SNC rebuttal testimony to be submitted on February 6, 2009, in response to hearing issues identified by the Board.

2. I have read the foregoing prepared testimony regarding environmental matters at the Plant Vogtle Site.

3. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record of this proceeding. I declare under penalty of perjury that those statements, and my statements in this affidavit, are true and correct to the best of my knowledge, information and belief.

Charles R. Pierce
Charles R. Pierce

Subscribed and sworn to before me
this 3rd day of February, 2009.

Gloria H. Buie
Notary Public

MR. LeJEUNE: Thank you, Your Honor.

And we also have a number of exhibits to mark in support of Mr. Pierce's 1.3 rebuttal testimony.

First is SNC000058, curriculum vitae of Charles R. Pierce.

JUDGE BOLLWERK: Let the record reflect that SNC000058 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000058-00-BD01 for identification.)

MR. LeJEUNE: SNC000059, NRC Backgrounder, New Nuclear Power Plant Designs.

JUDGE BOLLWERK: Let the record reflect that SNC000059 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000059-00-BD01 for identification.)

MR. LeJEUNE: SNC000060, Early Site Permit Standard Design Certifications.

JUDGE BOLLWERK: Let the record reflect that SNC000060 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000060-00-BD01 for identification.)

MR. LeJEUNE: SNC000061, Statement of NRC Chairman Lando Zech.

JUDGE BOLLWERK: Let the record reflect that SNC000061 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000061-00-BD01 for identification.)

MR. LeJEUNE: SNC000062, Position Paper on Standardization.

JUDGE BOLLWERK: Let the record reflect that SNC000062 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000062-00-BD01 for identification.)

MR. LeJEUNE: SNC000063, Statement by NRC Chairman Ivan Selin.

JUDGE BOLLWERK: Let the record reflect that SNC000063 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000063-00-BD01 for identification.)

MR. LeJEUNE: SNC000064, Conduct of New Reactor Licensing Proceedings.

JUDGE BOLLWERK: Let the record reflect that SNC000064 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000064-00-BD01 for identification.)

MR. LeJEUNE: And SNC000065, AP-1000 DCD Section 10.4.

JUDGE BOLLWERK: Let the record reflect that SNC000065 is marked for identification.

(Whereupon, the above-referred to document was marked as Exhibit No. SNC000065-00-BD01 for identification.)

MR. LeJEUNE: Thank you, Your Honor. We move for admission of these exhibits.

JUDGE BOLLWERK: All right. Any objection?

(No response.)

JUDGE BOLLWERK: Hearing none, then Exhibits SNC000058, 59, 60, 61, 62, 63, 64, and 65 are admitted into evidence.

(Whereupon, the above-referred to documents were received into the record as Exhibit Nos. SNC000058-00-BD01 through SNC000065-00-BD01.)

MR. LeJEUNE: Thank you, Your Honor.

We tender these witnesses for cross examination.

JUDGE BOLLWERK: Thank you, sir, for your patience.

All right. I think Judge Trikouros may have some questions for this panel.

JUDGE TRIKOUROS: Yes, first of all, in the interest of saving some time, I'm going to try and take a slightly bigger picture view rather than down into the testimony in all cases. And I wanted to give you an idea of where we're coming from.

The issues that we want to explore are whether dry cooling is a viable option for Vogtle units three and four. And associated with that is the AP-1000 design accommodation possibilities. And the relatively large size of this plant, issues associated with the location of the plant in terms of the environment, the temperature environment of the Vogtle site, issues associated with the cost of a dry cooling at Vogtle three and four.

There are some questions that I have regarding performance impact of dry cooling on AP-1000 operation, which is skirting some of the testimony but I think we need to discuss some of that.

The safety impact of dry cooling for a nuclear power plant, we have some testimony on that. I think we need to explore that a little bit.

And then these disadvantages of dry cooling that have been discussed in the FEIS.

And then finally, and I think we've covered most of this, is the issue of whether dry cooling is actually needed at the Vogtle site and there we're talking mostly about the environmental issues that we've been really talking at length about for the last, you know, day and a half. And so I don't think we need to spend too much time on that, which is good.

Let me start out with Mr. Cuchens. In terms of your direct testimony, question five, you use the word in -- well, you go through a significant amount of detail regarding the difficulties that one would have in implementing dry cooling at the Vogtle site for these plants.

And you use the word impossible. You say the extreme difficulty in resolving these significant design issues makes use of dry cooling for all practical purposes impossible.

I'd like, if you could, to elaborate on that for a moment because that is a very specific statement. You say impossible meaning not viable at all under any circumstances.

MR. CUCHENS: Yes, sir. We started with

the basic concept that AP-6000 is standardized using a six flow, triple exhaust turbine from Westinghouse. And it designed for an average back pressure of 2.92 inches -- back pressure, that being Westinghouse average of the three steam surface condenser back pressures.

So we basically started with trying to design an air cooling condenser to match that performance, if you will, on an apples-to-apples comparison to try to make it work, to make it possible. And in doing so, obviously the fundamental chief parameter for designing an air-cooled condenser is in a parameter called initial temperature difference so that the initial temperature, by definition, is the difference between the ambient temperature and the saturated steam temperature.

Obviously in the steam tables, if you go to the saturated steam temperature at 2.92, that is 114 degrees. The site ambient design temperature is 95 degrees. So basically 114 minus 95 is an ITD, by definition, of 19 degrees.

It is recognized throughout the industry pretty much that the state of the art on large surface or dry-cooling technologies, the state of the art is basically ITDs of 35 degrees and higher. So as you can see in comparison to that parameter, the 19 degrees is outside the realm of state of the art.

JUDGE TRIKOUROS: Okay. Now you go into that detail really in your answer on question nine. In your answer on question five, you really are discussing what I would call pragmatic design issues such as eliminating air-in leakage and being able to eliminate air-in leakage and that sort of thing.

You are really discussing, again, things that, in my opinion, have been done elsewhere. You know, for example, aren't there a number of very large dry-cooling systems in operation in the world today that would have to deal with all of the issues that you are discussing in your question five and that are dealing with them on a daily basis? Am I wrong there?

MR. CUCHENS: There are no large facilities of 1,000 to 1,100 megawatts, as this would be. No, sir. There are -- the largest of the installations that you are basically referring to would be those in South Africa, the Matimba, Majuba, those are roughly 660 megawatts. They have high back-pressure turbines and they are not triple exhaust turbine designs.

JUDGE TRIKOUROS: But they do have to deal with all of these issues that you have identified as technical difficulties.

MR. CUCHENS: They have.

JUDGE TRIKOUROS: And you are saying that the design of Vogtle -- or the size of Vogtle is what makes the difference in terms of being not able to implement these design challenges?

MR. CUCHENS: Not having the experience of a large high back-pressure turbine or even a low back pressure turbine on an ACC is the first premise.

They have dealt with these issues but they have, obviously, designed -- and where I was leading to was obviously they have designed their air-cooled condensers for 35 degrees or higher which means they are much smaller.

Even with their design concepts being different, they have had difficulties with trips and load swings that basically are outside of what we would consider the practical application of an ACC.

JUDGE TRIKOUROS: Could you elaborate on that? You are saying that experience with these -- with dry cooling has resulted in what -- swings in back pressure and leading to -- I guess the high end of swing would lead to a trip?

MR. CUCHENS: Yes, sir, I am. As was experienced by many of the installations in South

Africa on these large facilities, they experienced such significant weather shifts, that being the wind directions or ambient conditions, that it actually knocked the units off line rather unpredictably.

JUDGE TRIKOUROS: All right. But they were built and they were operating, I'm assuming, the majority of the time. Therefore, they were able to overcome the design issues that you are talking about in question five.

I'm just trying to -- I'm trying to understand the word impossible and my sense is that it is not impossible but it is very difficult. Am I --

MR. CUCHENS: I think the key word there is for all practical purposes and that is basically what I was trying to suggest is the practical application and the consideration of all of the other design considerations. In other words, we visited Matimba and Majuba to learn from their experiences and to learn from their practices.

And based on those practices or best practices, if you will, then we drew the conclusion associated with the Vogtle site.

JUDGE TRIKOUROS: Okay. But I mean you are kind of jumping the gun on me.

MR. CUCHENS: Sorry.

JUDGE TRIKOUROS: I'm sort of in item one of my outline when I said I wanted to look at these --

MR. CUCHENS: Sorry.

JUDGE TRIKOUROS: -- in some sort of order. This is the -- is it viable not if I build it, will it operate correctly. That's other issues.

MR. CUCHENS: Yes, sir. We did conceptualize two design options that would suggest it is possible to do so. Yes, sir.

JUDGE TRIKOUROS: That it is?

MR. CUCHENS: That it is possible -- theoretically possible.

JUDGE TRIKOUROS: But difficult?

MR. CUCHENS: But difficult. And the key word there, again, is it has not been done so it is theoretical.

JUDGE TRIKOUROS: Right. Okay. That's fine.

I will note on question nine of your direct testimony, here you are talking about the back pressure issues associated with this turbine, with the AP-1000 turbine. I guess you go into some detail here. Are you precluding a high back-pressure turbine in this testimony?

MR. CUCHENS: No, sir, I'm not precluding the high back-pressure. I'm precluding its feasibility here at the Vogtle site. I don't believe that the AP-1000, the standard plant, precludes from any technology.

It just is advocating the standard package, if you will, with the decision of the cooling technology being a site-specific evaluation. And that is where we are here on Vogtle.

But I am saying that since having done that homework, knowing that the AP-1000 is a low back pressure turbine, low back pressure turbines being turbines that have their operating range of one to six inches, that for the Vogtle site, it is an impractical -- unfeasible choice.

JUDGE TRIKOUROS: You talk about operating near five inches of mercury absolute. Are you suggesting that the plant could operate near five? Or would it have to operate at basically 2.9 for pretty much all of the time?

MR. CUCHENS: No, sir. It doesn't have to operate at 2.92. Under the Westinghouse conceptual design, it was intended to work at 2.92 obviously with a wet system.

It would not reach near five at all with that wet system. However, whenever we redesigned a second air-cooled system to reflect the 35 degrees ITD or state of the art, we then ended up with a 4.5-inches design, which is obviously on the high end of the relative scale.

Given that, you'd have less room for margin of error. You'd have less room for the fluctuations that you would possibly incur with the wind effects as well as the fouling effect of the dirty tubes or dirty condenser.

So you would be in a high back-pressure regime if not at the alarm points.

JUDGE TRIKOUROS: So for some part of the year, you would be operating at 2.9 as per design. For other parts of the year, you would be operating closer to five than you might feel comfortable.

And then what would you say about the very high temperature period, like the summertime? Would it be impossible to maintain the five inches?

MR. CUCHENS: I submit to you it would be very difficult, which relates back to my practically impossible thing because of the fact that we designed the 4.5 ACC on a perfect calm. That's kind of the opposite of a perfect storm.

The perfect calm being it is totally clean as if it has come right out of the shop. It has no fouling from dirt or air or any of the things that clog up your air filters on your air conditioning. And it has no in-leakages problems that have leaks from the thousands and thousands of feet of pipe related to it.

So it basically -- what we see in just the fouling itself can incur back pressures additive to half of an inch to one inch. So that would put us from four and a half, if you will, to five and a half if it were dirty just from an operational perspective.

And then the pressure drop in the line itself, that goes from the half mile of run from the turbine exhaust all the way out to the condenser, that would possibly incur additional additive losses. So I'm already -- I start at four and a half, it's clean. And if it is fouled, it will have one inch at five and a half. And I add another half inch to that because of the line losses, I'm already up to six inches just on a perfect calm.

Now if winds come along that are obviously blowing in the wrong direction, it induces additional decrement on the performance that even drive it higher.

JUDGE TRIKOUROS: In terms of wind, however, that could be accommodated in the design, correct?

MR. CUCHENS: Up to a point. Because of the mammoth size of it, it is very subjected to wind effects. The other thing -- and obviously with two-unit considerations, we have two large installations that we basically are trying to locate on the site, which Mr. Moorer can address later on if you choose to, but the whole point of that is to say is that we have very large equipment that is subject to air currents, ground air currents.

JUDGE TRIKOUROS: Okay. Let's see, let's go on to question 13.

You say in your answer -- forgive me for the time I'm taking but these are very long -- these are very long answers to questions.

MR. CUCHENS: I'm sorry.

JUDGE TRIKOUROS: You say in your answer as such, while I would not say that a high back-pressure turbine and/or an air-cooled system could never theoretically be used with any kind of AP-1000 plant design, I would say that it cannot be used with the current AP-1000 standard plant design.

Now when you say that, is that a sort of semantic argument that just -- where the word standard is the key word there? In other words, you are saying the standard plant design isn't a dry-cooling design. Therefore, you would have to modify the standard plant design. Is that what you mean there?

MR. CUCHENS: I am saying that to implement an air-cooled condenser, you would have to modify the standard design. Yes, sir. And so it does not support the current standard design.

JUDGE TRIKOUROS: In question 14, you indicate that there aren't any nuclear power plants of the Vogtle size and environment that use dry cooling anywhere in the world. Could you tell me what the largest fossil plant that uses dry cooling in the world is? And what type of turbine it uses? And are there any other nuclear fossil plants of this size being considered in the future anywhere?

MR. CUCHENS: The largest dry-cooling or air-cooled technologies that I am aware of, those are in South Africa. It has a two flow, single pressure turbine as opposed to obviously what we're talking about at Westinghouse -- with Westinghouse Toshiba.

With regard to the specific supplier, I don't exactly recall the point of the supplier but that is the largest one.

As with regard to future implementations, I believe that Eskom is considering additional 660 megawatts units similar to those that they have on the ground in South Africa for future potential installations.

That being said, they are not considering anything larger than that, I believe, because of the fact of the high mass flow associated with anything larger than that on the single-flow turbine presents a problem on the exhaust velocity of the turbine itself with regard to blading technology. It exceeds the annulus velocity out that is permissible based on current technologies of the turbine.

That is what I understand is -- that is what I know to be the largest. And there are none that large in the United States similar to Matimba because they are -- there again, they are the state of the art. They have high back-pressure turbines and they have high ITDs to keep the relative cost feasible.

JUDGE TRIKOUROS: Okay. What about the North Anna 3 plant?

MR. LeJEUNE: Excuse me, Your Honor. We'd like to renew our objection that we noted in our motion in limine earlier with regard to the hybrid or combination wet-dry cooling system proposed for North Anna and object to any discussion of that in this proceeding as not within the scope of Environmental Contention 1.3. And place that objection on the record please.

JUDGE BOLLWERK: Your objection is noted.

JUDGE TRIKOUROS: That plant in the exhibits associated with that plant, there is a discussion there that under much of the year, it actually -- or under at least some parts of the year, it might operate entirely with dry cooling, not the wet cooling.

So I really am focusing my question more specifically on the fact that they are indicating that they would build a plant that would be able to handle the full load of North Anna with dry cooling under certain times of the year which means at least they could -- they are proposing to construct it and operate it.

So I'm limiting my question to that portion of the testimony.

MR. CUCHENS: Thank you, Your Honor. I understand your question and I am prepared to answer if we can move on.

But in relation to North Anna 3, it is not -- obviously, as you stated, it is not a totally dry system. It is a combination of the wet and dry. And

North Anna further contends that they fully intend to operate on a wet system except whenever the water levels in the lake don't allow them to do so.

So they basically fully intend in their -- at least in their proposed design to operate wet as much as possible. And they call that energy conservation mode.

They state that they can possibly operate under a totally dry scenario that you basically alluded to a moment ago when there are favorable conditions. And they further go on to define that as cold. And whenever -- and obviously I would consider cold something in the magnitude of freezing to me. But they don't define it any further in detail other than just saying cold.

They also further explain that these favorable conditions are going to be very short lived in duration and are not to be construed as the normal operating expectations.

JUDGE TRIKOUROS: Okay. However, the reason I'm bring up North Anna is with respect to much of your testimony that deals with the inability to or the great difficulty associated with actually implementing dry cooling at a nuclear power plant in terms of all of these technical issues that you are discussing and also in terms of the back pressure issue.

So apparently they believe that they could at least build the system so that it does operate effectively when the ambient temperature conditions are right. So they do believe, in fact, that they could overcome a number of the things that you are saying with respect to Vogtle.

And I was trying to -- and I need to just understand your thinking in that regard. They are a bigger plant. They are almost a 50 percent bigger plant. They do have a standard design just as Vogtle has a standard design. And their standard design is probably not too much different, in fact, to standard BWR, you know, back-end design.

I don't think there is anything unusual there just as there isn't with Vogtle. And yet they are -- or they at least were proposing that -- well, I guess we can talk about that at some point here -- but so I just wanted to get your comments regarding that.

Do you -- what do you think that that means relative to much of your testimony in terms of these great difficulties in actually building something like that?

MR. CUCHENS: I think that North Anna

recognizes that they also have similar issues to contend with on their cooling systems. And obviously the site specifics of it associated with the lake and the other parameters that they have to deal with are obviously much different than Vogtle.

But second to that, yes, you are correct, Your Honor, in that they also have a six-flow, triple exhaust pressure on the ESBWR so they would have, as you say, an even bigger issue to deal with regard to the total heat load, total duty, and all the flows would be commensurately higher than those for the AP-1000 being only 1,100 or 1,200.

But they also seemingly understand that designing the dry system has some inefficiencies that they are willing to accept even to the point of having to shut the unit off if certain conditions prevail. If those unfavorable conditions prevail, if the lake levels prevail, that they are required to cut the unit off, they are prepared to accept those conditions.

Both from an deficiency or inefficiency -- I should say inefficiency standpoint, they are prepared to go forward with that as the choice for the North Anna site. That is the difference, Your Honor.

JUDGE TRIKOUROS: Yes, I understand that they are forced to do it and that is why they are doing it because they are incurring a significant cost in doing that. And certainly they have no choice but to do that or they wouldn't be doing it.

But I just wanted to make sure that we can both agree that they, at least, believe that it can be built.

MR. CUCHENS: I do not have sufficient details in the North Anna 3 information that I have that suggests that they are addressing all the issues that we are concerned with. So I can conclude from the proposition that they are moving on -- like you say, that they believe that they could do so. But I believe they will have problems, sir.

JUDGE TRIKOUROS: Okay.

MR. PIERCE: And, Your Honor, this is Chuck Pierce, one other thing I wanted to mention, you had mentioned earlier that they -- that this -- they could operate dry cooling at basically full load.

I would submit that if you look at some of the -- if you go back to the exhibits and I think Mr. Cuchens could elaborate further, that we're not talking about 1,500 megawatts electric coming out of the plant when this dry cooling is operating. We're talking about significantly less.

I don't think the numbers are -- I don't think we have the numbers directly from Dominion on what that is in the exhibits. And I don't think we know it fully. But it would be quite a bit less in terms of the load that it could carry when operating in the dry cooling.

Do you want to --

MR. CUCHENS: Yes, I would address that, as you have already surmised, they have concluded that -- they have at least conducted a preliminary design and there is not a lot of detail, but what we've been able to derive from the North Anna conceptual and brief is that there is a considerable parasitic load. And they will suffer a considerable performance decrement associated with the combined wet and dry system under those unfavorable conditions.

But they have not detailed what those are. And they have not detailed the performance capabilities of the unit during those unfavorable conditions.

JUDGE TRIKOUROS: All right. Well, again, I'm limiting my question to only because it is a wet/dry system and I'm limiting my question to only that very specific portion that I delineated with respect to your testimony regarding the great difficulty possibly and possibly impossible to resolve those problems.

And it is not to say that they won't, in fact, have all of those issues materialize and cause them great problems when they do get -- if they do get to that point. I'm not suggesting anything other than at least they believe that they could do this.

And your testimony, in a few places, is indicating that it cannot be done. And that's really where I -- that's where I wanted to take us.

Okay. With respect to this ITD, if you wanted to accommodate dry cooling for the entire year at the Vogtle site, and when I say the entire year, I mean when I was here last time, it was 105 degrees for a week, so that's what I'm talking about.

Would an ITD of 35 degrees be able to accommodate that?

MR. CUCHENS: No, sir, it would not. That's basically whenever we -- and when we looked at the second design doing an ITD with respect to the current state of technology, we basically took the steam turbine that is existing on the AP-1000 and said well, we know it is designed for 2.92 but we'll try to design something that will work for this site based on the 35-degree minimum.

So if we have a 95 degree day, and you

said, obviously, that you experienced 105 degrees -- and that, in itself, is considerably higher -- let's just assume for design purposes a 95-degree day, 95 degrees ambient with a 35 degree ITD means that you have a steam saturation temperature of 130 degrees -- 95 plus 35. So that, by definition, says your steam saturation temperature is 130, which corresponds to 4.5 inches at, there again, at the 4.5 inches.

As I alluded to before, is the perfect calm, that is perfectly clean and it has a lot of other considerations that go into the real world, the rest of the story which, as you would say, obviously things don't perfectly work in a 100 percent clean environment.

So 4.5 represents 95 degrees in a perfect calm, a very perfect calm day, no wind influence, no recirculation influence, no fouling influences.

So if I go to 105 degrees now, as you basically inferred that I should, which I would -- under prudent design practices, I would consider those extremes because I would not want to have a unit that was inefficient, that was possible load limited, if you will, because of the cooling systems, as the general trend, designing a unit to be more efficient as possible, to produce as much power as possible, to get the best utilization of the fuel.

So then I would incur back pressures of five and a half inches or six -- I would be at my trip point or alarm points because I would have gotten to the higher temperatures and all of the other considerations.

Yes, sir, you are presumably correct that I would be in a regime that would be somewhat subjective to being out of the bounds.

JUDGE TRIKOUROS: Your exhibit 34, SNC000034, could we bring that up and go to page ten? Mr. Cuchens, do you recognize this?

MR. CUCHENS: Yes, sir.

JUDGE TRIKOUROS: Could you interpret this for us in terms of what it means, what would be required for accommodating the entire max temperature situation at the Vogtle site?

In other words, what type of ITD would be necessary? I mean it looks to me like it is going to be less than 35. Am I correct?

MR. CUCHENS: Yes, sir, you are correct.

JUDGE TRIKOUROS: So why couldn't one design a dry cooling system with an ITD of less than 35?

MR. CUCHENS: Theoretically you can. It

has not been experienced. The industry trends and the state of the art has not gone there very -- and that's basically my point. And there is a reason for that that basically associates with the feasibility.

When we designed an air-cooled condenser for an ITD of 19, we ended up with 324 modules -- huge, mammoth, 324 modules, 200 horsepower fans, very large, very large.

And basically that is kind of reflected on this, in a certain manner, that maybe if you didn't know that parameter, you wouldn't probably understand that.

But in translating it further, designing for four and a half inches of back pressure, now we've reduced the number of modules down to 202 -- basically reduced it from 324 to 202. So you can see by going from a 19-degree ITD to a 35-degree ITD, we are able to reduce the size of the ACC, air-cooled condensers, substantially, reduce the parasitic load.

But at the same time while we did that, and reduced the cost of the ACC, we went up on the back pressure. And, there again, this is reflected on this curve as well. We went up in back pressure from 2.92 to four and a half. Obviously this being a low back pressure turbine, the higher the back pressure is, the poorer performance.

So basically while we increased the size of the -- or decreased the size of the condenser, excuse me, because raising the ITD, we reduced the parasitic load to approximately 55.

But then our decrement on the turbine, because we went from 2.92 to 4.5 is 30 megawatts, so the sum total is still approximately 85 megawatts of loss. And. there again, we are approaching the high end of the turbine curve.

JUDGE TRIKOUROS: Is there a manufacturer anywhere in the world that would be able to provide an air-cooled condenser system with that type of an ITD? Or is that something that can be purchased? Or would it have to be designed specifically for the plant? Or how would it work?

MR. CUCHENS: No, sir, there are suppliers. I'm sure they would love to sell us that large of an air-cooled condenser although they have never done so in an application sense. But I'm sure that there are suppliers that would love to sell us air-cooled condensers of this size.

JUDGE TRIKOUROS: So in the event that you did implement a dry cooling system that could accommodate all weather conditions at Vogtle, you would be having to purchase something that has never been designed before, never been built before?

MR. CUCHENS: Not on this scale, no, sir. And also, as I alluded to earlier, an air-cooled condenser of this size has not been implemented on a triple exhaust turbine either.

JUDGE TRIKOUROS: So where does that take us? Does that take us to where we absolutely require a high back-pressure turbine?

MR. CUCHENS: It would suggest, yes, sir, that you would use prudent technologies. And, there again, recognizing where the industry has done, the Majubas, Matimbas, and the majority of those in the United States that have dry technologies, they have high ITDs and high back-pressure turbines.

JUDGE TRIKOUROS: So basically we can all agree that a high back-pressure turbine is the only option for this plant?

MR. CUCHENS: Yes, sir.

JUDGE TRIKOUROS: Right? And there's no question regarding that really?

MR. CUCHENS: It doesn't exist at least from an application experience base.

JUDGE TRIKOUROS: And this is in accordance with what Mr. Powers from the Joint

Intervenors has said as well --

MR. CUCHENS: Yes, sir.

JUDGE TRIKOUROS: -- that a high back-pressure turbine would be able to resolve the issues that we have just been talking about.

MR. CUCHENS: Yes, sir. He did.

JUDGE TRIKOUROS: So, therefore, we can all agree that a high back-pressure turbine is necessary.

MR. CUCHENS: We agree on that, yes, sir.

JUDGE TRIKOUROS: Okay. In question 31, and actually really 31 through 33, I think, you go into a considerable amount of detail regarding the design changes that would be necessary to the AP-1000 if you went to a dry cooling system.

MR. CUCHENS: Yes, sir.

JUDGE TRIKOUROS: And I believe when you are in that discussion, you are talking -- well, let me ask you, in that discussion, are you talking about a high back-pressure turbine or a normal turbine?

MR. CUCHENS: No, sir, I'm basically addressing the changes that would have to occur in relation to adapting the current standard plant to an air-cooled condenser -- which would --

JUDGE TRIKOUROS: Okay.

MR. CUCHENS: -- which would also -- excuse me, I didn't mean to interrupt you, sir --

JUDGE TRIKOUROS: Go ahead.

MR. CUCHENS: -- which you would also have to implement, by the way, the same changes as you would if you had a high back-pressure turbine. So I don't want to make you think that you don't have to still do these because you still have to put in these mods irregardless or regardless of back pressure turbine changes or not.

JUDGE TRIKOUROS: Now if you did go to a high back-pressure turbine for this plant with regard to these three questions that I mentioned, would that simplify that process at all? Would it be simpler or more difficult than you described in question 31 -- 31 through 33 really?

MR. CUCHENS: If I may bring up one illustration -- if it would please you, if I could just have one illustration, if we could pull up a --

JUDGE TRIKOUROS: The whole system is at your disposal.

MR. CUCHENS: Okay. Great.

JUDGE TRIKOUROS: So ask for whatever you want.

MR. CUCHENS: All right. I would like to

pull up Exhibit SNC000026, which is the dry-cooling presentation. And I believe it is the first slide that I would like to -- on the first page of that I'd like to go to.

And basically he is going to pull up an illustration that will show you -- and it would probably be considered by us engineers as an artist rendition of the standard plant.

But I think it is a very good, realistic perspective of -- even though it doesn't have, you know, structural steel and a lot of wiring and a lot of other intricate details of the plant, I think it does show you a broad perspective of what the plant would really look like from the overall big equipment, major equipment perspective.

Okay, yes, sir. So this is -- basically, what I'm basically just suggesting here is that this reflects the standard plant, as you can see, which is -- if I can get this -- it basically shows the six-flow turbine right here and it has the high pressure in the three LP compartments with the steam surface condenser directly underneath it on the foundation of the site.

JUDGE BOLLWERK: So you are pointing with your laser pointer to the right-hand side of the illustration on the second and third -- oh, I guess the main floor and the floor underneath that.

MR. CUCHENS: That's correct.

JUDGE BOLLWERK: All the blue tanks.

MR. CUCHENS: This is considered the turbine floor. These are feedwater heaters. And there are basically seven feedwater heaters, they being dual trained, so there would be 14 of those total.

Some of these are actually in the neck of the condenser itself with the MSR, that being the moisture separator reheater, but they're not all -- some of these are on the turbine floor. Other ones are on the subsequent floors, as you can see.

So this kind of shows you a really good pictorial and not real detailed, but it shows you --

JUDGE BOLLWERK: And what you are pointing to are the smaller blue -- I want to call them tubes -- they're not tubes, I'm sure they are tanks, but they look like tubes on the picture.

MR. CUCHENS: Actually they are feedwater heaters. And their size -- they are the size of a tractor-trailer truck.

JUDGE BOLLWERK: All right.

MR. CUCHENS: They are about 50 or 60 feet long. So yes, sir, they are relatively large in the perspective of things.

So now I would like to move from this being the standard AP-1000 plant with the current steam surface condenser to what it would possibly look like with the modifications that would be required for either the high back-pressure or the low back-pressure. And I believe that is the very last.

All right. Basically -- what I'm basically trying to do here is basically just show you that I'm going to now have to transport this steam a very large distance, a quarter of a mile to a half a mile out into the plant perimeter somewhere. I'm going to have to.

And we're talking about 8,400,000 to 8,500,000 pounds per hour of steam, which is obviously a lot of steam. And to do so would require very, very large steam ducts that are very large themselves, have to be structurally supported and basically carry this steam all the way out to the air-cooled condenser modules themselves for further distribution.

But the point I'm making here is basically to show you that now I have to go into the building to get to the area immediately underneath the turbine where the steam is exiting the turbine. I have to go through that area where there is a lot of other equipment.

That being their major equipment, it is major changes. And there is a lot of structural steel there as well. So now I'm having to redesign the building as well as reposition equipment.

And this building already is optimized with limited spare room, if you will, so it assumes that I'm going to have room to just put these possibly anywhere but I cannot without re-engineering the building.

Yes, this is preliminarily the design but this is the preliminary standard design that has been approved by the NRC that basically represents this powerhouse building here.

And that's the only thing I really wanted to show you, in brief, is -- and I can belabor this at length but I really don't want to because I think you grasp the point of my contention that there are major issues to consider -- the turbine building, the foundation itself, as well as other issues regarding the steam pipe that goes for a considerable length.

JUDGE BOLLWERK: All right. Just for the record, what you were pointing to was on slide 26, there are several large orange tubes, they look like, that you were referring to with your laser pointer.

MR. CUCHENS: Those are 30-foot in diameter each, which probably wouldn't fit into this room.

JUDGE BOLLWERK: All right.

JUDGE JACKSON: Mr. Cuchens?

MR. CUCHENS: Yes, sir.

JUDGE JACKSON: Could I ask you a quick question? If you contemplate these kinds of changes, would that in some way feed back to the safety considerations, safety analysis of the standard design in any way and impact that?

MR. PIERCE: This is Chuck Pierce, Southern Nuclear. Yes, there would be really quite significant impacts on the design control document that Westinghouse has prepared.

If you go back and you look at the -- you start with, for example, the turbine changes and then these changes as well, you are looking at changes first of all the ITAAC in Section 242, the turbine is described as an ITAAC with the condenser system. So there would be some changes there.

There would be changes in Chapter 10-2 and 10-4, which are exhibits, where we describe the turbine in quite a bit detail as a Tier II item.

Then there would be changes in Chapter 15 as it relates to the accident transients and analyses.

You would also have changes in the turbine building design and turbine building layout.

There would be issues that the NRC would have with regard to the cooling system such as cooling towers and how it would interact and relate. And you would have to deal with that in the COLA as well.

So there would be quite a few changes to the DCD that we would be -- and then additional information provided in the COLA that would be required as a result of this.

JUDGE JACKSON: Okay, thank you.

JUDGE BOLLWERK: Before -- just as an administrative matter, we're probably going to go until around noon time. And then probably hope to take our lunch break. So if anyone -- we did take a break about ten o'clock. I hope that will not inconvenience anyone.

JUDGE TRIKOUROS: All right. With respect to your questions 31 through 33, Mr. Powers had indicated that that air-cooled condenser design system would be simpler than the standard design. Do you agree with that?

MR. CUCHENS: No, sir, I don't. I agree

that the principle of the heat transfer is simpler. But I do not agree that the system itself is simpler. And there are two or three major points in just describing why it is simpler.

The current system with a natural draft cooling tower has no moving parts. And it basically is obviously exchanging the heat via latent heat of evaporation through the cooling tower, which is basically a function of Mother Nature. We are relying on the draft effect, that hot air rises, to basically pull air through the cooling tower. So it has no moving parts.

Very low operation and maintenance costs associated with that. Most people would love to have a natural draft tower just because of its O&M considerations.

An air-cooled condenser, on the other hand, has such an elaborate piping system, the potential for leakage, air in-leakage, is significant. The potential for corrosion, obviously, is there as well because it is all metal.

It is a tremendous solar collector because it is a large mass of metal. And so it basically, while it is trying to distribute the heat, it is also collecting some degree of heat.

But in addition to that, the drawbacks associated with an ACC are primarily two things: the operational aspect of it because it wants to get dirty and it is unpredictable and it has load swings with day to night. You know, 25 degrees load swing from morning to night is a significant change in back pressure with a dry technology that you would not incur with a wet technology.

The second most and paramount thing is the number of mechanical components themselves. Even for the smallest air-cooled condenser that we implemented that had a 4.5 under a calm storm again, it would have 205 -- or, excuse me, 202 gear boxes. And these gear boxes are the size of an automobile engine.

They are oil-filled gear boxes and they have 200-horsepower motors. So I have a lot of moving parts, lots of potential for a lot of high maintenance, which has been experienced as a norm.

So I have a lot of moving parts. I have a lot of complicated piping systems. And I have to have an air removal system that will pull off what we call the non-condensables out of the system. And I have to pull those out of it before I can even start up the system. So I have to have very large air removal systems, which we haven't belabored on.

We have to have condensate systems that take the condensed water from half a mile out back to tanks. And we have to have tanks. And we have to have insulated lines. So we have to do a lot of things, if you will, that makes it a much more complicated system in comparison, to me, to the standard steam surface condenser.

JUDGE TRIKOUROS: And the bottom line of that would be that you believe that it would be higher cost?

MR. CUCHENS: Yes, sir. It is higher cost.

JUDGE TRIKOUROS: So you disagree with Mr. Powers' statement that it would be a lower cost?

MR. CUCHENS: No, I do not agree with him that it would be a lower cost.

JUDGE TRIKOUROS: In terms of the performance issues that you just discussed, let me -- I'll jump ahead a little bit.

MR. CUCHENS: Sure.

JUDGE TRIKOUROS: Have you ever spoken to anybody, any organization that is operating one of these with respect to your statement that there are operations and maintenance issues?

MR. CUCHENS: Yes, sir. When the first

Southern Company first decided that we were going to basically get -- indulge in dry cooling because we foresee dry cooling as one of the technologies that we would be engaged in in the future, we went to South Africa to visit all of the major facilities in South Africa -- Matimba, Majuba, Kendal. And we visited a number of those in the United States as well.

And in doing so, we basically talked directly with the plant operators in addition to Eskom personnel in corporate. So we went to the plants to basically derive from them their experiences that they had learned and the best practices that they had learned from designing them -- obviously since I'm a design engineer, I'm interested -- and also from an operational perspective.

And that's where we gleaned -- and that's where basically I'm using as my reference for the information that I'm basically conveying here with regard to the problems associated with load swings, cut backs, unit trips. I'm basing that on the experiences of real world. And those I do not wish to replicate.

JUDGE TRIKOUROS: But aside from all the difficulties we've been discussing, none of these actually preclude a dry cooling system? Cost aside.

MR. CUCHENS: Cost aside, no, sir. They do not preclude. And, there again, we're defining the feasibility as the consideration of one technology versus another technology with cost obviously being included.

We're considering cost, operations, reliability, stability, and the other factor is state of the art. So we consider that to be in the realm of the full comprehensive feasibility.

JUDGE TRIKOUROS: Okay. Judge Jackson started down this road but let me walk a little bit further down it as well.

With respect to the AP-1000 DCD, are you saying that it would be -- and this question is more general for the panel -- would you say that a Rev. would be required to the DCD? Or could this be accommodated in the application?

MR. PIERCE: No, sir, I'm not saying a Rev. would be required to the DCD. What would -- the DCD provides the standard design for the AP-1000. And so I do not believe that the standard -- that the AP-1000 with the dry cooling is a standard design.

If someone were to adopt dry cooling for their preference, they would have to address all the issues in their COL application and all its departures or exemptions. For example, this Tier I item would be an exemption and this ITAAC item would be an exemption. They would have to address those items as they occur and deal with the issues in the COL application.

JUDGE TRIKOUROS: Okay. Thank you.

The eight-inch mercury number has been discussed in various testimony, do you agree that a high back-pressure turbine could be purchased that would be able to operate in the normal range of eight inches?

MR. CUCHENS: Yes, sir. High back-pressure turbines generally operate in a back-pressure regime of seven to 12 inches. Most of them are in 10, 11 inches. And that makes, obviously, the ITDs high and that makes the air-cooled condenser much smaller.

JUDGE TRIKOUROS: Okay. The AP-1000 is a modular design, as I understand it. What would be the impact of such a change on this whole modular concept? Would you imagine that they would design modules that would be specific to this new dry cooling system? Or would this be some sort of an on-site implementation that would be unique?

MR. CUCHENS: The air-cooled condenser itself would be manufactured in modules, that being the air-cooled sections are basically comprised of hundreds and hundreds of tubes, which are thin, kind of like your radiator on your car. And so those sections would be manufactured in modules and shipped in hundreds of truckloads of modules.

The structural steel itself though would not be modularized. It would just be a site-erected commodity. It would not be like the steam surface condenser that would be prefabricated in modules and then quickly assembled.

It would be what I would call a stick-frame type of construction like you would a house.

JUDGE TRIKOUROS: But it would have to interface with the AP-1000 modules at some point?

MR. PIERCE: That's correct. It would interface with the modules that would be coming in from the design of the AP-1000 at some point. I don't know how -- you know, there would also be changes, quite a few changes to the turbine building.

And I do not know how the actual construction would proceed in that case -- whether the turbine building would be stick built or whether it would be modularized. I think that would be a decision made at the time of construction on how you would proceed with a change of this type because now you are doing something very unique to the AP-1000 design. That would have to be addressed during construction.

JUDGE TRIKOUROS: Has anybody from Southern spoken to Westinghouse about this?

MR. CUCHENS: We've spoken to Westinghouse with regard to the potential for consideration for a high back-pressure turbine. I don't know with regard to whether Southern Nuclear corporately has addressed anything with Westinghouse or not. No, sir.

JUDGE TRIKOUROS: So all of the discussion in your testimony is really generated internal to Southern. And it doesn't reflect any Westinghouse thinking at all.

MR. CUCHENS: No, I'm not quoting any Westinghouse representative. No, sir.

JUDGE TRIKOUROS: Was there a reason why this wasn't discussed with Westinghouse? It would certainly, in my opinion, it would give more definitive -- a more definitive position with respect to all these issues we're raising.

MR. CUCHENS: Well, we did discuss with them, I'm just not quoting them in any of my responses. I'm basically obviously quoting -- using my testimony as the reference here.

Yes, sir, we did discuss it with them. We discussed it with GE as well in the pursuit of the state-of-the-art technologies for a high back-pressure turbine. And we still ran into that limiting fact that 660, 670, 680 megawatts is the current limiting turbine size for a high back-pressure turbine.

JUDGE TRIKOUROS: Okay. I think what I'll do is -- let me give you a break, Mr. Cuchens. Let me move on to, for now, to Mr. Pierce.

Could you describe just very briefly the Tier I and Tier II concept for the standard design and which category this balance of plants that we're talking about fits in?

MR. PIERCE: Yes, sir. There are three categories in the design certification process of material.

The first is Tier I. This is considered certified material and requires an exemption to change.

The second is Tier II. That is considered approved material -- it is not necessarily certified -- that you can change through a departure process. And depending on the results of the departure process, you may be able to do it without going to the NRC. Or you may require NRC approval.

Then there are few components that are considered Tier II Star, which is not necessarily an exemption but requires an amendment to make changes to the design.

JUDGE TRIKOUROS: And where would the system we are discussing fit?

MR. PIERCE: This system fits in both Tier I and Tier II. If you go look at the design certification, design control document, you'll see in Section 2.4.2 of the DCD, Tier I, a very high-level description of the turbine that basically describes it as a high-pressure turbine with three low-pressure stages and a condenser. And that is an ITAAC that you certify that it is constructed that way. So you'd have to modify that.

And there would be various changes to Tier II material to address, again, the overall design of the turbine system, in terms of the -- dealing with the high-pressure, back-pressure turbine, you have to look at things like turbine trips and transients, missiles, effective tube leaks and ruptures. And there's a number of issues like full load reject that the current system has that would have to be addressed as well.

So there are a number of -- as you march through the design control document, there would be a number of things that you would need to look at to address this type of a change in the Tier II side.

JUDGE TRIKOUROS: Yes. So you are addressing the NRC licensing requirements here?

MR. PIERCE: Right.

JUDGE TRIKOUROS: All right. So you sort of jumped -- that was my next --

MR. PIERCE: Okay.

JUDGE TRIKOUROS: -- question.

MR. PIERCE: Good segue.

JUDGE TRIKOUROS: But that's good. So you believe that all the -- or at least a number of the Chapter 15 events would have to be re-analyzed?

MR. PIERCE: I think there would be some. I wouldn't say a number of them but certainly when you start looking at turbine performance in Chapter 15, you would have to consider that and whether that would require re-analysis of those sections.

JUDGE TRIKOUROS: Would this new system be able to accommodate the operating specifications of the reactor, for example feedwater temperature, feedwater enthalpy, none of that would be problematic in this system?

MR. PIERCE: I think that Mr. Cuchens

could probably better answer that. From my experience, I don't think that that would be -- that those issues would problematic in terms of the reactor itself.

MR. CUCHENS: The reactor, no, sir. I don't think --

MR. PIERCE: Now I think the one issue there that I would mention is the full-load reject capability. That would need to be looked at in terms of whether the dry cooling system could handle a full-load reject.

JUDGE TRIKOUROS: The AP-1000 is a 40 percent bypass system?

MR. PIERCE: I believe it is.

MR. CUCHENS: Yes, sir. I believe that is correct.

JUDGE TRIKOUROS: And I believe the -- which is another issue is the ESBWR is, I believe, a 100 percent bypass.

MR. CUCHENS: That is correct. The percent bypass obviously is something we wouldn't haven't even gone to in my engineering details. I haven't belabored it because obviously we are at a high level evaluation here.

But trying to -- what are we going to do on a turbine trip with that bypass? Yes, sir, we haven't figured out how that ACC would be able to accommodate that.

JUDGE TRIKOUROS: Mr. Pierce, let's see in your direct testimony, question 10, you talked about a primary to secondary system leakage analysis that you indicate would have to be redone. I think it is in your direct -- it is in your direct testimony.

I was having trouble understanding why there would be an issue with respect to primary to secondary system leakage. But perhaps you can explain that to me.

MR. PIERCE: Well, the -- when you look at this, if you did have a steam tube leak in the steam generator, the secondary system would be at, of course, a lower pressure. And it would be venting -- it would be leaking directly into the ACC system.

And so the -- what would need to be addressed here is how you -- is what type -- is what that would really do to the ACC, I mean what type of a Part 20 issues would that raise and so forth in the context of tube leakage. That is something that really haven't addressed.

JUDGE TRIKOUROS: I thought about it and it wasn't clear to me that there would be a problem there. I think that the assumptions that are made in the -- it is a radiological issue -- the assumptions that are made in the radiological analyses, I think don't take credit for any type of delay or hold up or secondary building of, you know, containment boundaries.

So I think it just sort of goes to the atmosphere but I'm not positive of that. But --

MR. PIERCE: You know the other issue, too, is that if you do have a contamination of the ACC system, what does that mean in terms of long-term effects of being able to, you know, decommissioning and so forth, too, as well at some point.

JUDGE TRIKOUROS: Yes. Okay. Well, I wanted to talk a little bit more -- a little bit later about some issues like that.

MR. PIERCE: Okay.

JUDGE TRIKOUROS: But I'm not sure that we're really going to get to that but perhaps.

With respect to the turbine missile analysis that you discuss in your testimony, do you view that as a big problem?

I mean it seems to me that that would be a fairly simple thing to accommodate. It would be a new turbine missile analysis with the new system. Do you see that -- is there some great difficulty that I'm not aware of?

MR. PIERCE: Well, in the context of the DCD, I'm not sure there is -- I'm just not sure that there would not be a great difficulty. I'm not sure what the probability of a rotor failure would be in this case. And what orientation the turbine would take in the building itself.

So I'm just -- in the context of the design of the turbine relative to the reactor building and so forth, I'm just not that familiar with how you would redesign the system at this point to address that.

JUDGE TRIKOUROS: All right. So in your testimony, you really bring it up only from the point of view of something that you think would certainly have to be re-analyzed.

MR. PIERCE: Certainly.

JUDGE TRIKOUROS: Not that there is any big problem or any unusual difficulty or anything like that?

MR. PIERCE: Right. You would have to design it into the building and then look and see how you would have to address it.

JUDGE TRIKOUROS: Okay. That's fine. And

in fact then, given your current testimony, there may be other things that are not in your direct testimony that may have to be looked at.

MR. PIERCE: Certainly, sir.

JUDGE TRIKOUROS: Including the load reject --

MR. PIERCE: Right.

JUDGE TRIKOUROS: -- 100 percent load. Okay.

Mr. Moorer?

MR. MOORER: Yes, sir?

JUDGE TRIKOUROS: In your direct testimony, question nine, you reference a 248.9 acre land use impact. I believe you, in your testimony or in one of your exhibits, you reference 324 cells -- a 324-cell air-cooled system that would be necessary in order to come up with this 248.9. And you mention accommodations for such things as air effects, for recirc issues, and all of that.

And I was going to ask why it has to be 324 cells but I think Mr. Cuchens made it clear that it wouldn't be 324 cells. It would be 202. And, therefore, I don't -- so I think there is disconnect here.

MR. MOORER: Let me respond to that and

maybe Mr. Cuchens will want to add to it as well.

He looked at two cases. He looked at a worst case that was the 324-cell design. And then he looked at another case that was the 202 design.

Basically what I did is I looked at what the worst case would be from the standpoint of the two cases, what the impact would be from the larger design. And found that I could put it on the site and found a place that it would fit. And analyzed it from that perspective.

And that's where the 248.9 acres comes from is that's the box, if you will, that would be required for the footprint of the two-unit towers of the larger design. I think it is safe to say that the smaller 202 design would fit within that footprint.

JUDGE TRIKOUROS: All right. In you testimony, using the 248.9 acre impact, you elaborate further, if I remember correctly, to discuss the fact that there may have to be development of land that was not normally going to be developed. And you had identified a bunch of impacts associated with that.

But I think the truth is that is probably not going to be necessary with a 202-cell ACC. Is that correct?

MR. MOORER: I think -- the way I would

characterize it is that the smaller design would have a significantly -- well, not significantly -- I'd say roughly two-thirds of the size of the footprint.

From the standpoint of the location, we actually went back and looked at that. The question kind of came up in some of our discussions that this might arise. So I did go back and look at that.

It really doesn't make a whole lot of difference. You still have a pretty good sized footprint. And the location doesn't change. You still have to orient it in a way that maximizes the prevailing wind direction and those types of things.

While it does have a less of a footprint, it is not dramatically less.

JUDGE TRIKOUROS: In your testimony, you discuss a parasitic load of 80 megawatts as one of the, I guess, negative aspects of this. Where did you get the number -- the 80-megawatt number?

MR. MOORER: That comes from Mr. Cuchens' report.

MR. CUCHENS: I'm not exactly sure that he's talking about -- I think -- I believe he is talking about a two-unit --

JUDGE TRIKOUROS: Well, it is in Mr. Moorer's testimony.

MR. MOORER: Yes.

JUDGE TRIKOUROS: But I think you provided that number probably.

MR. CUCHENS: Yes, sir, I did.

MR. MOORER: That's correct.

MR. CUCHENS: Yes, sir. He's talking two-unit parasitic load.

MR. MOORER: That is correct.

JUDGE TRIKOUROS: And did you calculate that? Or was that a -- was that based on a calculation that you had done?

MR. CUCHENS: Yes, sir, we did calculate it. But obviously we derived all of our air-cooled condenser designs based on vendor-supplied data, that being either a GEA or a Marley SPX who are the major suppliers for air-cooleds.

So we basically didn't theorize. We basically sized the air-cooled condensers based on the vendor data. And based on the steam flows, back pressures, and vendor data, then we came up with the total number of modules required for condensing that amount of steam. And then the parasitic load that associates with it.

JUDGE TRIKOUROS: Okay. Is there any discrepancy between your parasitic load calculations and Mr. Powers' that you are aware of?

MR. CUCHENS: I'm not aware of any differences other than possibly the assumption of different design parameters.

JUDGE TRIKOUROS: Okay.

JUDGE JACKSON: Judge Trikouros?

JUDGE TRIKOUROS: Yes?

JUDGE JACKSON: While we're on this topic, could I just ask what's the parasitic load of the current design? The wet cooling system? How does that stack up with the 80 megawatts?

MR. CUCHENS: Pardon me for one moment. I don't remember that number but I can get it very quickly here.

JUDGE BOLLWERK: Are you going to reference a document that is already -- it is in evidence? Is that what you are looking through?

MR. CUCHENS: This is the study that is on the record.

JUDGE BOLLWERK: Okay.

MR. CUCHENS: And it basically is detailing the parasitic load for the wet system, it's basically just the circulating water pumps themselves. Obviously the cooling tower has no parasitic load. It's a natural draft.

So it's basically just the circulating water pumps themselves which are approximately -- I'm looking at around 20,000 -- about 1,500 megawatts.

MR. MOORER: I think you need to correct your units.

MR. CUCHENS: Yes, I'm going to have to put my glasses on, excuse me, Your Honor.

JUDGE TRIKOUROS: I know that feeling.

MR. CUCHENS: Circulating water pumps, yes, 1,3298 kilowatts or 1.3 megawatts.

JUDGE BOLLWERK: And what page are you reading from?

MR. CUCHENS: I'm reading from page 26 of the feasibility study which is item document number SNC000024.

JUDGE BOLLWERK: It's actually R00024. There is a revised version.

JUDGE JACKSON: Okay. So that's 13 versus 80.

MR. CUCHENS: Yes, sir.

JUDGE JACKSON: Thank you.

MR. CUCHENS: Sorry I took so long.

JUDGE TRIKOUROS: Okay, shall we move on? Can -- Mr. Cuchens, can you talk to me about this energy penalty? The -- what would define as the average annual energy penalty? How do you define that term?

MR. CUCHENS: The energy penalty basically is associated with -- obviously I'm going to presume that your question associates from use of wet technology versus the dry technology.

JUDGE TRIKOUROS: Correct, correct.

MR. CUCHENS: The energy penalty is associated with the change in back pressure. And I'm changing the back pressure from 2.92 on an average to 4.95.

And since the 4.95 put me in the high end of the turbine exhaust pressure curve, it is in an area where whenever you are moving up and down the curve, it is somewhat linear so that degradation is going to remain relatively the same. That being the 30 megawatt is going to remain relative.

Just because I'm starting out on the very high end of the curve, the low end of the curve with 2.92 it starts to flatten out. But I'm not going to get there very often because of the site climatological conditions. So I'm not going to get down into low back-pressure regimes like I would with the wet power.

JUDGE TRIKOUROS: What kind of numbers do you think would be experienced -- what magnitude of energy penalty do you think would be experienced with a dry cooling system versus a wet cooling system.

MR. CUCHENS: The magnitude would be in the 20 to 30 megawatts of decrement on the turbine itself. And then, of course, the parasitic load would be additive to that. So we're -- then that would be an addition 45 to 55 megawatts of parasitic. So you're looking at 75 to 85 megawatts detriment.

JUDGE TRIKOUROS: The numbers that are in exhibits associated, for example, with the EPA are -- indicate some fairly large numbers like ten percent. And I believe Mr. Powers' calculation for that energy penalty is on the order of one-and-a-half percent. And I'm going to be asking him about that difference.

Do you have any feel for --

MR. CUCHENS: Yes, sir, I do.

JUDGE TRIKOUROS: -- what that energy penalty is? And I'm talking about the effect on the heat rate, the change on the net heat rate.

MR. CUCHENS: Yes, sir. Excuse me, yes, sir. Our numbers are along the same lines so obviously that's what you basically just described, that being we see a degradation in the heat rate or output in heat rate of the performance being in the magnitude of eight to ten percent which, obviously, does not coincide with the one to four percent that you alluded to a moment ago.

And so from our analysis, we would basically conclude with EPA, which obviously concluded that dry cooling in this, while it is not the best technology available, it is still not precluded from being considered.

But they have had the same conclusion with regard to the impact on performance, yes, sir. They have numbers coincident with ours.

JUDGE TRIKOUROS: If one were to implement a high back-pressure turbine, would there be a reduced energy penalty associated with that?

MR. CUCHENS: Yes, sir, there would be.

JUDGE TRIKOUROS: Would that eliminate the issue of energy penalty with respect to dry cooling versus wet cooling?

MR. CUCHENS: It would certainly reduce it to the potential levels. But it would not eliminate it completely because the parasitic load would be still there. So the parasitic load is obviously a big contributor to the net here, if you will.

But as far as the turbine degradation, you could reduce that. There again, you have to consider the definition of feasibility that I alluded to earlier.

JUDGE TRIKOUROS: Well, would you consider the energy penalty issue to be a non-important issue with respect to dry cooling?

MR. CUCHENS: I do not consider it to be a non-important issue. The loss of 30 megawatts -- and there, again, we believe that our numbers are conservative but because we still believe it is still going to be in the eight to ten percent range of degradation.

But I don't consider that to be negligible, especially on a nuclear unit. Obviously I have inherent problems with designing inefficiency into any system as a cooling system engineer, not just a nuclear system engineer.

JUDGE TRIKOUROS: Did you actually do calculations of the impact on efficiency with different back pressures?

MR. CUCHENS: Yes, sir.

JUDGE TRIKOUROS: Is that something that you did as part of this?

MR. CUCHENS: Yes, sir. We look at it seasonally. We look at it monthly, seasonally, annually.

JUDGE TRIKOUROS: Okay. Again, North Anna 3, now, again, with a very limited view of this, I believe it is -- I believe they were talking about numbers like 12 percent. And I wasn't sure. Are you familiar with any numbers associated with North Anna on energy penalty?

MR. CUCHENS: No, sir. North Anna 3, I have very sketchy info. What I do know about it is what you alluded to earlier is that it is a different turbine. And it has a different characteristic curve, if you will.

So I wouldn't expect it to be identical, hence the correlation from any one manufacturer or different turbines to be equitable is not exactly directly relative.

JUDGE TRIKOUROS: All right.

Okay, just turning for a moment to -- I'll try and end this quickly because I would like to get you guys off before lunch -- turning again to the performance impact of dry cooling on the plant, is it your opinion that there will be a reliability impact on the plant?

MR. CUCHENS: Yes, sir. It is based on what -- the concept that we basically have tried to pursue is that to make it work, to use it at a 35-

degree current state of the technology and to use a 4.5-inch air-cooled condenser is putting the very edge.

And there again, because I know that I've designed for this perfect calm, that I am at risk for not considering the other implications from climatological additions, the fouling effect, which I would, if I were to go forward and I detailed, I would basically go to a much higher level of evaluation.

But because I know these things from intuitive and experience base, those drawn on the conclusions from the actual world in South Africa, I know that I am at risk for being in that high back-pressure regime as well as load swings creating a tremendous change on the turbine and the nuclear steam supply system and possibly the reaction time, the reaction time being if I have tremendous load swings that are basically sudden implications on the turbine, I do not know how the rest -- how quick the rest of the nuclear island could respond to that.

JUDGE TRIKOUROS: Now would that go away with a high back-pressure turbine?

MR. CUCHENS: A high back-pressure turbine allows you to have those load swings more forgivingly.

JUDGE TRIKOUROS: Because we tend to speak in apples and oranges with respect to high back-pressure turbine versus standard turbine and I want to make sure that we constantly juggle both of those --

MR. CUCHENS: Yes, sir.

JUDGE TRIKOUROS: -- so the reliability impacts, the major reliability impacts that you are discussing would be associated with a standard turbine. But if one were to implement a high back-pressure turbine, the impact would be improved?

MR. CUCHENS: As I have alluded to before, we were starting with a design point, you know the AP-1000 has a low back-pressure turbine. And we are starting with a back pressure of 4.5.

So I don't have a whole lot of margin. Reverse engineering this thing, I don't have a whole lot of margin to escape from because of all other auxiliary implications.

If I were to use a high back-pressure turbine, I would, as an engineer, design it for a back pressure that would have sufficient margins.

In other words, if I knew I was going to have temperatures over 100 that would drive me up into high back pressures on it, I would start with designing it to have a much higher relative degree of margin so that I would not get encumbered by ambient conditions that cause load swings and the consequences of that.

So I basically said by going to a high back-pressure turbine, I'm forward engineering it rather than reverse engineering it as I would for the AP-1000 for the low back-pressure turbine. Does that explain that? Does that answer your question?

JUDGE TRIKOUROS: Yes. I think since we've pretty much concluded that it has to be a high back-pressure turbine, we probably should -- if I ask you a question about reliability, just assume that it is for high back-pressure turbine rather than, you know, answering it for a standard turbine.

All right. I think I'm okay for now. I am going to need to ask Dr. Coutant a question after lunch. But -- and I have a little bit additional for you, Mr. Cuchens so perhaps we will need a few minutes after lunch.

MR. CUCHENS: Okay.

JUDGE TRIKOUROS: But I think we can end now otherwise it will go on longer.

JUDGE BOLLWERK: All right. Let's then plan on taking -- given the need to make sure that we get Mr. Sulkin on, if we do an hour today, would that be acceptable to everyone? Can we get lunch within an hour?

All right. Then why don't we say that we will adjourn now and we will reconvene at one o'clock then. Thank you very much.

(Whereupon, the foregoing matter went off the record at 12:01 p.m. to be reconvened in the afternoon.)

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

(1:02 p.m.)

CHAIRMAN BOLLWERK: Let's go on the record, please. We are back after a lunch break to continue with the EC 1.3 contention panel for the applicant. Before we continue with some questions from Judge Trikouros, I want to take care of one evidentiary record matter. We had been given at one point two exhibits. They are actually called exhibits for cross -- well, we were given by the applicant exhibits for cross-examination that we have marked SNC000095 and SNC000096.

(Whereupon, the aforementioned document was marked for identification as Exhibit Number SNC000095-00-BD01 and SNC000096-00-BD01.)

CHAIRMAN BOLLWERK: Judge Trikouros had actually utilized those as part of the questions, although he didn't identify them as such, utilized those to generate some of the questions he asked the panel in the very beginning of his questioning.

So I am going to go ahead and identify those for the record. And then I will see if anybody has any objections to admitting them. But, again, those were utilized by Judge Trikouros.

So let's go ahead and for the record

identify SNC000095, which is pages 8-4 and 8-5 to the North Anna final environmental impact statement. That one is identified for the record.

Also SNC000096. That's pages 2-173, 2-174, 2-193, and 2-194 of the North Anna 3 combined license application. That exhibit is identified for the record as well.

Any objection to the entry of those exhibits?

(No response.)

CHAIRMAN BOLLWERK: Hearing none, then SNC000095 and 96 are admitted into evidence.

(Whereupon, the aforementioned document, having previously been marked for identification as Exhibit Number SNC000095-00-BD01 and SNC000096-00-BD01, was received in evidence.)

CHAIRMAN BOLLWERK: At this point, Judge Trikouros, I think we're back with you.

JUDGE TRIKOUROS: Okay. In terms of the safety analysis, I think I am comfortable that we have covered enough of that. I just wanted to ask Mr. Cuchens if he believes that there would be an increased likelihood of balance of plant-initiated transients. And I'm talking about things like high backpressure turbine trips or high backpressure scram, that sort of thing, even with a high pressure turbine.

MR. CUCHENS: With a high pressure turbine design with sufficient margins, those would be minimized. But with the current low backpressure turbine, I think the risk is enhanced.

JUDGE TRIKOUROS: Okay. So would you say that the dry cooling system with a high pressure turbine would not necessarily have a higher likelihood of balance of plant-initiated transients?

MR. CUCHENS: I would say it could be designed out to some extent, yes, sir.

JUDGE TRIKOUROS: With respect to the load rejection, I don't know if this is a question for you or Mr. Pierce, but with respect to the 100 percent load rejection with the 40 percent bypass, do you see any difficulty with a high backpressure turbine of being able to accommodate that event with dry cooling and that turbine?

MR. PIERCE: Not with the turbine, but I think with the downstream air cooling system, you could have a problem, an issue that would need to be addressed.

MR. CUCHENS: Okay. And, Your Honor, I might stand corrected, but I think that is 60 percent and not 40 percent on the AP1000. I could be in error, but I think that is a 60 percent rejection, rather than 40.

JUDGE TRIKOUROS: Okay. That's fine. That's easy to look up.

MR. CUCHENS: Yes. But the whole point I really wanted to make is that rejection obviously has inside the current steam condenser is definitely not -- is already addressed, and it can be accommodated without any implications.

We don't know exactly how we are going to accommodate it going from obviously a vacuum to a positive pressure without blowout diaphragms and I think a solution, mind you, to go atmospheric. So I am not even going to go there.

So the whole point of that is to say I am not prepared to say how we could address that.

JUDGE TRIKOUROS: So suffice it to say that there would have to be a review of certain events, one of which would be the 100 percent load rejection?

MR. PIERCE: Yes, sir.

JUDGE TRIKOUROS: Okay. Good. All right. I think that should be it for the non-environmental side. I have one question for Dr. Coutant.

This is with respect to your direct testimony, question 6. It's covered in 6 and 7. And it relates to some rebuttal testimony by Dr. Young in his rebuttal question 6.

It says, according to Dr. Young, "The EPA definition of extremely sensitive biological resources does not require that the species be subjected to significant risks."

How do you respond to that? And what is the basis for your narrower definition of "extremely sensitive biological resources"? I wouldn't mind if you repeated your definition.

DR. COUTANT: Okay, Your Honor. The question in answer 6 in my testimony referred to the preamble section in Clean Water Act section 316(b) that brought up this term, "extremely sensitive biological resources."

Fortunately or unfortunately, I guess, EPA didn't explain what it meant by that term other than parenthetically mentioning threatened and endangered species. So it's left to a bit of conjecture as to what they did mean.

What you can do is look toward other EPA documents and federal agency documents that have essentially given a precedent for what is meant by the rather cursory phrases in the preamble.

There are a number of them, incidentally. And when you do that, you see a common thread that requires an analysis of the likelihood of exposure to something that could reasonably cause some harm to the population of threatened and endangered species. It doesn't mean there should be no development where there are populations of the listed species.

I would go through some examples. For instance, in the Clean Water Act section 316(a) guidelines for implementation, it specifically goes through mandatory analyses for threatened and endangered species for thermal discharge evaluations and giving permits for thermal discharges.

They are very clear that you need to -- they list these. And I won't go through all of them, but things you should look for that are areas where you might expect to reasonably cause some harm. And those would be areas of discharge into a spawning area, critical nursery areas, critical migration routes. There are a number of these that are itemized.

If you look at other parts of the 316(b); that is, the Clean Water Act section 316(b) that deals with intake, they go into more detail than this particular phrase that we are dealing with here.

And they also list the same sorts of -- well, first of all, they mandate an analysis, not unlike what we are talking about with a hard look under NEPA. They mandate an analysis to see whether the affected areas would be nursery areas, spawning beds, and that sort of thing.

If you look at the Endangered Species Act implementation procedures that are used by all government agencies, they also stress the analysis, not the prohibition but analysis -- and the typical process where endangered species are being evaluated is to have the proposing agency develop what's called a biological assessment, which, again, is not unlike the hard look that is required under NEPA. And the potential impacts on the endangered species or listed species are gone through in detail.

And then subsequent to that, the agency that is responsible for the particular species, usually the Fish and Wildlife Service if it's a terrestrial or freshwater species, the National Marine Fisheries Service if it's a marine or estuarine species, that agency has to issue what is called the biological opinion. That is, in their opinion, the biological assessment has been adequate to show either that there will not be significant impacts to the threatened and endangered species population from the action or if they choose that there would be significant impacts. So you have to go through this process of evaluation that is laid out in the series of biological assessment and biological opinion.

Then there is also what is called the section 7 consultation, which is a procedure under the Endangered Species Act, where separate from the biological assessment, biological opinion routine, an agency proposing an action writes a letter to the agency saying essentially, "This is what we plan to do. Would you tell us your opinion on what the action would be and if there are any biologically important habitats that would be affected by the action."

And from that request by the group trying to do the action, the agency comes back with a letter. In the case of an anadromous species, the ones that migrate up the rivers, it would be the National Marine Fisheries Service.

And in this particular case, in the Vogtle case, we do have the letter from the National Marine Fisheries Service that was the result of the section 7 consultation. And that is exhibit SNC-22.

So the bottom line is that what is

required in precedent for explaining this little staccato bit in the phrase we have in front of us is a long history that mandates a detailed analysis of whether there will be significant impacts, as I said, not unlike the hard look that is expected under NEPA.

And that is the basis of my conclusion in my testimony that what is required is an evaluation of impacts and whether there are alterations that would affect sensitive areas in the vicinity of the proposed cooling system, intake or discharge.

Perhaps that is a bit long of an answer, but I hope it covers your question.

JUDGE TRIKOUROS: Well, not entirely. It still doesn't go to the definition. The definition as it's defined by the EPA according to Dr. Powers doesn't require any -- that the sensitive biological or extremely sensitive biological resource exists because of the fish or whatever it is that is there. And it's independent of any consideration of significant effects or anything.

Do you agree with that definition?

DR. COUTANT: No, I don't, actually. I think what I have tried to show is that when that kind of a phrase has been used previously in EPA documents, what they are referring to is, are these biologically significant functions and habitats and areas that could potentially be harmed and the analysis, then, to determine whether you would have a significant impact on the population from the action.

CHAIRMAN BOLLWERK: Let me put it to you. There is always the possibility here -- I can't say there's zero possibility -- that one of those two species we have been talking about could get into the inlet and be impinged or entrained. I'm going to get the right word, "impinged," right?

I guess the question, from your perspective, that possibility doesn't necessarily create the situation that EPA was concerned about. Is that --

DR. COUTANT: That's right.

CHAIRMAN BOLLWERK: Is that what you are saying?

DR. COUTANT: There would have to be some reasonable reason for there being exposure that could affect the population. I mean, the basis of the Endangered Species Act is effect on populations.

So these precedents that I have mentioned really are stressing effects on the population and that there would be a reasonable chance that there could be harm.

CHAIRMAN BOLLWERK: If what I described just now, one of these two fish, were being essentially hurt by the plant by getting entrained or impinged, what are the consequences for Southern if that were to happen on a, say, set of fish or whatever?

DR. COUTANT: Well, usually one fish doesn't trigger the action. It would have to be enough to be -- enough harm to have a population effect.

And, again, I think of the Endangered Species Act situations we have in other places. In the Columbia River, for instance, we have a number of endangered salmon. And, yet, both the federal hydropower system is allowed to operate and the commercial fishery is allowed to operate that does take some of the salmon.

In that case, they go to great lengths to determine what the take is and then determine whether that take is enough to affect the population extinction risk for that stock of salmon.

So, again, the precedent is that it isn't the occurrence of one individual fish impinged. If we had a sturgeon impinged, which we have not, that in itself would not under the basis of what I am using as precedent be enough to trigger canceling the site, for instance.

CHAIRMAN BOLLWERK: I often think of, one other question, obviously I think that it may have changed, but there was a problem for years with American eagles. And if you killed an eagle, you were in serious trouble: one eagle.

There are people who have gone to jail for this. I take it you are saying this is not the situation with respect to these fish.

DR. COUTANT: That hasn't been the situation with respect to fish. That's correct.

JUDGE TRIKOUROS: Perhaps we are really arguing semantics. I mean, in a practical way, if there were extremely sensitive biological resources, that would be one justification for the utilization of dry cooling. However, it stands to reason that you would have had to make the determination that the alternate did not have a small impact or had an insignificant impact, which is really what we are doing here in this proceeding anyway.

So perhaps it's nothing more than semantics, although maybe only in application does this become clear.

DR. COUTANT: Well, if that is a question, I agree that we are dealing with a situation where the staff, I think correctly, has judged the impacts to be small. And, therefore, they would not be enough to trigger this phrase that has been used in the 316(b) document.

JUDGE TRIKOUROS: Okay. I think we are all right for now. Thank you.

CHAIRMAN BOLLWERK: Judge Jackson?

JUDGE JACKSON: A quick question. You testified that the problems faced by the robust redhorse related principally to decrease in spawning grounds, appropriate spawning places. Is that correct?

DR. COUTANT: That's correct, among other things. There are several others, actually, but --

JUDGE JACKSON: Okay. That's one of the factors, though, that --

DR. COUTANT: Right.

JUDGE JACKSON: -- I believe you mentioned. Would the construction of units 3 and 4 at Vogtle further limit the spawning habitat that would be available?

DR. COUTANT: It would not.

JUDGE JACKSON: Okay. What about the passage of the robust redhorse past these new units?

Would that in any way restrict or limit access to suitable --

DR. COUTANT: As the intervenors have testified, the robust redhorse tend to occupy the deep channel habitats. And those would not be affected by the thermal plume, which is a buoyant plume that tends to come up to the surface and occupy the surface waters. And the intake is along the shoreline again, which is not on the habitat where the robust redhorse would be migrating.

So my bottom line is that the migration of the robust redhorse would be fine with both the intake and the discharge at the new units.

JUDGE JACKSON: Okay. Thank you.

JUDGE TRIKOUROS: Just before we close this panel, just a warning that I want to ask the staff the same question regarding extremely sensitive biological resource definition. And it will also come up with Dr. Young.

CHAIRMAN BOLLWERK: All right. I should also mention I think my example of the eagle may not be a good one because that may be protected under other statutes that have nothing to do with the Endangered Species Act but, nonetheless. All right.

I think at least the Board at this point is done with the panel. However, we need to give you all an opportunity if you have any questions that you want to generate. How long do you think you need? Ten minutes? Fifteen?

MR. BLANTON: We need zero.

(Laughter.)

CHAIRMAN BOLLWERK: You need zero? Okay.

MS. GOLDSTEIN: We need about ten minutes.

CHAIRMAN BOLLWERK: Ten minutes?

MS. GOLDSTEIN: Yes.

CHAIRMAN BOLLWERK: That will work? Ten minutes? All right. Why don't we take a ten-minute break, then. And we'll be back in ten minutes. Thank you.

(Whereupon, the foregoing matter went off the record at 1:23 p.m. and went back on the record at 1:42 p.m.)

CHAIRMAN BOLLWERK: We've taken a brief recess to receive questions from the parties relative to the panel, the applicant's panel, on EC 1.3.

We received some questions from the intervenors. We did not receive anything from the other parties. And I'll turn first to Judge Trikouros.

JUDGE TRIKOUROS: This is for Mr. Cuchens.

MR. CUCHENS: Yes, sir?

JUDGE TRIKOUROS: You testified that air-cooled units in South Africa are regularly knocked offline unpredictably by weather. What evidence do you have to support this assertion?

Do you have any trip reports or other information documenting the alleged problems with these plants? If such events actually occur with regularity, why are air-cooled units so prevalent in South Africa with additional units being planned?

MR. CUCHENS: That's several-part questions. And I'll answer the last one first.

CHAIRMAN BOLLWERK: If we need to, we can go back through it again for you.

MR. CUCHENS: Great.

CHAIRMAN BOLLWERK: Whatever order you can. And if we need to repeat it, we will do that certainly.

MR. CUCHENS: Last shall be first. That said, why are there so many units air-cooled in South Africa? That one is the easiest. Because of the lack of water and the availability of natural resources typically mandates that you use dry cooling. With no water availability, then obviously that's the alternative of choice.

Secondly, with regard to the trip reports or the experience recognized in South Africa, the experience that was recognized in South Africa was in the early years of operations whenever they first came on line with the units, which now that has been some ten years approximately that I was there.

At that time they recognized that they had inherent problems with the design. And they have made substantial modifications subsequent to that time, partitions, bifolds, walls, to try to accommodate or improve on the aerodynamics from the lessons learned.

But in their earlier years, discovery-wise, just designing one to best orient it to the best wind conditions does not necessarily in itself circumvent a problem.

They also discovered that there are a number of factors in designing air-cooled condensers that are limiting, that being whenever you put multiple air-cooled condensers together, you are now inducing another potential implication of unit-to-unit interference between each other.

So these factors were basically witnessed in their earlier years associated with these what I would call optimized units, that being they had high ITADs and their ACCs are small in relation to the low backpressures, concepts.

So recognizing this, basically it's from my experience that they have had pretty much several years, but in the earlier years, it basically suggested you have to take additional matters in the front end of designing those things to basically mitigate these climatological influences.

With that being said, the AP1000, in translating that to AP1000, the AP1000 is even more of a mammoth entity than any of South Africa's. Basically I guess I'm saying we're going where you haven't gone before in experienced how-to or know how to mitigate that on a larger scale. So that's basically what I'm suggesting that we be aware of and concerned of and address.

And my reports back in that spectrum are obviously associated with our gleaming for their experience.

JUDGE TRIKOUROS: So you don't have trip reports or any direct written evidence. You were there. You spoke to them.

MR. CUCHENS: Yes, I do have trip reports.

JUDGE TRIKOUROS: Thank you.

CHAIRMAN BOLLWERK: All right. Judge Jackson?

JUDGE JACKSON: Mr. Cuchens?

MR. CUCHENS: Yes, sir.

JUDGE JACKSON: Again, you testified that a 20 to 30-megawatt average output degradation would be expected with an ACC. You also testified that the EPA estimated an eight to ten percent energy penalty on average.

Given the 20 to 30 megawatts, is about 1.8 percent of 1,117 megawatts 1.8 to 2.7? Can you explain the apparent contradictory testimony between that percentage and the EPA ten percent?

MR. CUCHENS: Yes, sir. I don't believe it is contradictory. I believe that the 30 megawatts is part of the picture but not all of the story. The 30 megawatts is a degradation in the actual turbine because of the higher backpressure. The parasitic load represents another 50 megawatts.

So that the sum total is about 84 to at the lowest end 84 megawatts, which represents 8 percent. So that gets you back to the eight to ten percent number.

Now, the EPA analysis says eight to ten percent, like you say. And they're basing theirs on the parasitic load again being, I think they analyzed it to be, something like 150 megawatts. So they're also saying a similar thing, that because of the combined parasitic load, in addition to the turbine degradation, is eight to ten percent.

JUDGE JACKSON: Thank you.

CHAIRMAN BOLLWERK: All right. Judge Trikouros?

JUDGE TRIKOUROS: Yes. SNC-57 exhibit sets forth examples of natural draft cooling towers with air-cooled condensers. How many acres would such a system size for the AP1000 require?

CHAIRMAN BOLLWERK: We're bringing 57 up now.

JUDGE TRIKOUROS: Keeping in mind that the number for the AP1000 in Mr. Moorer's testimony is probably more like half or so of the acreage that you identified, 248.9, right, not for this system but for the system you were looking at?

MR. MOORER: The system that Mr. Cuchens provided in his report, the 324-cell system, took the 248 acres, correct. The --

JUDGE TRIKOUROS: But a 202-cell unit would be proportionately smaller?

MR. MOORER: Proportionately smaller. Roughly two-thirds was my guess.

CHAIRMAN BOLLWERK: Do you need us to

scroll through this for you? It's about five pages long, I think, nine pages, actually, testimony. If you see something you want us to stop on, let us know.

JUDGE TRIKOUROS: Mr. Cuchens, are you familiar with air-cooled systems that have natural draft cooling towers? Is that something you are familiar with?

MR. CUCHENS: That being a system like Kendal, which has a natural draft, yes, sir, I am familiar with it. It's a dry cooling tower, if you will.

JUDGE TRIKOUROS: Okay. And so the question really is, what acreage does that require?

MR. CUCHENS: It is a larger entity than a natural draft wet tower because the dry cooling system is less efficient than the wet evaporative cooling. So it's comparatively larger. I don't have an exact number. I do know it is not as efficient. So it has to be larger.

JUDGE TRIKOUROS: Larger than the dry cooling, the air-cooled condensers we are talking about in the testimony that you have given?

MR. CUCHENS: No, sir, not as large as the air-cooled condenser footprint. No, sir. The dry system at Kendal, basically a dry natural draft cooling tower, uses a glycol solution.

So they basically have recirculated. They still have a steam surface condenser. And they are recirculating a glycol solution through the tubes.

And natural draft tower air is still the heat transfer media. It's still a dry system. But it has -- rather than condensing steam in the tower like an air-cooled condenser would, it's basically just recirculating glycol solution through the unit. And the steam surface condenser still exists, as in the case of the AP1000.

JUDGE TRIKOUROS: So it's an indirect --

MR. CUCHENS: Yes, sir.

JUDGE TRIKOUROS: And typically they're smaller?

MR. CUCHENS: Yes, sir.

JUDGE TRIKOUROS: Okay. So there is no percentage, just smaller?

MR. CUCHENS: Just smaller than an air-cooled condenser, yes, sir, but larger than natural draft.

JUDGE TRIKOUROS: All right. Thank you.

CHAIRMAN BOLLWERK: Anything else?

JUDGE TRIKOUROS: I think that's it.

CHAIRMAN BOLLWERK: All right. Anything

else?

JUDGE JACKSON: Nothing.

CHAIRMAN BOLLWERK: All right, then. I believe at this point, then, if there are no other questions, we are finished with this panel. Gentlemen, I thank you very much for talking with us today and your service to the Board. Some of you I think we will see again. So, again, thank you very much.

MR. CUCHENS: Thank you.

CHAIRMAN BOLLWERK: Just as a time check here, it's about 5 until 2:00. I believe we have about an hour, you think? Probably somewhere around there for the staff. So hopefully with respect to Mr. Sulkin, we'll have him on by 3:00 o'clock or a little after.

His testimony is basically one paragraph, which we certainly need to get in the record. If we have additional questions for, I think, Mr. Powers or Dr. Young, we may well continue on with that questioning. But it's important to get his testimony and any questions. And then he can be dismissed if he needs to get out to the airport. So all right. That is the way we'll plan on doing it.

All right. Let's have the staff panel on contention 1.3, if we could, please.

MR. MOULDING: Mr. Martin will be introducing the staff witnesses, exhibits, and testimony.

CHAIRMAN BOLLWERK: All right. This is one panel. I believe everyone looks like a familiar face. So you all have already been previously sworn, I recollect. And you will remain under oath.

MR. MARTIN: Okay. I'll just go ahead for the Court Reporter and introduce everybody one more time.

CHAIRMAN BOLLWERK: All right. That's fine.

MR. MARTIN: You may already know who they are. Starting on the far right, we have Dr. Christopher Cook, and we have Mr. Lance Vail, Dr. Michael Masnik, and Ms. Rebekah Krieg.

Can I please see the NRC staff's direct testimony for contention 1.3? Okay. I am going to ask you all to respond to the following statement. Are you familiar with the testimony entitled "NRC Staff's Testimony of Dr. Michael T. Masnik, Rebekah H. Krieg, Dr. Christopher B. Cook, and Lance W. Vail Concerning Environmental Contention EC 1.3" dated February 26, 2009, which has been provided to the

Court Reporter in electronic format under file name "Vogtle ESP NRC Staff EC 1.3 Direct Testimony"?

DR. COOK: Yes, I am.

MR. VAIL: Yes, I am.

DR. MASNIK: I am.

MS. KRIEG: Yes, I am.

MR. MARTIN: Do you affirm that those portions of the direct testimony bearing your initials were prepared by you and that they are true and correct, to the best of your knowledge and belief?

DR. COOK: I do so affirm.

MR. VAIL: I do.

DR. MASNIK: I do.

MS. KRIEG: I do.

MR. MARTIN: I now move to have the staff's EC 1.3 direct testimony admitted as if read.

CHAIRMAN BOLLWERK: All right. Any objections?

(No response.)

CHAIRMAN BOLLWERK: Then the record should reflect that the staff's prefiled testimony on contention EC 1.3 should be inserted into the record at this point as if read as DDMS item ID 59322.

(NRC Staff Direct Testimony (EC 1.3) (DDMS-59322) to be inserted at this point)

Corrected on: February 26, 2009
Corrected on: February 2, 2009
Originally Filed on: January 9, 2009

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
SOUTHERN NUCLEAR OPERATING CO.	)	Docket No. 52-011-ESP
	)	
(Early Site Permit for Vogtle ESP Site)	)	

NRC STAFF TESTIMONY OF DR. MICHAEL T. MASNIK, REBEKAH H. KRIEG, DR. CHRISTOPHER B. COOK, AND LANCE W. VAIL CONCERNING ENVIRONMENTAL CONTENTION EC 1.3

Q1. Please state your names, occupations, and by whom are you employed.

A1(a). (MTM) My name is Michael T. Masnik (MTM). I am employed as a Senior Aquatic Biologist in the Division of Site and Environmental Reviews in the U.S. Nuclear Regulatory Commission's ("NRC") Office of New Reactors. I am the lead technical reviewer for the NRC on the aquatic resources issues associated with the application submitted on August 14, 2006, by Southern Nuclear Operating Company, Inc. ("Southern" or "Applicant") for an early site permit ("ESP") for a site within the existing Vogtle Electric Generating Plant ("VEGP") site near Waynesboro, Georgia. A statement of my professional qualifications is attached hereto.

A1(b). (RHK) My name is Rebekah H. Krieg (RHK). I am employed as a Senior Research Scientist in the Ecology Group, Environmental Sustainability Division, Energy and environment Directorate of the Pacific Northwest National Laboratory ("PNNL"). I am a technical reviewer for PNNL's contract with the NRC on aquatic resource issues associated with the application submitted on August 14, 2006, by Southern for an ESP for a site within the existing VEGP site near Waynesboro, Georgia. A statement of my professional qualifications is attached hereto.

A1(c). (LWV) My name is Lance Vail (LWV). I am employed as a Senior Research Engineer in the Hydrology Group, Environmental Sustainability Division, Energy and environment Directorate of PNNL. I am a technical reviewer for PNNL's contract with the NRC on hydrological alterations, water use, and water quality issues associated with the application submitted on August 14, 2006, by Southern for an ESP for a site within the existing VEGP site near Waynesboro, GA. A statement of my professional qualifications is attached hereto.

A1(d). (CBC) My name is Dr. Christopher B. Cook (CBC). I am employed as a Senior Hydrologist in the Division of Site and Environmental Reviews, Office of New Reactors (NRO), NRC. I was employed as a Senior Research Engineer at PNNL and was assigned as the lead technical reviewer on hydrology issues for PNNL's contract with the NRC when the application was submitted on August 14, 2006, by Southern for an ESP for a site within the existing VEGP site near Waynesboro, GA. While at PNNL, I assisted with the development of portions of NUREG-1872, "Draft Environmental Impact Statement for an Early Site Permit (ESP) at the Vogtle Electric Generating Plant Site," September 2007 ("DEIS"), relating to hydrological alterations, water use, and water quality issues. As part of my current employment, I was a technical reviewer for the NRC on hydrological alterations, water use, and water quality issues associated with the Vogtle ESP. A statement of my professional qualifications is attached hereto.

Q2. *Please describe your current responsibilities in relation to this review.*

A2(a). (MTM) As part of my official responsibilities as the senior aquatic biologist assigned to the VEGP ESP review, I provided technical oversight to the NRC and PNNL reviewers as well as performing aspects of the review related directly to a portion of evaluation of impact to aquatic organisms due to interactions with the proposed station intake and discharge structures. My assessment of impact is contained in part in sections 4.4, 5.4 and 7.5 of NUREG 1872, Final Environmental Impact Statement for an Early Site Permit (ESP) at the

VEGP site, August 2008 ("FEIS") (Exhibit NRC000001). I also had technical input to the descriptive information contained in Section 2.7.2 of the FEIS.

A2(b). (RHK) In my current responsibility as the aquatic ecology technical reviewer assigned to the VEGP ESP review, I wrote the descriptive information contained in Section 2.7.2 and performed the review of the impact to aquatic organisms due to interactions with the proposed station intake and discharge structures as presented in Sections 5.4 and 7.5 of NUREG 1872, Final Environmental Impact Statement for an Early Site Permit (ESP) at the VEGP site," August 2008 ("FEIS"). I worked under the technical oversight of Dr. Michael T. Masnik of the NRC.

A2(c). (LWV) In my current responsibility as the hydrology technical reviewer assigned to the VEGP ESP review, I am responsible for the analysis related to surface water and plant water systems documented in Chapters 2, 3, 4, 5, 7, and 9 of NUREG 1872, Final Environmental Impact Statement for an Early Site Permit (ESP) at the VEGP site," August 2008 ("FEIS").

A2(d). (CBC) As part of my official responsibilities at PNNL as a hydrology technical reviewer to the VEGP ESP review, I evaluated the surface water hydrology and plant water systems documented in Chapters 2, 3, 4, 5, 7 and 9 of the DEIS. As part of my official responsibilities at the NRC as the hydrology technical reviewer assigned to the VEGP ESP review, I was responsible for reviewing the analysis prepared by Mr. Vail (LWV) related to surface water hydrology and plant systems until March 2008. Although I was not a technical reviewer on the application during completion of the FEIS, I am familiar with the Staff's analysis and conclusions documented in Chapters 2, 3, 4, 5, 7, and 9 of the FEIS concerning surface water hydrology and plant water systems.

Q3. What is the purpose of this testimony?

A3. (ALL) The purpose of this testimony is to present the NRC Staff's views with respect to Contention EC 1.3, which challenges the adequacy of the alternatives analysis of a dry cooling system in the FEIS.

Q4(a). Are you familiar with Contention 1.3?

A4(a). (ALL) Yes. Contention EC 1.3, submitted in this proceeding by the Center for a Sustainable Coast, Savannah Riverkeeper, Southern Alliance for Clean Energy, Atlanta Women's Action for New Directions, and Blue Ridge Environmental Defense League (collectively, "Joint Intervenors"), as restated by the Atomic Safety and Licensing Board in its Memorandum and Order of March 12, 2007, alleges that:

> The [Environmental Report (ER)] fails to satisfy 10 C.F.R. § 51.45(b)(3) because its analysis of the dry cooling alternative is inadequate to address the appropriateness of a dry cooling system given the presence of extremely sensitive biological resources.

(MTM, RHK) We are familiar with the contention and the bases submitted in its support presented in the Joint Intervenors' filing dated December 11, 2006, as well as with the declarations of Shawn Paul Young, Ph.D., dated December 07, 2006, November 11, 2007, and September 22, 2008. It is our understanding that the contention concerns the adequacy of the alternatives analysis regarding the appropriateness of a dry cooling system for VEGP Units 3 and 4. Specifically, it alleges that the Staff is required to perform a more in-depth alternatives analysis given the presence of extremely sensitive biological resources.

(LWV, CBC) We are familiar with the contention and the bases submitted in its support presented in the Joint Intervenors' filing dated December 11, 2006, as well as with the declaration of Barry W. Sulkin, dated November 9, 2007, the declaration of Bill Powers dated November 12, 2007, and the declarations of Thomas C. Moorer dated October 17, 2007 and James W. Cuchens dated October 15, 2007. It is our understanding that the contention concerns the adequacy of the alternatives analysis regarding the appropriateness of a dry cooling system for VEGP Units 3 and 4. Specifically, it alleges that the Staff is required to perform a more in-depth alternatives analysis given the presence of extremely sensitive biological resources

(All) The Staff discusses system design alternatives, including plant cooling systems, in section 9.3 of the FEIS. That FEIS section discusses once-through cooling systems, dry cooling towers, and wet/dry hybrid cooling towers. Our testimony therefore focuses on the Staff analysis documented in the FEIS. However, in preparing this testimony we have also considered and referenced the specific documents listed below:

- NUREG-1555 Standard Review Plans for Environmental Reviews for Nuclear Power Plants ("ESRP") (2000) (Exhibit NRC000009).
- NUREG-1555 Standard Review Plans for Environmental Reviews for Nuclear Power Plants ("ESRP") Rev. 1 (2007) (Exhibit NRC000010).
- United States Environmental Protection Agency, "National Pollutant Discharge Elimination System; Regulations Addressing Cooling Water Intake Structures for New Facilities; Final Rule" 66 Fed. Reg. 65,256, (December 18, 2001) (Exhibit NRCR00035)
- Regulatory Guide 4.2 Rev. 2, "Preparation of Environmental Reports for Nuclear Power Stations" (1976) (Exhibit NRC000007).
- Status Review of the Atlantic sturgeon, (prepared by the Atlantic Sturgeon Status Review Team for the National Marine Fisheries Service National Oceanic and Atmospheric Administration dated February 23, 2007, updated with corrections on July 27, 2007) (Exhibit NRC000025).
- Grabowski T.B. and J.J. Isely. 2006. "Seasonal and Diel Movements and Habitat Use of Robust Redhorses in the Lower Savannah River, Georgia, and South Carolina." Transactions of the American Fisheries Society 135(5):1145-1155. (Exhibit NRC000017).
- Draft Interim Report of Fish Impingement and Entrainment Assessment at the Plant Vogtle Electric Generating Plant (Exhibit NRC000030).
- Richmond, A.M. and B. Kynard. 1995. "Ontogenetic Behavior of Shortnose Sturgeon, Acipenser brevirostrum." Copeia (1):72-182. (Exhibit NRC000046).
- Hall J.W., T.I.J. Smith, and S.D. Lamprecht. 1991. "Movements and Habitats of Shortnose Sturgeon, Acipenser brevirostrum, in the Savannah River." Copeia 1991 (3):695-702 (Exhibit NRC000047).
- Collins M.R. and T.I.J. Smith. 1997. "Distributions of Shortnose and Atlantic Sturgeon in South Carolina." North American Journal of Fisheries Management, 17:995-1000. (Exhibit NRC000022).

- Letter from United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service from Roy E. Crabtree, Ph.D., Regional Administrator, to William Burton, dated August 11, 2008, "A Biological Assessment for the Shortnose Sturgeon for the Vogtle Electric Generating Plant Early Site Permit Application." (Exhibit SNC000022).

I. <u>Cooling System Designs</u>

Q5. Describe briefly the cooling system that is proposed in the application.

A5. (LWV, CBC) The applicant proposes a closed-cycle wet cooling system. Exhibit NRC000001 at 3-5 to 3-8. In a closed-cycle wet cooling system, the majority of the heat is dissipated to the atmosphere through the evaporation of water. A fraction of the water withdrawn from the river is returned as blowdown to the river. The entire volume of the water evaporated is assumed to be consumed. In contrast, the water returned to the river is generally not assumed to be consumed. Conversely, an open-cycle cooling once-through system withdraws vastly more water than a closed-cycle wet cooling system and returns all the reject heat to the water body as sensible heat instead of discharging it to the atmosphere. Compared to a once-through system, a closed-cycle system results in greater net loss of water to the water source, in this case the Savannah River.

Q6. What regulations or guidance does the Staff follow in evaluating alternatives to the cooling system proposed by the applicant?

A6. (LWV, CBC) Pursuant to 10 C.F.R. 51.45(b)(3), the Staff must consider alternatives to the proposed heat dissipation system. The Staff analyzes heat dissipation design alternatives using the guidance in Section 9.4.1 of the ESRP. Exhibit NRC000010 at 9.4.1-1 to 9.4.1-13.

Q7. Did the Staff evaluate cooling system design alternatives in the FEIS? Did the analysis include evaluation of a dry cooling system?

A7. (LWV, CBC) Yes, in Chapter 9 of the FEIS, the Staff considered open-cycle once–through, and closed-cycle dry or wet/dry hybrid cooling systems. The Staff found that a once-through system for both units would withdraw essentially the entire flow of the river during a low flow period, making this alternative clearly unsuitable for the VEGP site and not preferable to the proposed closed-cycle wet cooling system. Exhibit NRC000001 at 9-26. The Staff determined that a wet/dry closed-cycle alternative would reduce the impacts to water supply and water quality. *Id.* The Staff also determined that a dry closed-cycle cooling system would eliminate impacts to water supply and water quality. *Id.* at 9-27.

Q8. Please describe in general terms the "dry cooling" system design the Staff considered.

A8. (LWV, CBC) As considered by the Staff in the FEIS, a dry cooling system transfers reject heat to the atmosphere as sensible heat, whereas wet cooling transfers most of the heat into the latent heat of evaporation of water. Simply stated, dry cooling systems transfer heat to the atmosphere by heating up the air, whereas wet cooling towers transfer heat by adding water vapor to the atmosphere. Therefore, a dry cooling system involves moving large volumes of air to exchange heat directly to the air and is limited by the temperature of the air. A wet cooling tower is controlled by the air temperature and relative humidity. The effect of the humidity (wet bulb temperature) makes it easier for wet cooling systems to obtain a lower temperature of cooling water being returned to the condenser in most conditions.

Q9. Did the Staff reach a conclusion as to whether a dry cooling system would be preferable to the wet tower system proposed for Units 3 and 4?

A9. (LWV, CBC) Yes, the Staff found that a dry cooling system would not be environmentally preferable to the proposed wet tower system. *Id.*

Q10. Would dry cooling largely eliminate impacts on aquatic biota (by eliminating thermal and chemical discharges as well as losses to organisms due to impingement and entrainment)?

A10. (MTM) Yes. Dry cooling towers would transfer sensible heat directly to the atmosphere. The makeup flow rate to the circulating water system would be negligible. It is estimated to be on the order of one gallon per minute. There would be no routine blowdown from the circulating water system. Therefore, with no makeup other than the one gallon per minute mentioned above and no blowdown, there would be no impingement or entrainment of any significance and no thermal or chemical discharges from a dry cooling system.

Q11. *If dry cooling would eliminate those impacts, what was the Staff's basis for concluding that dry cooling would not be preferable to the proposed wet cooling system?*

A11. (LWV, CBC, MTM) The Staff explicitly states in the FEIS that use of a dry cooling system would essentially eliminate all impacts to water resources (including with respect to water use, water quality, and aquatic ecosystems). Exhibit NRC000001 at 9-26 and 9-27. However, the Staff also acknowledges that there would be some disadvantages with use of a dry cooling system, including with respect to land use, fuel use, spent fuel transport, and spent fuel storage. *Id.* at 9-27. Dry cooling systems involve very large heat-exchange surface areas that would require more land area than an equivalent capacity natural-draft or mechanical-draft cooling system. As mentioned in the answer to Question 8, the temperature of cooling water being returned to the condenser would be lower for a wet cooling system than a dry cooling system, thereby allowing the plant with the wet cooling system to operate at a higher electrical generation efficiency. Therefore, a dry cooling system would have an increase in fuel use and an associated increase in spent fuel transport and spent fuel storage to match the electrical output of a similar plant with wet cooling.

Q12. *Were the disadvantages of dry cooling mentioned in the FEIS (parasitic energy costs such as fans, reduced generation efficiency, fuel cycle, land use, etc.) the sole basis for the Staff's conclusion with respect to whether a dry cooling system would be preferable at the Vogtle ESP site?*

A12. (LWV) No. The FEIS stated that even with those disadvantages, the Staff might consider a dry cooling system to be a preferred option if the proposed wet tower system would cause significant adverse impacts to water availability, water quality, or aquatic resources. *Id.* at 9-27.

Q13. Did the Staff find that the proposed wet tower system would cause significant adverse impacts?

A13. (MTM, LWV) No. In Chapters 4, 5, and 7 of the FEIS, the Staff concluded that the impacts of the proposed cooling tower system would be SMALL.

Q14. Did the Staff consider the arguments set forth by the Applicant and Joint Intervenors regarding the technical feasibility of using a dry cooling system at VEGP?

A14. (LWV, CBC) In connection with the Applicant's motions for summary disposition of the admitted contentions, the Applicant and the Joint Intervenors presented arguments concerning the technical feasibility and costs of a dry cooling alternative for the AP1000 reactor design at the VEGP ESP site. The Staff has not evaluated the technical feasibility or precise costs of using dry cooling for the AP1000 design at Vogtle and takes no position regarding the merits of either the Joint Intervenors' or the Applicant's testimony concerning technical feasibility. Instead, the Staff has relied on the rationale presented in this testimony and in the FEIS. However, because both filings occurred before the FEIS was completed, the Staff was familiar with the general arguments presented by both of the other parties. The Applicant and Joint Intervenors appeared to agree that compared to the proposed wet-tower design, dry cooling would A) require more land, B) cost more to implement, and C) decrease the operating efficiency of the plants. The Staff thus understands the other two parties to dispute the magnitude of these impacts, but not their existence.

Q. 15. How did the Staff decide whether to consider dry cooling in more detail in the FEIS?

A. 15. (LWV) Section 9.4.1 of the ESRP states:

> The depth of the analysis should be governed by the nature and magnitude of proposed heat dissipation system impacts predicted by the reviews of ESRP Chapters 4.0 and 5.0. If adverse impacts are predicted, the reviewers should

> coordinate in identifying and analyzing means to mitigate these impacts. The proposed system with any verified mitigation schemes (i.e., measures and controls to limit adverse impacts) should be the baseline system against which alternative heat dissipation systems are compared. The nature and adversity of the remaining unmitigated impacts for this baseline system should establish the level of analysis required in the review of alternative systems. This should permit staff evaluation and conclusions with respect to the environmental preference of these alternatives. When no adverse impacts have been predicted for the proposed system and the system will comply with the requirements of the CWA, the reviewer should conclude that there are no environmentally preferable heat dissipation-system alternatives.

Exhibit NRC000010 at 9.4.1-5.

Based on the Staff's assessment that all the heat dissipation system related impacts in Chapters 4.0 and 5.0 of the FEIS were SMALL and the Staff's assessment that there would be some adverse impacts with the subject alternative (dry cooling), the Staff determined that there are no preferable heat dissipations systems. Exhibit NRC000001 at 9-27.

Q16. Why did the Staff not consider dry cooling in more detail in the FEIS?

A16. (MTM, LWV) From the perspective of assessing impacts to the aquatic biota, the Staff concluded that impingement and entrainment losses due to operation of the proposed intake, and station thermal and chemical discharges, even under low flow river conditions, would only have at most a SMALL impact on aquatic organisms. *Id.* at 5-39. Additionally, water use and water quality impacts would also be SMALL. A SMALL impact is defined in Section 1 of the FEIS on page 1-4 as "environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource." *Id.* at 1-4.

Consistent with ESRP Section 9.4.1, the depth of the Staff's system design alternatives analysis was governed by the nature and magnitude of proposed heat dissipation system impacts predicted by the reviews of FEIS Chapters 4.0 and 5.0. The Staff determined in Chapters 4 and 5 that the impacts to water resources from the proposed wet cooling tower system were SMALL. If the Staff had instead reached a conclusion that water-related impacts were greater than SMALL, the Staff would have identified and analyzed alternatives in greater depth.

In other words, the impacts from the proposed cooling system provided the baseline against which impacts from alternative heat dissipation systems were compared. The nature of the water impacts that the Staff analyzed for this baseline cooling system (SMALL) established what depth of analysis was required in the review of alternative cooling systems. As further described in Chapter 5 of the FEIS, the Staff determined impacts would be SMALL for the proposed system because of the availability of water in the Savannah River to meet the consumptive and nonconsumptive requirements of the closed-cycle cooling system and to assimilate effluents under both normal conditions and even under drought conditions. This SMALL impact and the fact that several disadvantages of the dry-cooling alternative were identified provided the basis for the Staff's concluding that the identified alternative heat dissipation-system alternative would not be environmentally preferable to the proposed wet cooling system.

II. Impacts to Aquatic Resources

Q17. The admitted contention refers to the appropriateness of a dry cooling system given the presence of "extremely sensitive biological resources." Is the Staff familiar with that term?

A17. (MTM) Yes. The Staff is familiar with the term. It appears in the U.S. EPA's December 18, 2001 rulemaking entitled "National Pollutant Discharge Elimination System; Regulations Addressing Cooling Water Intake Structures for New Facilities; Final Rule." Exhibit NRCR00035. *Section V.C. of the December 18, 2001 rulemaking states:*

> Although EPA has rejected dry cooling technology as a national minimum requirement, EPA does not intend to restrict the use of dry cooling or to dispute that dry cooling may be the appropriate cooling technology for some facilities. This could be the case in areas with limited water available for cooling or waterbodies with extremely sensitive biological resources (e.g., endangered species, specially protected areas).

Id. at 65,282.

Q18. What does the Staff believe the EPA meant in establishing this category of aquatic biota?

A18. (MTM) The construct "extremely sensitive biological resource" is mentioned only once in the 91 page rulemaking. It is not defined in the *Federal Register* notice and is not a term that is commonly used elsewhere in evaluating impact. The State of California does refer to a category of "sensitive biological resources"; however, I believe the use of that category, in an official context, is limited to the State of California. The December 18, 2001 U. S. EPA rulemaking does provide two general examples of extremely sensitive biological resources they are: "endangered species" and "specially protected areas." *Id.* at 65,282. It is not clear whether these examples refer to just Federally-protected endangered species or Federally-protected threatened and endangered species and/or state protected species. It is also unclear if the examples given are all inclusive or whether there are other categories or examples of extremely sensitive biological organisms. In my opinion, the U.S. EPA recognized that under certain limited situations where there are formally-protected species or habitat that potentially could be seriously harmed by operation of a water withdrawal system, or the consumptive use of the withdrawn water might remove or alter significantly the aquatic environment affecting protected or valued species, or that habitat critical to the existence of the species might be harmed, the use of dry cooling may be warranted. I believe "extremely sensitive biological resources" used by the U.S. EPA is a subset and a more restrictive category than the NRC Staff's concept of "important species."

Q19. Did the Staff in the FEIS identify species in the vicinity of the site that could be considered "extremely sensitive biological resources?

A19. (RHK, MTM) The Staff did not use the concept of "extremely sensitive biological resources" in its review. Instead, the Staff relied on the concept of "important species" as defined in Regulatory Guide (RG) 4.2 (Exhibit NRC000007 at 2-3, 2-4), Section 2.7 of the FEIS, and ESRP Section 2.4.2-7 (Exhibit NRC000009) to assess the impact from VEGP Units 3 and 4 on aquatic resources. For a more in depth discussion of "important species," see the Staff's response to Questions 10 and 11 in the testimony for Environmental Contention 1.2. Not all species identified by the Staff as "important" would be considered "extremely sensitive biological resources." However, as we understand the concept all "extremely sensitive biological resources" would likely be considered "important." Therefore, the Staff in the FEIS did evaluate the potential impacts to any other species that might be considered "extremely sensitive biological resources" and concluded that the impacts, if any, would be minor. Exhibit NRC000001 at 5-36 to 5-37, 5-41 to 5-42.

There are no specially protected aquatic areas in the vicinity of the VEGP site that could be adversely affected by operation of two additional units. The only Federally protected aquatic species occurring in the vicinity of the VEGP site is the shortnose sturgeon, *Acipenser brevirostrum*. The Joint Intervenors identified two species present in the Savannah River that they claim would qualify as "extremely sensitive biological resources." Those are the endangered shortnose sturgeon and the State of Georgia endangered robust redhorse, *Moxostoma robustum*. The robust redhorse is not afforded Federal protection under the Endangered Species Act. However, both the shortnose sturgeon and the robust redhorse are considered by the NRC Staff to be "important species" and potential impacts to these two species as a result of the operation of two additional units at the VEGP site using wet closed-cycle cooling are discussed in the FEIS. *Id.* at 5-36, 5-41 to 5-42.

Q20. Has the Staff identified any species since the publication of the FEIS that would be considered an "important species" and would they likely be adversely affected by operation of the proposed VEGP units 3 and 4?

A20. (RHK) In the FEIS, the Staff identified the Atlantic sturgeon (*Acipenser oxyrinchus*) as a species of concern. *Id.* at 2-89. This statement was based on information provided by NMFS in its letter dated October 24, 2006, in response to NRC's letter dated October 12, 2006, requesting a list of endangered, threatened, candidate and proposed species. Exhibit NRC000018. However, the Atlantic sturgeon's Federal listing status was changed from "species of concern" to "candidate species" on October 17, 2006. 71 Fed. Reg. 61,022, 61, 023. While being a candidate species affords no legal protection under the Endangered Species Act, the Atlantic sturgeon should have been included in the FEIS under the definition of "important species" as provided in ESRP 2.4.2. Exhibit NRC000009 at 2.4.2-6.

The Atlantic sturgeon is known to inhabit the Savannah River in the vicinity of the VEGP site and has a life history that is similar to that of the shortnose sturgeon (*A. brevirostrum*) in that it is anadromous, has adhesive eggs that are deposited on the bottom substrate, usually on hard surfaces, and the larvae tend to stay near the bottom until the yolk sac is fully absorbed, at which time they move downstream to rearing grounds in the estuarine waters. Exhibit NRC000025 at 3, 4. The potential for impact of an adult or juvenile sturgeon from impingement and thermal discharges at the proposed VEGP site is low because the older juveniles and adults are large fish that can easily avoid impingement and the size of the thermal plume is small enough that they can avoid the plume. The potential for entrainment is also low because the eggs are demersal and adhere to hard surfaces and the larvae tend to stay near the bottom. *Id.* at 4. Thus, the Staff concludes that the Atlantic sturgeon will not be adversely affected by the proposed VEGP units.

Q21. The Joint Intervenors identified the shortnose sturgeon (SNS) and the robust redhorse (RR) as extremely sensitive biological resources. How did the Staff assess the potential for impact to these two species due to the operation of two additional units at the Vogtle site?

A21. (RHK, MTM) The Staff looked at the distribution and life history of the robust redhorse and the shortnose sturgeon in the middle Savannah River and evaluated potential impacts due to plant operation. The Staff determined the susceptibility of the species to impingement, entrainment, and thermal effects. The susceptibility of the robust redhorse to impingement, entrainment and thermal effects is discussed in section 5.4.2.6 of the FEIS. Exhibit NRC000001 at 5-36. The susceptibility of the shortnose sturgeon to impingement, entrainment and thermal effects is discussed in Section 5.4.3.2 of the FEIS. *See Id.* at 5-41, 5-42. Impacts to shortnose sturgeon are discussed more with regard to impingement and entrainment in the response to questions 24, 30 and 33 of the Staff's testimony for Environmental Contention 1.2.

The Staff in Section 5.4.2.6 of the FEIS concluded that the potential for impact to the robust redhorse from entrainment and thermal discharges would be minor because the nearest spawning area was located about 25 RM upstream of the VEGP site, the eggs develop in gravel and the larval fish remain in the gravel until all yolk material has been absorbed. *Id.* at 5-36. In addition, the adult robust redhorse has been observed to stay primarily in the main channel as they move up and downstream. Exhibit NRC000017 at 1148, 1152. Further, although not explicitly stated in the FEIS, the adult robust redhorse is a large fish that can easily avoid impingement and the size of the thermal discharge plume is small enough that it can avoid the plume.

No shortnose sturgeon larvae or robust redhorse larvae were identified in the entrainment sampling that was performed by Southern during the impingement and entrainment sampling program that was received by the Staff after the publication of the FEIS. Exhibit NRC000030 at 23, 25, Appendix D.

The Staff in Section 5.4.3.2 of the FEIS concluded that the potential for impact of the shortnose sturgeon is small from entrainment and thermal discharges because the eggs are demersal and adhere to hard substrate and are thus less likely to be entrained into the cooling water system than eggs of other species. Exhibit NRC000001 at 5-41, 5-42. In addition, the embryos (age 1-8 days old) tend to stay near the bottom and seek cover and young juveniles (greater than 40 days old) spend most of the time swimming on the bottom. Exhibit NRC000046 at 172, 179, 180. Further, shortnose sturgeon larvae collected in rivers (as are Atlantic sturgeon larvae) were found in the deepest water, usually within the channel rather than in the area near the intake where they would be more susceptible to entrainment. *Id.* at 180. Further, the identified spawning grounds for the shortnose sturgeon are located downstream of the site at RM 111-118 and upstream at RM 171-172. Exhibit NRC000047 at 695. Collins and Smith reported a probable spawning site between RM 111 and 142. Exhibit NRC000024 at 485. In comparison, the VEGP units 3 and 4 intake structure is approximately at RM 151. Further, although not explicitly stated in the FEIS, the shortnose sturgeon is a large fish that can easily avoid impingement. In addition, the size of the thermal plume is small enough so that the shortnose sturgeon can avoid the plume.

A biological assessment (BA) was prepared for the shortnose sturgeon because it is a Federally-listed endangered species. The BA was forwarded to the National Marine Fisheries Service (NMFS) Southeastern Regional Office for its review and concurrence. NMFS concluded in a letter that was received by the U.S. NRC after the FEIS was published; that this proposed action is unlikely to adversely affect shortnose sturgeon. Exhibit SNC000022 at 4.

Q22. In light of the above, why is the Staff's analysis in the FEIS sufficiently detailed to predict impacts on important species like the redhorse?

A22. (MTM) ESRP 2.4.2 states that "the type of data and information needed will be affected by site- and station-specific factors, and the degree of detail should be modified according to the anticipated magnitude of potential impacts." Exhibit NRC000009 at 2.4.2-2. The Staff considered the distribution, abundance, relevant life history data and past sampling and assessments in the river system for each of the "important species" and then assessed the potential impacts that the design, location and operating parameters of the structures, systems and components of the VEGP Units 3 and 4 cooling water system would have on the populations of the important fish and shellfish. If the distribution, abundance, relevant life history, or past data collected in the Savannah River did not identify a causal link to a particular impact category (impingement, entrainment, or thermal effects) that could result in a population level impact to that species, then a SMALL impact was predicted.

For example, the robust redhorse is a large fish and relatively strong swimmer and could easily avoid the thermal plume and impingement on the intake screens. Exhibit NRC000001 at 5-36. No robust redhorses have been impinged on the screens at VEGP Units 1 and 2 during the impingement sampling program. Exhibit NRC000030. The species is a prolific spawner and spawns over habitat unlike that found in the vicinity of the site. The station will take only a small percentage of the flow in the river. Impingement and entrainment losses related to operation of all four units at the site will not result in a detectable impact to the population, nor is the species likely to be affected by the thermal discharge; therefore, the Staff has enough information to predict that any impact to the species will be minor. Exhibit NRC000001 at 5-36.

Q23. As part of that determination, did the Staff find that the proposed cooling system would have significant adverse impacts to any important species, including the shortnose sturgeon and the robust redhorse?

A23. (RHK) No. The Staff determined that the potential for impact to the state-listed robust redhorse from entrainment, impingement, and thermal or chemical discharges would be minor as discussed in Section 5.4.2.6 of the FEIS on page 5-36 and that for the robust redhorse and all other aquatic biota the impacts from operation would be SMALL. Exhibit NRC000001 at 5-39. The Staff also determined that the impacts to the shortnose sturgeon would be SMALL, as discussed in Section 5.4.3.2 of the FEIS. *Id.* at 5-41, 5-42. It is the Staff's opinion that because the impacts to important species are SMALL, the impacts to any extremely sensitive biological organisms will also be SMALL since, as discussed in the response to Question 19, as the Staff understands the concept, "important species" would include all "extremely sensitive biological resources." These impacts are also discussed in detail in Questions 24 and 33 in the Staff's testimony for Environmental Contention 1.2.

III. <u>Conclusions</u>

Q. 24 Please summarize the impacts to aquatic resources from the proposed design and from a dry cooling system.

A24. (MTM)The Staff determined that impacts from the wet tower system on aquatic resources would be SMALL. The Staff also found that a dry cooling system would largely eliminate those impacts.

Q. 25 Given that the impacts to shortnose sturgeon and robust redhorse could, in theory, be rendered even smaller by using a dry cooling system, why did the Staff not therefore view dry cooling as the preferred option?

A25. (MTM, LWV) The Staff determined that operation of VEGP Units 3 and 4 would result in the mortality of fish and shellfish due to impingement and entrainment of organisms from the withdrawal of cooling water and mortality due to thermal effects related to the station discharge. *Id.* at Section 5.4.2. However, the Staff found that the overall impact to aquatic resources due to the operation of two additional units at the VEGP site would be SMALL. This conclusion is discussed in more detail in questions 25, 26, 33 and 53 of the Staff's testimony for Environmental Contention 1.2. A SMALL impact is defined in the FEIS as "environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource." *Id.* at 1-4. The Staff acknowledges that the use of dry cooling would eliminate all or almost all of the mortality associated with station operation including any mortality or morbidity to the shortnose sturgeon, the robust redhorse, other "important species," and the Atlantic sturgeon. The Staff, however, found that a further reduction in mortality and morbidity was unnecessary for these species since impacts at the population level would be undetectable. NEPA does not require the selection of the most preferable alternative, and in this case the wet cooling and dry cooling tower alternatives are predicted to have the same level of impact on the Savannah River population for both the shortnose sturgeon and robust redhorse as well as the other "important species" and the Atlantic sturgeon.

Additionally, the Staff's assessment of impact to the shortnose sturgeon was confirmed by the National Marine Fisheries Service Southeastern Region (NMFS SERO). On January 25, 2008, the Staff forwarded a Biological Assessment related to the two additional units planned for the VEGP site to NMFS SERO. In a letter dated August 11 2008, NMFS SERO found that the construction and operation of two additional units at the VEGP site is not likely to adversely affect the shortnose sturgeon. Exhibit SNC000022. This completed the Staff's Endangered Species Act consultation responsibilities for this facility.

Further, as discussed in Section I of our testimony, the Staff determined impacts would be SMALL for the proposed system because of the availability of water in the Savannah River to meet the consumptive and nonconsumptive requirements of the closed-cycle cooling system and to assimilate effluents under both normal conditions and even under drought conditions.

This SMALL impact and the fact that several disadvantages of the dry-cooling alternative were identified provided the basis for the Staff's concluding that the identified dry-cooling alternative would not be environmentally preferable to the proposed wet cooling system.

Q26. Given the above answers, is the Staff required to do a more in depth analysis of cooling alternatives? And why is the Staff's analysis of the dry cooling alternative sufficient to satisfy 10 CFR 51.45(b)(3)?

A26. (All) No, the Staff is not required to provide a more in-depth analysis of cooling alternatives. The Staff followed the guidance given in ESRP 9.4.1 and described the alternative cooling system in the FEIS and determined that a dry-cooling system would not be preferable to the proposed wet tower system for VEGP Units 3 and 4. Exhibit NRC000001 at 9-26.

This analysis is sufficient to satisfy 10 CFR 51.45(b)(3), which states:

> (3) Alternatives to the proposed action. The discussion of alternatives shall be sufficiently complete to aid the Commission in developing and exploring, pursuant to section 102(2)(E) of NEPA, "appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources."

The Staff, in Section 9.3 of the FEIS, identifies and discusses alternative cooling technologies and discloses the associated potential impacts of such alternatives. *Id.* at 9-24 to 9-27.

Q27. Does this conclude your testimony?

A27. (All) Yes.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
SOUTHERN NUCLEAR OPERATING CO.	)	Docket No. 52-011-ESP
	)	
(Early Site Permit for Vogtle ESP Site)	)	

AFFIDAVIT OF ANNE R. KUNTZLEMAN CONCERNING
PREFILED TESTIMONY ON ENVIRONMENTAL CONTENTIONS 1.2 AND 6.0

I, Anne R. Kuntzleman, do declare under penalty of perjury that my statements in *NRC Staff Testimony of Dr. Michael T. Masnik, Anne R. Kuntzleman, Rebekah H. Krieg, Jill S. Caverly, and Lance W. Vail Concerning Environmental Contention EC 1.2*, and in *NRC Staff Testimony of Mark D. Notich, Anne R. Kuntzleman, Rebekah H. Krieg, Jill S. Caverly, and Lance W. Vail Concerning Environmental Contention EC 6.0,* as well as in my attached statement of professional qualifications are true and correct to the best of my knowledge, information, and belief.

Executed in Accord with
10 C.F.R. § 2.304(d)

Anne R. Kuntzleman

Executed at Rockville, Maryland
This 9th day of January, 2009

Anne "Nancy" R. Kuntzleman
STATEMENT OF PROFESSIONAL QUALIFICATIONS
UNITED STATES NUCLEAR REGULATORY COMMISSION
Washington, D.C.

I am currently employed as an aquatic biologist in the Office of New Reactors, Division of Site and Environmental Reviews, Environmental Technical Support Branch, U.S. Nuclear Regulatory Commission. As an NRC staff member, I am responsible for conducting the aquatic and terrestrial technical reviews associated with the preparation of an environmental impact statement (EIS) for siting, construction, and operation new nuclear power plants.

I hold a Bachelor of Science in Biology from the Pennsylvania State University (1975), a Master of Science in Education from Temple University (1981), and a Master of Science in Biology from the University of Michigan (1982). I have also pursued graduate studies in biology at the University of Maryland (1980) and the University of Pennsylvania (1985).

From July 1975 through August 1986, I was an aquatic ecologist for two environmental consulting firms (Ichthyological Associates and Radiation Management Corporation, respectively) under contract to Philadelphia Electric Company. I assisted in all phases (field work, data processing, data analyses, report writing) of both aquatic and terrestrial preoperational studies at the Limerick Generating Station (LGS), Limerick Township, PA. My duties during this time included assisting in the age and growth survey of redbreast sunfish (*Lepomis auritus*), green sunfish (*Lepomis cyanellus*), and white sucker (*Catostomus commersonii*) from the East Branch Perkiomen Creek and the Schuylkill River in the vicinity of LGS by participating in field sampling with a small stream shocker and performing fish scale removal, pressing, and reading. I also participated in field work to conduct fish population estimates along the Schuylkill River via electrofishing, fish community characterizations via seine in the Perkiomen Creek, and angler surveys along the East Branch Perkiomen Creek and Schuylkill River in conjunction with the pre-operational monitoring program at LGS. Assisted in writing the procedures for collecting plant, mammal, sediment, and fish samples in conjunction with the Radiological Environmental Monitoring Program (REMP) at LGS and was responsible for coordinating the collection of the REMP sediment, vegetation, and fish samples.

In addition, from August 1975 through December 1976, I supervised two fishery biologists and two fishery technicians during the field work performed for two Clean Water Act (CWA) Section 316(a) thermal plume investigations on the Schuylkill River: Schuylkill Generating Station (SGS), Philadelphia, PA, and Cromby Generating Station (CGS), Phoenixville, PA, respectively. Field work included electrofishing, larval fish tows, Ponar grabs for benthic macroinvertebrates, plankton sampling, thermal plume mapping, and collection of physical chemistry data. I sorted, identified, measured, and processed both adult and larval fish collections. I assisted in report writing, data coding, and editing. I conducted a thorough non-parametric statistical analysis of both the catch per effort and larval fish data for SGS. Our electrofishing efforts at the base of Fairmount Dam in Philadelphia documented the presence of American shad (*Alosa sapidissima*). This finding assisted the Pennsylvania Fish Commission in justifying construction of the Fairmount Dam Fish ladder in 1979.

During the late 1970's I was also a field biologist for CWA Section 316(b) cooling water intake studies (impingement of fish and macroinvertebrates and entrainment of plankton, macroinvertebrates, and larval fish) at four freshwater and seven estuarine steam electric power stations on the Schuylkill and Delaware Rivers, respectively. I sorted, identified, measured, and processed the impingement and larval fish collections. I assisted in the preparation of the 316(b) evaluations for CGS and SGS located on the Schuylkill River and the Eddystone Generating Station and Edge Moor Power Station on the Delaware River.

Later as an environmental educator, I developed and presented aquatic ecology and fish identification in-service training programs for elementary and secondary schoolteachers within the Philadelphia Electric service area. I also presented lectures to community groups, environmental organizations, and students explaining the environmental preoperational studies and monitoring requirements for LGS.

From September 1986 until September 1987 I taught life science and physical science at Northeast Junior High School, Reading, PA.

From October 1987 until June 2006, I was a senior biologist with the Department of the Navy, Engineering Field Activity Northeast (EFANE), a component of the Naval Facilities Engineering Command, Atlantic Division. For almost 18 years, I served as the sole professional/technical authority for EFANE in the preparation and coordination of all Department of the Army permit applications, Coast Guard permits, state wetland permits, and water quality certificates for activities in waters of the United States (U.S.) and navigable waters of the U.S. within the regulatory authority of Sections 401 and 404 of the Clean Water Act (CWA), Sections 9 and 10 of the Rivers and Harbors Act of 1899, and Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972. In addition, I also prepared federal consistency determinations pursuant to Section 307 of the Coastal Zone Management Act and Volume 15 of the Code of Federal Regulations, Part 930, Federal Consistency.

During my tenure at EFANE, I had signatory authority for permit applications and attendant issues involving some of the Navy's most complex, controversial, and environmentally sensitive projects in the northeastern U.S.: dredging and dredged material disposal, waterfront construction, and new construction in or adjacent to wetlands.

Concomitant with regulatory requirements, I prepared or evaluated environmental documentation or analyses (prepared by Navy contractors) conducted under the National Environmental Policy Act (NEPA), Section 7 of the Endangered Species Act (ESA), the Magnuson-Stevens Fishery Conservation and Management Act (Essential Fish Habitat Assessment), Marine Mammal Protection Act, Fish and Wildlife Coordination Act, Executive Order 11988 (Floodplain Management), Executive Order 11990 (Protection of Wetlands), and Executive Order 13112 (Invasive Species).

As the Navy technical representative, I developed scopes of work, prepared independent cost estimates, analyzed contractor proposals, participated in negotiations, and developed contract execution schedules for Navy contractors. I provided technical oversight of contractor's work, monitored work in progress, and evaluated contractor's performance. I reviewed technical submissions for accuracy and interpreted biological, chemical, and other environmental test results during contractor preparation of a variety of environmental documents including: NEPA environmental assessments and EISs, essential fish habitat assessments, coastal zone consistency determinations, 401 water quality certification applications, sediment sampling and testing plans for dredging projects, wetland delineations, wetland restoration plans, CERCLA remedial action plans, and integrated natural resources management plans.

In June 2006, I joined the Nuclear Regulatory Commission as an aquatic biologist. I serve as a technical specialist whose primary responsibility is that of independently assessing the environmental impacts of siting, construction, and operation of new nuclear power plants and related facilities on the aquatic environment. This involves reviewing and evaluating specific aspects of Environmental Reports submitted to the NRC by applicants and licensees and then assisting in the preparation an EIS. My duties also include updating the NRC environmental standard review plans for aquatic ecology contained in NUREG-1555, preparing biological assessments for Federal threatened and endangered species, and coordinating with federal and/or state agencies pursuant to NEPA, ESA, Sections 401 and 404 of the CWA, Section 10 of the Rivers and Harbors Act of 1899, Magnuson-Stevens Fishery Conservation and Management Act (Essential Fish Habitat Assessment), Marine Mammal Protection Act, and Fish and Wildlife Coordination Act.

Thus far I have participated in pre-application activities for the Bell Bend, North Anna, Shearon Harris, William States Lee, Vogtle, River Bend, South Texas Project, Comanche Peak, and Callaway combined license (COL) applications. I have conducted the aquatic and terrestrial acceptance reviews for the Shearon Harris, William States Lee, and Callaway COL applications. In addition, I have participated in site audits and alternative site visits for the Vogtle Early Site Permit (ESP) as well as the William States Lee and Shearon Harris COL applications. I have provided technical oversight for the aquatic and terrestrial sections of the Vogtle ESP draft and final EISs.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
SOUTHERN NUCLEAR OPERATING CO.	)	Docket No. 52-011-ESP
	)	
(Early Site Permit for Vogtle ESP Site)	)	

AFFIDAVIT OF LANCE W. VAIL CONCERNING
PREFILED TESTIMONY ON ENVIRONMENTAL CONTENTIONS 1.2, 1.3 AND 6.0

I, Lance W. Vail, do declare under penalty of perjury that my statements in *NRC Staff Testimony of Dr. Michael T. Masnik, Anne R. Kuntzleman, Rebekah H. Krieg, Jill S. Caverly, and Lance W. Vail Concerning Environmental Contention EC 1.2*, in *NRC Staff Testimony of Dr. Michael T. Masnik, Rebekah H. Krieg, Jill S. Caverly, and Lance W. Vail Concerning Environmental Contention EC 1.3*, and in *NRC Staff Testimony of Mark D. Notich, Anne R. Kuntzleman, Rebekah H. Krieg, Jill S. Caverly, and Lance W. Vail Concerning Environmental Contention EC 6.0,* as well as in my attached statement of professional qualifications are true and correct to the best of my knowledge, information, and belief.

Executed in Accord with
10 C.F.R. § 2.304(d)

Lance W. Vail

Executed at Richland, Washington
This 9th day of January, 2009

STATEMENT OF PROFESSIONAL QUALIFICATIONS OF LANCE W. VAIL

CURRENT POSITION

Senior Research Engineer II
Environmental Technology Division
Battelle, Pacific Northwest Division
Pacific Northwest National Laboratory

Since joining Battelle in 1981, Mr. Vail has been involved in projects covering a diverse set of water related issues. His professional experience includes basic and applied research, and regulatory compliance assessments. His areas of expertise cover a broad spectrum of areas related to water resources.

RESEARCH INTERESTS

Water resource management
Multiple objective tradeoff analysis in water resources
Uncertainty analysis in water resources
Advanced hydrologic process modeling
Impacts of climate on water resources
Neural networks, fuzzy logic, and genetic algorithms applied to water resource issues
Linking simulation models with optimization methods to water resource problems
Linkage of physical and biological models in fisheries management

EDUCATION

B.S.	Humboldt State University, environmental resources engineering	1979
M.S.	Montana State University, civil engineering	1982

PROFESSIONAL AFFILIATIONS

American Geophysical Union
American Society of Civil Engineers
American Water Resources Association

CURRENT PROJECTS

Hydrologic Site Safety Reviews for Early Site Permits. Principal Investigator and Project Manager. Three applications for an Early Site Permit (ESP) have been submitted to the Nuclear Regulatory Commission. This project provides an independent assessment of hydrologic suitability of the proposed sites. Assessments include a broad range of considerations such as flooding, low water conditions, ice impacts, seiches, storm surge, and tsunamis.

Water-related Environmental Reviews for Early Site Permits. Task Manager. Three applications for an Early Site Permit (ESP) have been submitted to the Nuclear Regulatory Commission. This task provides an independent assessment of the proposed sites' environmental suitability. Assessments include a broad range of considerations such as water-use conflicts and changes in water quality.

Snohomish Basin Characterization. Technical Lead. Advanced distributed watershed models were applied to provide the Tulalip Tribes of Western Washington state a thorough understanding of the impacts of logging, development, and climate on the Snohomish River Basin.

Acid Rain TMDL. Principal Investigator and Technical Project Manager. The objective of this work assignment for Region II of the U.S. Environmental Protection Agency is to develop a preliminary assessment approach for TMDLs for pH impaired waters listed on the New York State Section 303(d) list. The intent is to enhance and further develop TMDL program capabilities by providing expertise in both acid deposition and TMDL development. The development of such an assessment approach requires that available models and data resources be reviewed. Systems engineering methods will be used in developing a conceptual model to ensure the relationships between models and data are fully understood. The assessment approach will be tested on one or more representative watersheds to be determined in close coordination with EPA, NYSDEC and Battelle. http://acidraintmdl.pnl.gov

PAST PROJECTS

Environmental Impact of License Renewal of Commercial Nuclear Power Plants. Contributor. Mr. Vail assesses the water use, water quality, and hydrologic impacts of license renewal for the Nuclear Regulatory Commission's NEPA process. He has performed this function for the following commercial nuclear plants: Calvert Cliffs, Oconee, Arkansas Nuclear One, Hatch, McGuire, Catawba, North Anna, Robinson, Ginna, and St. Lucie.

Chehalis Basin Characterization. Principal Investigator and Project Manager. Advanced numerical modeling and GIS methods were applied to assist the Corps of Engineers in characterizing the Chehalis Basin in Western Washington State. The Chehalis Basin is subject to frequent flooding. The native populations of anadramous fish have been stressed to adverse changes in habitat resulting from development and logging.

Generic Environmental Impact Statement (GEIS) for Decommissioning Commercial Nuclear Power Plants. Contributor. Mr. Vail is providing expertise in the development of a GEIS for decommissioning of nuclear plants. He provides expertise on water use, water quality, and hydrologic impacts for the Nuclear Regulatory Commission.

Impact of Climate on the Lower Yakima Basin. Principal Investigator and Project Manager. The objective of this three-year EPA STAR Grant Project was to develop and demonstrate an integrated assessment of the impact of climate variability and climate change on a diverse set of interests in the Lower Yakima Valley in Central Washington State. Interests considered include: surface and groundwater supply, surface and groundwater quality, air quality, public health, farm and regional economics, and fisheries. The project considered the effectiveness of changes in land management (crop selection) and water management (reservoir operation) in adapting to an uncertain future climate. A diverse set of models was linked with an optimization procedure to ensure that the tradeoffs between various resource management objectives are clearly articulated. http://projects.battelle.org/yakima/

Use of NOAA's Seasonal Climate Forecast for Water Resource Management. Task Manager of Reservoir Optimization Task. The objective of this NOAA funded project was to show the potential value of improved climate forecasts in managing surface water reservoirs for multiple objectives. Using a pareto genetic algorithm, the reservoir operating rules were optimized to define the tradeoff curves for hydropower, flood control, and instream flow requirements in the Tennessee River basin. Changes in forecast reliability result in changes to these tradeoffs and thereby express the value of such improved forecasts.

Accelerated Climate Prediction Initiative. Task Manager of Water Resources and Habitat Task. This project will provided a limited, systematic assessment of the potential effects of anthropogenic climate change over the next half-century on water resources in the western United States. This objective was accomplished by "downscaling" the results of the global-scale simulations described above to the spatial and temporal resolution needed to drive impact assessment models. Downscaling is particularly important for the West, where topography is a dominant climate driver. An important aspect of the hydrology of almost all western rivers is water management. Other than a few headwater streams, the hydrology of most rivers in the west is strongly affected by water use and artificial storage. Water management models were used to study the effect of reservoir operations and understand the implications of climate variability and change on the water resources of the west. http://acpiwater.pnl.gov

Linking Physical and Biological Models. Principal Investigator and Project Manager. The objective of this three-year Laboratory Directed Research and Development project is to develop and demonstrate an integrated natural resource analysis framework. This framework: dramatically improves the ability to integrate physical and biological models, thereby encouraging the utilization of advanced process models; allows utilization of large, sparse, and distributed data sets (including model output); communicates high-level tradeoffs and their respective uncertainties; and assesses, communicates, and minimizes scales issues. During the first year, the fundamental structural differences between such models was identified as a significant obstacle to successful linking of physical and biological models. The pervasive vagueness of rules and the multivaluedness associated with temporal/spatial upscaling suggested an approach using "fuzzy methods". The second year of this project utilized a variety of fuzzy methods including: fuzzy arithmetic, fuzzy logic, fuzzy clustering, and adaptive neural fuzzy inference systems (ANFIS). A series of rules and a database from the Multispecies Framework Process were employed to test the various fuzzy methods. These rules and data are used to define aquatic habitat diversity in the Pacific Northwest. A tool called FuzzyHab was developed to estimate habitat diversity from a set of categorical statements about the environment. Each of these categorical statements is vaguely defined. Estimates for each categorical statement are derived from physical process models.

Integrated Natural Resource Data System. Contributor. This project is to demonstrate INRDS. INRDS is an advanced, web-based environmental information system that will promote public understanding of natural resource management issues and assist planners and decision makers in accessing the most relevant information and analytical tools and evaluating the tradeoffs of alternate actions. http://inrds.pnl.gov

Early Warning of El Ni o Southern Oscillation (ENSO) Events for Regional Agriculture. Task Manager of Reservoir Optimization Task. This project is investigating the current predictability of interannual variability in climate conditions in the Pacific Northwest to determine whether and how early warning and seasonal climate forecasts by the Climate Prediction Center (CPC) of the National Oceanic and Atmospheric Administration (NOAA) forecasts can be used to reduce the vulnerability of irrigated agriculture to low water-availability conditions. The study is funded by a grant from the economics and Human Dimensions Program of the NOAA Office of Global Programs. The Economics and Human Dimensions program aims to improve our understanding of how social and economic systems are currently influenced by fluctuations in short-term climate (seasons to years), and how human behavior can be (or why it may not be) affected based on information about variability in the climate system. http://elrino-northwest.labworks.org

Impact of Reservoir Operating Strategies on Resident Fish - Mr. Vail has employed several models to assess the impact on resident fish species of a variety of reservoir operating strategies. This study was undertaken as part of the Columbia Basin System Operation Review process. Mr. Vail helped define the values and value measures of the Resident Fish Work Group.

Multiobjective Optimization - Mr. Vail is the project manager of an effort to assess the multiobjective optimization needs of Bonneville Power Administration. Objectives include: hydropower, resident fish, anadramous fish, irrigation, flood control, wildlife, and navigation. Mr. Vail is developing definitions of the canonical mathematical form of each of these objectives. The resulting multiobjective statement will be used to define the required optimization tools.

Integrated Environmental Monitoring Initiative - Mr. Vail is a co-principal investigator for the Integrated Environmental Monitoring Initiative. The objective of this initiative is to develop and demonstrate a comprehensive interdisciplinary methodology targeted to improve the effectiveness of environmental monitoring and restoration activities. This objective required comprehensive integration of monitoring regimes, analytical practices, design methodologies, and compliance needs.

Coupled Simulation/Optimization of Ground Water Remediation - Mr. Vail developed a computer code that coupled a ground water flow model with an optimization procedure. The code was able to provide estimates of the pumping/injection rates that would mitigate or remove a plume at minimal cost.

Simulation of Watershed Hydrologic Responses to Alternative Climates - Mr. Vail is the principal investigator of a project studying the impacts of global climate change on the hydrologic response of a watershed. The results of hydrologic simulations using distributed snowmelt and soil moisture accounting algorithms were graphically compared via video displays of daily simulated snow water equivalent, soil moisture, and runoff for the American River, Washington, which drains 204 square kilometers of the east slopes of the Cascade Mountains, Washington. Snow water equivalents and snowmelt were simulated using a simplified distributed temperature-index model augmented with seasonally estimated net solar radiation. A classification scheme was used to partition the empirical cumulative probability distributions of precipitation (rain plus melt) and a topographic index over the basin into groups of near-equal membership. Topographically-based soil moisture capacities were assumed for each class and were estimated via automated calibration methods using historical data. The simulated soil moisture and snow water accumulations for each class were geographically mapped for visualization. Test of the effect of alternative, warmer climates on snow accumulation, the seasonal distribution of soil moisture, and runoff were conducted by adjusting historical (daily) temperature and precipitation and repeating the analysis.

Pacific Northwest Climate Change Case Study - Water Resource Impacts - Mr. Vail is investigating the effects of global climate change on water resources of the Pacific Northwest. Spatially distributed snowmelt, soil moisture, and runoff models have been combined with a graphics visualization package to understand the changes in snowpack, soil moisture, and evapotranspiration over time. A weather classification scheme has been developed which estimates point precipitation as a function of large-scale atmospheric variables. This allows the synthesis of point precipitation given large-scale meteorological information as might be produced by GCM simulations. Orographic effects also have a significant role in defining climate at the watershed scale. Efforts are under way to develop a scientific basis to extend the sparse meteorological measurements basis to extend the sparse meteorological measurements available for any watershed to estimate the spatial distribution of precipitation, temperature, and wind speed within the watershed. A reservoir network model for the Columbia River Basin has been aggregated to fourteen nodes. This network model of the Columbia River Basin has been aggregated to fourteen nodes. This network model will be driven by a collection of index watersheds. A daily hydroclimatological data set has been developed to aid in the selection of index watersheds.

Acid Rain Watershed Modeling Project - Mr. Vail directed the hydrologic part of a study to evaluate and apply several coupled hydrology/geochemical codes that were developed to model the impact of acid rain on surface water chemistry. The project involved extensive behavior and sensitivity analyses of three coupled geochemical/hydrological simulation codes.

Incineration at Sea - The objective of this project was to assess the impact of incinerating toxic waste at sea on the aquatic environment. Mr. Vail developed a model on an IBM-PC to estimate the concentration of contaminant in the ocean.

Aquifer Thermal Energy Storage - The objective of this project was to develop and apply computer codes that would simulate the trade-offs between different management policies of an Aquifer Thermal Energy Storage system. Mr. Vail independently developed, validated, and applied several computer codes for this purpose.

Flow and Fractured Media - The objective of this study is to develop a state-of-the-art predictive capability for flow and transport in saturated fractured media. Mr. Vail was responsible for implementing, modifying, and testing a computer code that models steady flow in permeable media with discrete fractures. Mr. Vail has also developed a computer code that models steady flow through fractures in an impermeable rock mass. The fractures can either be specified or generated via Monte Carlo Methods. This code was applied in an investigation of the potential impact of a nuclear meltdown on groundwater.

Modeling Flow With Certainty in Hydraulic Parameters - The objective of this study is to develop a methodology to analyze the uncertainty in predicting piezometric surfaces caused by uncertainty in groundwater flow parameters. Mr. Vail developed a computer code that couples perturbation and finite-element techniques to estimate the mean and variance of the piezometric surface.

Stripa Mine Hydrogeologic Characterization - The objective of this study was to perform three-dimensional simulations with the CFEST code for ground water flow at the Stripa Mine in Sweden. Mr. Vail was the Battelle project manager of this effort.

PUBLICATIONS

Coleman A, LW Vail, and A Savery. 2005. "Landscape Classification for Assessment of Impacts of Landuse and Climate on Water Resources." Presented by Andre M Coleman (Invited Speaker) at 25th Annual Environmental Systems Research Institute International User Conference, San Diego, CA on July 25, 2005. PNWD-SA-7118.

Prasad R, LW Vail, CB Cook, and G Bagchi. 2005. "Establishment of Safety-Related Site Characteristics Based on Consideration of External Sources of Flooding at Nuclear Power Plant Sites in the United States of America." Presented by Rajiv Prasad (Invited Speaker) at IAEA-India External Flooding Hazards Workshop, Kalpakkan, Tamil Nadu on August 29, 2005. PNNL-SA-46005.

Scott MJ, LW Vail, CO Stockle, A Kemanian, KM Branch, R Prasad, MS Wigmosta, and JA Jaksch. 2005. "Benefits and Costs of Options to Mitigate the Uncertain Effects of Climate Change on Irrigated Agriculture in the Yakima Basin. What Matters? What Doesn't?" Presented by Michael J. Scott (Invited Speaker) at 39th Annual Pacific Northwest Regional Economic Conference, Bellingham, WA on May 20, 2005. PNWD-SA-6980.

Scott MJ, LW Vail, and R Prasad. 2005. "Managing Water for Irrigated Agriculture Under Extended Climate-Related Drought." Presented by Micahel J. Scott at American Water Resources Association 2005 Annual.

Scott MJ, LW Vail, CO Stockle, A Kemanian, KM Branch, R Prasad, MS Wigmosta, and JA Jaksch. 2005. "Benefits and Costs of Options to Mitigate the Uncertain Effects of Climate Change on Irrigated Agriculture in the Yakima Basin. What Matters? What Doesn't?" Presented by Michael J. Scott (Invited Speaker) at Pacific Northwest Regional Economic Conference, Bellingham, WA on May 20, 2005. PNWD-SA-6902.

Vail LW. 2005. "Adaptive Management of Water Resources in the Puget Sound." Presented by Lance W. Vail (Invited Speaker) at Puget Sound Georgia Basin Research Conference, Seattle, WA on March 29, 2005. PNNL-SA-44581.

Scott MJ, LW Vail, CO Stockle, A Kemanian, KM Branch, R Prasad, MS Wigmosta, and JA Jaksch. 2005. "Adapting Irrigated Agriculture to Climate Variability and Change." Presented by Michael J. Scott (Invited Speaker) at 2005 Annual Meeting, American Association for the Advancement of Science, Washington, DC on February 20, 2005. PNWD-SA-6848.

Scott MJ, LW Vail, CO Stockle, A Kemanian, KM Branch, R Prasad, MS Wigmosta, and JA Jaksch. 2005. "Adapting Irrigated Agriculture to Climate Variability and Change." Presented by Michael J. Scott (Invited Speaker) at 2005 Annual Meeting, American Association for the Advancement of Science, Washington, DC on February 20, 2005. PNWD-SA-6743.

Scott MJ, LW Vail, and R Prasad. 2005. "Managing Water for Irrigated Agriculture Under Extended Climate-Related Drought." Presented by Michael J. Scott (Invited Speaker) at American Water Resources Association 2005 Annual Conference, Seattle, WA on November 8, 2005. PNNL-SA-47342.

Scott MJ, LW Vail, CO Stockle, and A Kemanian. 2005. "Impacts of Water Availability on Washington Agriculture in a Changing Climate." Presented by Michael J. Scott (Invited Speaker) at 2005 Fall Climate Change Conference, Seattle, WA on October 27, 2005. PNNL-SA-47128.

Meza EP, and LW Vail. 2005. Real-time Harvesting of Distributed Environmental Data for Improved Management of Complex Distributed Water and Power Management Systems . PNNL-15333, Pacific Northwest National Laboratory, Richland, WA.

Prasad R, LW Vail, CB Cook, and G Bagchi. 2005. "Establishment of Safety-Related Site Characteristics Based on Consideration of External Sources of Flooding at Nuclear Power Plant Sites in the United States of America". In Proceedings of International Workshop on External Flooding Hazards at Nuclear Power Plant Sites (tentative; title yet to be finalized by IAEA). PNNL-SA-46268, Pacific Northwest National Laboratory, Richland, WA.

Coleman A, LW Vail, and A Savery. 2005. "Landscape Classification for Assessment of Impacts of Landuse and Climate on Water Resources." PNWD-SA-7118, Battelle—Pacific Northwest Division, Richland, WA.

Prasad R, LW Vail, CB Cook, and G Bagchi. 2005. "Establishment of Safety-Related Site Characteristics Based on Consideration of External Sources of Flooding at Nuclear Power Plant Sites in the United States of America." PNNL-SA-46005, Pacific Northwest National Laboratory, Richland, WA.

Scott MJ, LW Vail, CO Stockle, A Kemanian, KM Branch, R Prasad, MS Wigmosta, and JA Jaksch. 2005. "Benefits and Costs of Options to Mitigate the Uncertain Effects of Climate Change on Irrigated Agriculture in the Yakima Basin. What Matters? What Doesn't?" PNWD-SA-6902, Battelle—Pacific Northwest Division, Richland, WA.

Scott MJ, LW Vail, CO Stockle, A Kemanian, KM Branch, R Prasad, MS Wigmosta, and JA Jaksch. 2005. "Benefits and Costs of Options to Mitigate the Uncertain Effects of Climate Change on Irrigated Agriculture in the Yakima Basin. What Matters? What Doesn't?" PNWD-SA-6980, Battelle—Pacific Northwest Division, Richland, WA.

Scott MJ, LW Vail, and R Prasad. 2005. "Managing Water for Irrigated Agriculture Under Extended Climate-Related Drought." PNWD-SA-6946, Battelle—Pacific Northwest Division, Richland, WA.

Vail LW. 2005. "Adaptive Management of Water Resources in the Puget Sound." PNNL-SA-44581, Pacific Northwest National Laboratory, Richland, WA.

Scott MJ, LW Vail, CO Stockle, A Kemanian, KM Branch, R Prasad, MS Wigmosta, and JA Jaksch. 2005. "Adapting Irrigated Agriculture to Climate Variability and Change." PNWD-SA-6848, Battelle—Pacific Northwest Division, Richland, WA.

Scott MJ, LW Vail, CO Stockle, and A Kemanian. 2005. "Climate Change and Adaptation in Irrigated Case Study of the Yakima River ." American Association for the Advancement of Science, Portland, OR.

Cook, CB, LW Vail, and DL Ward. 2005. "North Anna Early Site Permit Water Budget Model (LakeWBT) for Lake Anna". PNNL-14944, Pacific Northwest National Laboratory, Richland, WA.

Pennell WT, LR Leung, MS Wigmosta, and LW Vail. 2004. "Prospects for Adapting to Near-Term Climate Change: The Yakima River Example ." Presented by William T. Pennell (Invited Speaker) at American Water Resource Association's annual state conference, Seattle, WA on October 28, 2004. PNNL-SA-43189.

Scott MJ, JA Jaksch, and LW Vail. 2004. "Water Exchanges: Tools to Beat Climate Variability." Journal of the American Water Resources Association 40(1):15-31.

Scott MJ, LW Vail, R Prasad, and JA Jaksch. 2004. "Can WE Use Long-Lead Climate Forecasts to Operate the Pacific Northwest Rivers Better?" PNWD-SA-6512, Battelle – Pacific Northwest Division, Richland, WA.

RL Skaggs, LW Vail, and SA Shankle. 2003. "Operationalizing Adaptive Management for Water Supply Planning: Sustaining Mexico City's Water Supply." In Urban Water Supply Infrastructure Management Handbook. J. Wiley. New York, NY.

Burke JS, GR Danielson, DA Schulz, and LW Vail. 2002. "Parallel computing for automated model calibration." vol. XVIII, pp. 424-429. The 6th World Multiconference on Systemics, Cybernetics, and Informatics (SCI 2002), Orlando, FL.

Scott MJ, LW Vail, and A Kemanian. 2002. "Integrated Impact of Climate Warming on Yakima Valley Water Demand and Availability." PNWD-SA-5613, Battelle—Pacific Northwest Division, Richland, WA.

Scott MJ, LW Vail, JA Jaksch, CO Stockle, and A Kamenian. 2002. "Early Warning of ENSO Events For Regional Agriculture." PNWD-SA-5834, Battelle—Pacific Northwest Division, Richland, WA

Skaggs R, and LW Vail. 2002. "Adaptive Management Platform: Approach and Application." PNNL-SA-36755, Pacific Northwest National Laboratory, Richland, WA.

Vail LW. 2002. "Adaptive Management in Nooksak River, Wa Flow Selection." PNNL-SA-36605, Pacific Northwest National Laboratory, Richland, WA.

Vail LW, and R Skaggs. 2002. "Adaptive Management Platform for Natural Resources in the Columbia River Basin." PNNL-13875, Pacific Northwest National Laboratory, Richland, WA.

Vail LW, and R Skaggs. 2002. "Integrated Process Modeling to Assess Performance of Salmon Recovery Strategies." PNNL-13903, Pacific Northwest National Laboratory, Richland, WA

Vail LW, MS Wigmosta, R Prasad, and CK Knudson. 2002. "Accelerated Climate Prediction Initiative." PNNL-SA-36759, Pacific Northwest National Laboratory, Richland, WA.

Ramsdell JV, K Rhoads, CA Brandt, LW Vail, PR Nickens, PL Hendrickson, DA Neitzel, and EE Hickey. 2001. "Generic Environmental Impact Statement for License Renewal of Nuclear Plants Supplement 3 Regarding Arkansas Nuclear One, Unit 1." PNNL-13473, Pacific Northwest National Laboratory, Richland, WA.

Scott MJ, LW Vail, and CK Knudson. 2001. "El Nino and the Yakima Valley." PNWD-SA-5597, Battelle—Pacific Northwest Division, Richland, WA.

Scott MJ, JA Jaksch, and LW Vail. 2001. "Water Exchanges: Tools to Beat Climate Variability." PNWD-SA-5425, Battelle—Pacific Northwest Division, Richland, WA.

Scott MJ, LW Vail, A Kemanian, and CO Stockle. 2001. "Integrated Impact of Climate Warming on Irrigated Crop Production." PNWD-SA-5468, Battelle—Pacific Northwest Division, Richland, WA.

Scott MJ, LW Vail, JA Jaksch, CO Stockle, and A Kemanian. 2001. "Integrated Impact of Climate Warming on Irrigated Crop Production." PNWD-SA-5596, Battelle—Pacific Northwest Division, Richland, WA

Skaggs R, LW Mays, and LW Vail. 2001. "Application of Enhanced Annealing to Ground Water Remediation Design." Journal of the American Water Resources Association 37(4):867-875

Skaggs R, LW Mays, and LW Vail. 2001. "Simulated Annealing With Memory and Directional Search for Ground Water Remediation Design." Journal of the American Water Resources Association 37(4):853-866.

Vail LW, EA Jenne, HL Diefenderfer, WR Barchet, and LF Hibler. 2001. "Assessment of pH-Impaired Lakes for TMDL Development in New York State." PNWD-SA-5234, Battelle—Pacific Northwest Division, Richland, WA.

Vail LW, HL Diefenderfer, CK Knudson, and JD Carroll. 2001. "Assessment of pH-Impaired Lakes for TMDL Development in New York State." PNNL-SA-35658, Pacific Northwest National Laboratory, Richland, WA.

Vail LW. 2001. "Application of Fuzzy Logic in Estimating Impact of Water and Land use Practices on Aquatic Habitat Diversity ." PNNL-SA-34213, Pacific Northwest National Laboratory, Richland, WA

Vail LW. 2001. "Drought 2001 Water Management Implications for the Yakima River Basin." PNWD-SA-5326, Battelle—Pacific Northwest Division, Richland, WA.

Vail LW, JA Jaksch, and CO Stockle. 2001. "Regional Climate Forecasts and Water Markets in Irrigated Agriculture." PNWD-SA-5375, Battelle—Pacific Northwest Division, Richland, WA.

Vail LW, MS Wigmosta, and R Prasad. 2001. "Impact of Climate on Aquatic Habitat in the Yakima River." PNNL-SA-35194, Pacific Northwest National Laboratory, Richland, WA.

Vail LW. 2001. "Adapting to Climate Change in the Yakima Basin." PNWD-SA-5488, Battelle—Pacific Northwest Division, Richland, WA.

Vail LW. 2001. "Impact of Climate on the Lower Yakima Basin." PNWD-SA-5489, Battelle—Pacific Northwest Division, Richland, WA

Kincaid CT, MP Bergeron, CR Cole, MD Freshley, VG Johnson, DI Kaplan, R Serne, GP Streile, DL Strenge, PD Thorne, LW Vail, GA Whyatt, and SK Wurstner. 2000. "Composite Analysis for Low-Level Waste Disposal in the 200 Area Plateau of the Hanford Site, Southeast Washington." In Environmental Toxicology and Risk Assessment: Recent Achievements in Environmental Fate and Transport Vol. 9; STP 1381, ed. Fred T. Price, Kevin V Brix, and Nancy K. Lane, pp. 104 - 117. Am. Soc. For Testing and Materials, West Conshohocken, PA

Scott MJ, LW Vail, JA Jaksch, KK Anderson, and CO Stockle. 2000. "Climate Forecasts and Water for Regional Irrigated Agriculture ." PNWD-SA-5050, Battelle—Pacific Northwest Division, Richland, WA.

Scott MJ, LW Vail, JA Jaksch, and KK Anderson. 2000. "Considerations for Management of Irrigation Water with Climate Variability ." PNWD-SA-5069, Battelle—Pacific Northwest Division, Richland, WA.

Rosenberg NJ, DJ Epstein, D Wang, LW Vail, R Srinivasan, and JG Arnold. 1999. "Possible Impacts of Global Warming on Hydrology of the Ogallala Aquifer Region." Climatic Change 42(4):677-692.

Bergeron MP, CR Cole, MD Freshley, NL Hassig, DI Kaplan, CT Kincaid, R Serne, GP Streile, DL Strenge, PD Thorne, LW Vail, GA Whyatt, and SK Wurstner. 1998. "Composite Analysis for Low-Level Waste Disposal in the 200-Area Plateau of the Hanford Site." PNNL-11800, Pacific Northwest National Laboratory, Richland, WA.

Geist, D, LW Vail, and DJ Epstein. 1996. "Analysis of Potential Impacts to Resident Fish From Columbia River System Operation Alternatives." Environmental Management 20 (2) :275-288.

Jenne, EA., SE Faulk, LW Vail, JP Zipperer, M. I. McKinley. 1994. "$H_2$0TREAT Version 2.0 User's Manual: An Aid for Evaluating Water Treatment Requirements for Aquifer Thermal Energy Storage." In Proceedings of International Symposium on Aquifer Thermal Energy Storage. November 14-15, 1994, The University of Alabama, Tucaloosa.

Leung L, MS Wigmosta, SJ Ghan, JL Epstein, and LW Vail. 1996. "Application of a Subgrid Orographic Precipitation/Surface Hydrology Scheme to a Mountain Watershed." Journal of Geophysical Research 101:12,803-12,817

Leung L, MS Wigmosta, SJ Ghan, and LW Vail. 1994. "Regional Modeling of Climate-Hydrology Interactions." No clearance number available, Pacific Northwest National Laboratory, Richland, WA.

Vail, LW, and EA Jenne. 1994. "Optimizing the Design and Operation of Aquifer Thermal Energy Storage Systems." In Proceedings of International Symposium on Aquifer Thermal Energy Storage. November 14-15, 1994, The University of Alabama, Tucaloosa.

Brown, DR, KK Humphreys, and LW Vail. 1993. "Carbon Dioxide Control Costs for Gasification Combined-Cycle Plants in United States." PNL-SA-22634, Pacific Northwest Laboratory, Richland, Washington.

Scott, MJ, RD Sands, LW Vail, JC Chatters, DA Neitzel, and SA Shankle. 1993. "Effects of Climate Change on Pacific Northwest Water-Related Resources: Summary of Preliminary Findings." PNL-8987, Pacific Northwest Laboratory, Richland, Washington.

Vail, LW, EA Jenne, JP Zipperer, MI McKinley. 1993. "H_2O-TREAT User's Manual: An Aid for Evaluating Water Treatment Requirements for Aquifer Thermal Energy Storage Systems." PNL-8504, Pacific Northwest Laboratory, Richland, Washington.

Wigmosta, MS., DP Lettenmaier, and LW Vail. 1993. "A Distributed Hydrology-Vegetation Model for Mountainous Catchments." In Proceedings of Workshop on Distributed Hydrologic Modeling. July 1992, Venice Italy. International Association of Hydrologic Science. PNL-SA-23540, Pacific Northwest Laboratory, Richland, Washington.

Geist, DR, LW Vail, and D Daley. 1992. "Screening Analysis of Columbia River System Operation Alternatives for the Resident Fish Work Group." PNL-SA-10687, Pacific Northwest Laboratory, Richland, Washington.

Lettenmaier, DP, KL Brettman, and LW Vail, SB Yabusaki, and MJ Scott. 1992. "Sensitivity of Pacific Northwest Water Resources to Global Warming." Northwest Environmental Journal, 8:265-283. University of Washington, Seattle, Washington.

Vail, LW, EA Jenne, and LE Eary. 1992. "H_2O-TREAT: An Aid for Evaluating Water Treatment Requirements for Aquifer Thermal Energy Storage." Presented at the IECEC Conference. August 3-4, 1992, San Diego, California.

Vail, LW, MS Wigmosta, and DP Lettenmaier. 1992. "Influence of Vegetation, Topography, and Climate on Hydrologic Processes in a Mountainous Catchment." PNL-SA-20673A, Pacific Northwest Laboratory, Richland, Washington.

Wigmosta, MS, LW Vail, DP Lettenmaier. 1992. "Simulations of Distributed Lard Surface Fluxes and Runoff from a Mountainous Drainage Basin." Presented at the 1992 Fall Meeting of America Geophysical Union, San Francisco, California.

Eary, LE, EA Jenne, LW Vail, and DC Girvin. 1991. "Recovery of the Highly Acidified Clearwater Lake Watershed, Ontario, Canada, Simulated with ILWAS Model." Applied Geochmistry. 6:613-634.

Yabusaki, SB, LW Vail, and DP Lettenmaier. "Impact of Global Climate Change on the Water Resources of the Pacific Northwest." Presented at Hydrology Days 1991. Fort Collins, Colorado.

Lettenmaier, DP, KL Brettman, and LW Vail. 1990. "Robustness of a Multiple-Use Reservoir to Seasonal Runoff Shifts Associated with Climate Change." PNL-SA-18266, Pacific Northwest Laboratory, Richland, Washington.

Vail, LW, DP Lettenmaier, and SB Yabusaki. 1990. "Simulations of Hydrologic Response of Mountainous Catchment to Alternative Climate." Presented at Fall American Geophysical Union Conference, San Francisco, California. PNL-SA-18582, Pacific Northwest Laboratory, Richland, Washington.

Eary, LE, EA Jenne, LW Vail and DC Girvin. 1989. "Numerical Models for Predicting Watershed Acidification." Archives of Environmental Contamination and Toxicology. 18:29-53.

Vail, LW. 1989. "ATES/Heat Pump Simulations Performed with the ATESSS Code." In Proceedings of the Third Workshop on Solar-Assisted Heat Pumps with Ground-Coupled Storage. January 16-18, 1988, Gothenborg, Sweden.

Vail, LW. 1989. "Status of Numerical Models for ATES." In U.S. Department of Energy Thermal Energy Storage Research Activities Review, 1989 Proceedings. March 15-17, 1989, New Orleans, Louisiana. CONF-89-0351.

Jenne, EA, LF Eary, LW Vail, DC Girvin, MJ Monsour, LF Hibler, TB Miley, and A Liebetrau. 1988. "An Interim Report on Evaluation and Analysis of Dynamic Watershed Acidification Models (Magic II, ETD, and ILWAS)." Prepared for the U.S. Environmental Protection Agency, Washington, D.C.

Kannberg, LD, and LW Vail. 1988. "Stratigraphy Effects on Energy Recovery for Aquifer Thermal Energy Storage." STES Newsletter 10:3. International Council for Thermal Energy Storage, Public Works Canada, Ottawa Canada.

Dauble, DD, RM. Ecker, LW Vail, and DA Neitzel. 1987. "Downstream Extent of the N. Reactor Plume." PNL-6310, Pacific Northwest Laboratory, Richland, Washington.

Dauble, DD, LW Vail, and DA Neitzel. 1987. "Evaluation of the Potential for Fish Passage through the N. Reactor and Hanford Generating Project Discharges." PNL-6309, Pacific Northwest Laboratory, Richland, Washington.

Droppo, JG, LW Vail, and RM Ecker. 1987. "Final Report on INSEA User's Manual, Environmental Performance Model of Incineration-At-Sea Operations." Prepared for the U.S. Environmental Protection Agency, Office of Marine and Estuarine Protection, Washington, D.C.

Gale, JR, Macleod, J Whelan, CR Cole, and LW Vail. 1987. "Hydrogeological Characterization of the Stripa Site." SKB-87-15, Swedish Nuclear Fuel and Waste Management, Stockholm, Sweden.

Shafer, JM, and LW Vail. 1987. "Screening Method for Contaminant Plume Control." Journal of Water Resource Management and Planning Division, American Society of Civil Engineers 113:3, May 1987.

Droppo, JG, LW Vail, CJ English, and RM Ecker. 1986. "Technical Support for the Ocean Incineration Regulation Model, Part 1 - Review and Recommendations, Part 2 - Revised Model." Prepared for the U.S. Environmental Protection Agency, Office of Marine and Estuarine Protection, Washington, D.C.

Cole, CR, LW Vail, GM Petrie, and RL Skaggs. 1985. "Ground Water Modeling on Small Computers: Past, Present, and Future," BN-SA-2074. In Proceedings of ASCE Hydraulics Division Conference. August 13-16, 1985, Orlando, Florida.

Onishi, Y, RM Ecker, DS Trent, SB Yabusaki, and LW Vail. 1985. "Oceanographic Modeling of Beaufort Sea in Relation to the Proposed Lisborne Development." Volumes I and II. Prepared for ARCO Alaska, Inc. by Battelle, Pacific Northwest Laboratories, Richland, Washington.

Vail, LW, LD Kannberg, and CT Kincaid. 1985. "A Computer Code for Analyzing the Performance of Aquifer Thermal Energy Storage Systems." In Proceedings of International Conference on Energy Storage for Building Heating and Cooling. September 22-27, 1985, Toronto, Ontario, Canada. PNL-SA-12870, Pacific Northwest Laboratory, Richland, Washington.

Kincaid, CT, LW Vail, and JL Devary. 1983. "Stochastic Ground Water Flow Analysis - FY81 Status Report." PNL-4025, Pacific Northwest Laboratory, Richland, Washington.

Vail, LW, and CT Kincaid. 1983. "A Simple Areal Flow Model: A Screening Tool for Managing Aquifer Thermal Energy Storage Systems." In Proceedings of International Conference on Subsurface Heat Storage. June 6-8, 1983, Stockholm, Sweden. PNL-SA-11126, Pacific Northwest Laboratory, Richland, Washington.

Vail, LW, and CT Kincaid. 1983. "Numerical Model for Analysis of Multiple Well ATES Systems." In Proceedings of the DOE Physical and Chemical Energy Storage Annual Contractors' Review Meeting. September 12-14, 1983, Arlington, Virginia. CONF-830974.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
SOUTHERN NUCLEAR OPERATING CO.	)	Docket No. 52-011-ESP
	)	
(Early Site Permit for Vogtle ESP Site)	)	

AFFIDAVIT OF MICHAEL T. MASNIK CONCERNING
PREFILED TESTIMONY ON ENVIRONMENTAL CONTENTIONS 1.2 AND 1.3

I, Michael T. Masnik, do declare under penalty of perjury that my statements in *NRC Staff Testimony of Dr. Michael T. Masnik, Anne R. Kuntzleman, Rebekah H. Krieg, Jill S. Caverly, and Lance W. Vail Concerning Environmental Contention EC 1.2*, and in *NRC Staff Testimony of Dr. Michael T. Masnik, Rebekah H. Krieg, Jill S. Caverly, and Lance W. Vail Concerning Environmental Contention EC 1.3*, as well as in my attached statement of professional qualifications are true and correct to the best of my knowledge, information, and belief.

Executed in Accord with
10 C.F.R. § 2.304(d)

____
Michael T. Masnik

Executed at Rockville, Maryland
This 9th day of January, 2009

Michael T. Masnik
STATEMENT OF PROFESSIONAL QUALIFICATIONS
UNITED STATES NUCLEAR REGULATORY COMMISSION
Washington, D.C.

I am currently employed as a Senior Aquatic Ecologist in the Office of New Reactor Operations, U. S. Nuclear Regulatory Commission (NRC). As a senior member of the staff I am responsible for understanding and assessing the non-radiological impacts of nuclear power generation on a variety of aquatic environments.

I hold a Bachelor of Science in Conservation from Cornell University (1969), a Master of Science in Zoology from Virginia Polytechnic Institute and State University (1971), and a Doctor of Philosophy in Zoology also from Virginia Polytechnic Institute and State University (1975).

While at Virginia Polytechnic Institute and State University (VPI&SU), I undertook research in a variety of areas, specializing in zoogeography and distribution of freshwater fishes in large river systems. Other areas of research which resulted in published papers include thermal studies on fishes, recovery of damaged aquatic ecosystems, and development of sampling methodology for fish and macroinvertebrates. I have authored or co-authored some 16 publications on the above areas or research. My formal education has encompassed and emphasized studies in Zoology, Aquatic Ecology, Ichthyology, and Evolutionary Biology. Prior to joining the Federal government I participated as scientific staff for a Duke University Caribbean cruise conducting oceanographic investigations, and served as a consultant, through VPI&SU, for American Electric Power Company, Koppers Company, Inc., U.S. Army Corps of Engineers, and the Tennessee Valley Authority. I was also employed by Ichthyological Associates as a field biologist investigating the fisheries resources of the Delaware Bay as part of a baseline study for several new nuclear stations.

I joined the Atomic Energy Commission, the predecessor to the NRC, in 1974 as a Fisheries Biologist performing and overseeing NEPA reviews for nuclear power reactor license applications. My principal expertise was in evaluating the impacts of various cooling system designs and intake structures on fish and shellfish in source and receiving waterbodies. In the late 1970s and early 1980s I participated in the initial licensing reviews for more than 10 sites, three alternative site reviews and investigated numerous environmental events involving aquatic resources occurring at operating nuclear power stations. In 1976, as the NRC representative, I participated in the development of U.S. Environmental Protection Agency's draft Guidance for Evaluating the Adverse Impact of Cooling Water Intake Structures on the Aquatic Environment as well as the 316(a) Technical Guidance Manual and Guide for Thermal Effects Sections of Nuclear Facilities Environmental Impact Statements. I also provided expert testimony at a number of NRC administrative hearings on a variety of environmental topics including shipworms, alternative site reviews, impingement and entrainment, and shortnose sturgeon. I developed the NRC staff's practices related to Commission compliance to the Endangered Species Act.

In 1982 I became the Technical Assistant to the Director of the Three Mile Island (TMI-2) Program Office. For the next 13 years I provided technical oversight on all aspects of the TMI-2 cleanup. I made over 15 containment entries at TMI-2, conducted numerous inspections and surveys developed custom technical specifications for the damaged facility, and oversaw the preparation of three supplements to the programmatic environmental impact statement on the cleanup. I provided expert testimony at an administrative hearing on the impacts of disposal of the TMI-2 accident generated water. From 1982 to 1995 I served as the Designated Federal Official (DFO) to the NRC sponsored TMI-2 Advisory Panel. During my tenure as the DFO the panel held over 65 public meetings in the Harrisburg, PA area. In 1993, as the TMI-2 cleanup effort neared its conclusion I assumed project management responsibilities for the decommissioning of the Trojan Nuclear Power Plant. Trojan was the first large PWR to permanently cease operation and immediately begin active decontamination and dismantlement.

In 1997 I became first Acting, then Section Chief, of the Decommissioning Section in the NRC's Office of Nuclear Reactor Regulation (NRR). I was responsible for the project management of 19 permanently shutdown reactors. I also oversaw the implementation of NRC's 1996 final rule on decommissioning and the development of the 2002 Generic Environmental Impact Statement on the decommissioning of nuclear power reactors. During my tenure as Section Chief I made numerous presentations on the subject before industry, trade, and professional society meetings. In 1997, along with two coworkers, I developed and taught a one week course on reactor decommissioning at the University of Kiev, Ukraine. During my assignment to the TMI-2 cleanup effort and then as Chief of the Decommissioning Section I continued to periodically assist the NRC in the specialized areas of aquatic impact assessment and compliance with the Endangered Species Act. In the early 1990s I assisted in the development of the Generic Environmental Impact Statement for License Renewal of Nuclear Plants, and the Final Environmental Impact Statement, Operating License Stage, for the Watts Bar Nuclear Station Unit 1.

In 2001, with the transfer of the responsibility for decommissioning within the NRC to the office of Nuclear Materials Safety and Safeguards I joined the license renewal effort in NRR, again as an expert in environmental impacts assessment. Since 2001 I has served as the license renewal environmental project manager for the St. Lucie, Browns Ferry, and the Oyster Creek nuclear stations, worked on numerous other license renewals as well as several early site permits serving as the Commission's expert in aquatic and terrestrial ecology, and water intake design. I also was responsible for or assisted in conducting formal and informal endangered species consultations for a number of nuclear power stations including Crystal River, Hatch, Saint Lucie, and Turkey Point. I provided oversight in the preparation of the aquatic and in some cases the hydrological sections of the supplemental environmental impact statements for license renewal for the following both closed-cycle and once through nuclear stations: Arkansas, Turkey Point, Saint Lucie, Fort Calhoun, North Anna, Surry, Catawba, Ginna, Summer, Cook, Quad Cities, Millstone, Vermont Yankee, Nine Mile Point, Monticello, FitzPatrick and Wolf Creek.

In early 2007 I transferred to the NRC's Office of New Reactors to devote myself full time to the environmental assessment of the construction and operation of new reactors, both at existing as well as Greenfield sites, on aquatic ecosystems. I am the NRC's principal contact for endangered species concerns with the National Marine Fisheries Service (NMFS) Southeast Regional Office (SERO). I assisted in the development of the Biological Assessment for the Vogtle Early Site Permit (ESP) application that was submitted to SERO for their review. I have also provided oversight to the aquatic ecology and hydrology sections for the preparation of the environmental impact statements for the North Anna, Clinton, and Grand Gulf ESP sites. I am currently providing technical oversights to the Grand Gulf, North Anna, Bellefonte, Vogtle, and Levy Combined License Applications as well as the Vogtle ESP. I am a member of the American Fisheries Society.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
SOUTHERN NUCLEAR OPERATING CO.	)	Docket No. 52-011-ESP
	)	
(Early Site Permit for Vogtle ESP Site)	)	

AFFIDAVIT OF REBEKAH HARTY KRIEG CONCERNING
PREFILED TESTIMONY ON ENVIRONMENTAL CONTENTIONS 1.2, 1.3 AND 6.0

I, Rebekah Harty Krieg, do declare under penalty of perjury that my statements in *NRC Staff Testimony of Dr. Michael T. Masnik, Anne R. Kuntzleman, Rebekah H. Krieg, Jill S. Caverly, and Lance W. Vail Concerning Environmental Contention EC 1.2*, in *NRC Staff Testimony of Dr. Michael T. Masnik, Rebekah H. Krieg, Jill S. Caverly, and Lance W. Vail Concerning Environmental Contention EC 1.3*, and in *NRC Staff Testimony of Mark D. Notich, Anne R. Kuntzleman, Rebekah H. Krieg, Jill S. Caverly, and Lance W. Vail Concerning Environmental Contention EC 6.0,* as well as in my attached statement of professional qualifications are true and correct to the best of my knowledge, information, and belief.

Executed in Accord with
10 C.F.R. § 2.304(d)

Rebekah Harty Krieg

Executed at Richland, Washington
This 9th day of January, 2009

Resume

Rebekah Harty Krieg

Ecology Group
U.S. DOE's Pacific Northwest National Laboratory, operated by Battelle
P.O. Box 999 K6-85
Richland, WA. 99352
(509) 371-7155 (509) 371-7160 (fax)

Education:

M.S. in Fisheries and Oceanographic Sciences, University of Washington, 1983

B.S. in Biology , Washington State University, 1979.

Experience:

Senior Research Scientist (1979-2002 and 2005 – present) Battelle, Pacific Northwest National Laboratory, Richland, WA.

Technical Reviewer for the aquatic ecology sections of the Combined License (COL) application in support of the U.S. Nuclear Regulatory Commission's (NRC's) environmental evaluation of Tennessee Valley Authority's application for a COL for Bellefonte Units 3 and 4..

Technical Reviewer for the aquatic ecology sections of the Early Site Permit (ESP) application in support of the U.S. Nuclear Regulatory Commission's (NRC's) environmental evaluation of Southern Nuclear Corporation's application for an ESP for Vogtle Units 3 and 4.

Preapplication Team lead for COLs for Summer (SCEG), Bellefonte (TVA), Levy (Progress Energy), and Victoria (Exelon). Aquatic Ecology reviewer for Comanche Peak preapplication.

Technical contributor on project to assist the Army Corps of Engineers (Walla Walla District) develop configuration and operation plans for their hydroelectric projects to meet the requirements of the Biological Opinion on anadromous salmonid species listed under the Endangered Species Act.

Task leader for the Knowledge Management portion of the Infrastructure for New Reactor Environmental Reviews project. This project includes developing tools (GIS, comment databases, collaboration sites) for the Nuclear Regulatory Commission and their contractors to use during the environmental reviews that will occur when applications are received for new power reactor licenses.

Technical leader for NRC's review of license renewal applications. Managed interdisciplinary teams that provided technical support to the NRC on their review of the environmental impacts related to the renewal of operating licenses for commercial nuclear power stations. Specifically Ms. Krieg managed the team that developed the Supplemental Environmental Impact Statement for the Oconee Nuclear Station and co-managed the teams for McGuire and Catawba.

Technical leader for development of an interdisciplinary team that provided assistance to the NRC on the development of a Supplemental Environmental Impact Statement for the Watts Bar Nuclear Plant.

Deputy Team lead for updating and revising the Environmental Standard Review Plan (ESRP), NUREG-1555.

Project Manager for assisting the NRC with development of a Generic Environmental Impact Statement (GEIS) to decommissioning of commercial nuclear power reactors. Includes the development of a revision to the Generic Environmental Impact Statement (GEIS) on Decommissioning that was originally published in 1988, development of Regulatory Guides and review plans related to the initial phases of the decommissioning process, technical review of the types of accidents that are of concern during the decommissioning process and the development of a handbook related to decommissioning for resident inspectors.

Project Manager to provide technical assistance to the NRC on the cleanup of Three Mile Island, Unit 2. Included occupational dose calculations, safety evaluations, development of supplements to a programmatic environmental impact statement, and measurement of fuel quantities remaining in the facility.

Provided technical support to the U.S. Department of Energy (DOE) in relation to the use of collective dose as a performance measurement, the development of guidance for fetal/reproductive health hazards from ionizing radiation and chemicals and extremity dosimetry.

Publications:

Krieg, RH, E.E. Hickey, J.R. Weber, and M.T. Masnik. 2004. *Nuclear Power Plants, Decommissioning of* contained in *Encyclopedia of Energy.* Cutler J. Cleveland, Editor-in-Chief. Volume 4. Elsevier Inc. Oxford, England.

Minns, JL, MT Masnik, R. Harty and EE Hickey. 2000. *Staff Response to Frequently Asked Questions Concerning Decommissioning of Nuclear Power Reactors.* NUREG-1628. U.S. Nuclear Regulatory Commission. Washington, DC.

Strom, D.J., R. Harty, E.E. Hickey, R.L. Kathren, J.B. Martin, and M.S. Peffers. 1998. *Collective Dose as a Performance Measure for Occupational Radiation Protection Programs: Issues and Recommendations.* PNL-11934. Pacific Northwest National Laboratory. Richland, Washington.

Durbin, N. E and R. Harty. *U.S. Experience with Organizational Issues During Decommissioning.* 1997. Prepared for the Swedish Nuclear Power Inspectorate. SKI 9X:X; PNWD-2419.

Harty, R., K. L. Swinth, and R. J. Traub. 1996. *Assessment and Control of Fetal Exposures. Proceedings of the Thirtieth Hanford Symposium on Health and the Environment: Current Topics in Occupational Health.* Applied Occupational and Environmental Hygiene. Vol. 11, No. 4, pp 354-358.

Harty, R., W. D. Reece, and C. D. Hooker. 1990. *Performance Testing of Extremity Dosimeters, Study 2.* NUREG/CR-5540, PNL-7276, Pacific Northwest Laboratory, Richland, Washington.

Harty, R., W. D. Reece, C. D. Hooker, and J. C. McDonald. 1990. *Performance Testing of Extremity Dosimeters Against a Draft Standard.* PNL-7277, Pacific Northwest Laboratory, Richland, Washington.

Harty, R., W. D. Reece, and C. D. Hooker. 1987. *Performance Testing of Extremity Dosimeters.* PNL-6218, NUREG/CR-4959, Pacific Northwest Laboratory, Richland, Washington.

Herrington, W. N., R. Harty, and S. E. Merwin. 1987. *Occupational Radiation Exposures Associated with Alternative Methods of Low-Level Waste Disposal.* PNL-6217, NUREG/CR-4938, Pacific Northwest Laboratory, Richland, Washington.

Harty, R., and G. A. Stoetzel. 1986. *Occupational Dose Estimates for a Monitored Retrievable Storage Facility.* PNL-5744, Pacific Northwest Laboratory, Richland, Washington.

Harty, R., W. D. Reece and J. A. MacLellen. 1986. *Extremity Dosimetry at U.S. Department of Energy Facilities.* PNL-5831, Pacific Northwest Laboratory, Richland, Washington.Reece, W. D., R. Harty, L. W. Brackenbush and P. L. Roberson. 1985. *Extremity Monitoring: Considerations for Use, Dosimeter Placement, and Evaluation.* NUREG/CR-4297, U.S. Nuclear Regulatory Commission, Washington, D.C.

Munson, L. F., and R. Harty. 1985. *Possible Options for Reducing Occupational Dose from the TMI-2 Basement.* NUREG/CR-4399, U.S. Nuclear Regulatory Commission, Washington, D.C.

Parkhurst, M. A., D. E. Hadlock, R. Harty and J. L. Pappin. 1985. *Radiological Assessment of BWR Recirculatory Pipe Replacement.* NUREG/CR-4494, U.S. Nuclear Regulatory Commission, Washington, D.C.

Reece, W. D., R. T. Hadley, R. Harty, J. Glass, J. E. Tanner and L. F. Munson. 1984. *Personnel Exposure from Right Cylindrical Sources (PERCS).* NUREG/CR-3573, U.S. Nuclear Regulatory Commission, Washington, D.C.

Fisher, D. R., and R. Harty. 1982. "The Microdosimetry of Lymphocytes Irradiated by Alpha Particles." Int. J. Radiat. Biol. 41(3):315-324.

W. E. Kennedy, Jr., E. C. Watson, D. W. Murphy, B. J. Harrer, R. Harty and J. M. Aldrich. 1981. *A Review of Removable Surface Contamination on Radioactive Materials Transportation Containers.* NUREG-CR/1858, PNL-3666, Pacific Northwest Laboratory, Richland, Washington.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
SOUTHERN NUCLEAR OPERATING CO.	)	Docket No. 52-011-ESP
	)	
(Early Site Permit for Vogtle ESP Site)	)	

AFFIDAVIT OF DR. CHRISTOPHER B. COOK CONCERNING
PREFILED TESTIMONY ON ENVIRONMENTAL CONTENTIONS 1.2, 1.3
AND 6.0 AND REBUTTAL TESTIMONY ON ENVIRONMENTAL CONTENTION 1.2

I, Dr. Christopher B. Cook, do declare under penalty of perjury that my statements in *NRC Staff Testimony of Dr. Michael T. Masnik, Anne R. Kuntzleman, Rebekah H. Krieg, Dr. Christopher B. Cook, and Lance W. Vail Concerning Environmental Contention EC 1.2 (as corrected and refiled on February 2, 2009 and February 26, 2009)*, in *NRC Staff Testimony of Dr. Michael T. Masnik, Rebekah H. Krieg, Dr. Christopher B. Cook, and Lance W. Vail Concerning Environmental Contention EC 1.3 (as corrected and refilled on February 2, 2009 and February 26, 2009)*, in *NRC Staff Testimony of Mark D. Notich, Anne R. Kuntzleman, Rebekah H. Krieg, Dr. Christopher B. Cook, and Lance W. Vail Concerning Environmental Contention EC 6.0 (as corrected and refilled on February 2, 2009 and February 26, 2009,* and in NRC Staff Rebuttal testimony of *Dr. Michael T. Masnik, Anne R. Kuntzleman, Rebekah H. Krieg, Dr. Christopher B. Cook, and Lance W. Vail Concerning Environmental Contention EC 1.2 (as corrected and refiled on February 26, 2009*) (including to the extent it modifies my testimony in the Staff's prefiled direct testimony on EC 1.2), as well as in my attached statement of professional qualifications are true and correct to the best of my knowledge, information, and belief.

Executed in Accord with
10 C.F.R. § 2.304(d)

Christopher B. Cook

Executed at Rockville, Maryland
This 26th day of February, 2009

Christopher Bruce Cook
STATEMENT OF PROFESSIONAL QUALIFICATIONS

Current Position

Senior Hydrologist
Hydrologic Engineering Branch
Division of Site and Environmental Reviews
Office of New Reactors
U.S. Nuclear Regulatory Commission

Education

Ph.D., Civil and Environmental Engineering, University of California at Davis, 2000
M.S., Civil and Environmental Engineering, University of California at Davis, 1993
B.S., Civil Engineering, Colorado State University, 1991

Professional Experience

Dr. Cook joined the U.S. Nuclear Regulatory Commission in 2007. Prior to joining the NRC, he was employed as a Senior Research Engineer at the Pacific Northwest National Laboratory (PNNL) for over seven years. Dr. Cook's professional experience covers a diverse set of hydrology-related areas including basic and applied research and regulatory compliance assessments. Past research areas have focused on the use of multi-dimensional hydrodynamic and water-quality modeling of surface water systems, including simulation of complex density-driven flows in stratified environments, and field instrumentation relevant to environmental fluid mechanics.

NRC Experience

Hydrologic Reviews for New Plant Applications. Dr. Cook's duties include support of NRC reviews associated with early site permits and combined license applications. Dr. Cook is currently the lead hydrologist for the Bell Bend, Bellefonte, Grand Gulf, and North Anna combined license applications. Responsibilities associated with these reviews include preparation of hydrology-related sections of the Safety Evaluation Report (SER) and Environmental Impact Statement (EIS). Safety-related assessments include a broad range of surface water and groundwater site hazard assessments. Responsibilities on the EIS reviews include assessment of water-use and water-quality impacts to the environment from construction and operation of the proposed nuclear reactor, as well as evaluation of alternatives to the proposed action.

IAEA Safety Standard Development. Dr. Cook is currently assisting with the development of hydrology-related sections of the new International Atomic Energy Agency (IAEA) Safety Guide DS417, "Meteorological and Hydrological Hazards in Site Evaluation for Nuclear Installations." This new guide will both update and combine Safety Guide NS-G-3.5 "Flood Hazard for Nuclear Power Plants on Coastal and River Sites" and Safety Guide NS-G-3.4 "Meteorological Events in Site Evaluation for Nuclear Power Plants."

Private Sector Experience

Hydrologic Site Safety Reviews for Early Site Permits. PNNL Task Manager. Dr. Cook prepared surface water hydrology (Section 2.4) sections of the Safety Evaluation Reports (SERs) associated with the North Anna (NUREG-1835), Clinton (NUREG-1844), and Grand Gulf (NUREG-1840) early site permit applications. Assessments included a broad range of site hazards, including flooding from extreme storm events and cascade-failure of upstream dams.

Hydrology-Related Environmental Reviews for Early Site Permits. PNNL Task Manager. Dr. Cook provided assessments for the hydrology-related sections of the Environmental Impact Statements associated with the North Anna (NUREG-1811), Clinton (NUREG-1815), Grand Gulf (NUREG-1817), and Vogtle (NUREG-1872; draft) early site permit applications. Assessments include a broad range of water-use and water-quality impacts to the environment from both construction and operation of the proposed nuclear reactors.

Field Assessment and Simulation of Temperature Fluctuations in the Lower Snake River. PNNL Principal Investigator and Project Manager. Dr. Cook lead a multi-year project to monitor and model temperature fluctuations in the lower Snake River (contract totaling over $1 million per year). He applied three-dimensional numerical models to simulate transient density currents at the confluence of the Clearwater and Snake rivers, and a two-dimensional laterally-averaged model to simulate temperature variations throughout the 140 river mile reach downstream to the confluence of the Snake and Columbia rivers. *In situ* measurements in the confluence region focused on density gradients and their impacts on juvenile Chinook salmon migration, and included the use of a wide range of field instrumentation.

Analysis and Simulation of 3-D Free-Surface Hydrodynamics near Hydroelectric Dams. PNNL Principal Investigator and Project Manager. Dr. Cook participated in and managed several free-surface computational fluid dynamics (CFD) modeling projects to compute water velocities, turbulence intensities, and pressure variations (including hydraulic loads) to assist with designing various hydraulic structures at several hydroelectric dams. Typical examples are an analysis of the spillway and tailrace conditions at The Dalles Dam (Columbia River) and simulation of entrance conditions at the Bonneville Second Powerhouse Ice and Trash Sluiceway (Columbia River).

Three-Dimensional Hydrodynamic and Water Quality Simulation of a Terminal Basin Lake. UC Davis Post-Graduate Research Engineer. While at the University of California at Davis, Dr. Cook modified and applied the multi-dimensional finite element model RMA10 to the Salton Sea, California. To calibrate and verify the model, a team lead by Dr. Cook implemented a year-long field data monitoring program to obtain *in situ* water current (ADCP) and quality (e.g. temperature, salinity, pH, and dissolved oxygen) information. Applications of the computational model focused on management alternatives to restore the Salton Sea's degrading saline environment.

Selected Publications and Technical Reports

Cook, C. B., M. C. Richmond, and J. A. Serkowski. (2007). "Observations of Velocity Conditions near a Hydroelectric Turbine Draft Tube Exit using ADCP Measurements." Journal of Flow Measurement and Instrumentation, 18(3):148-155.

Cook, C. B., G. A. McMichael, J. A. Vucelick, B. Dibrani, E. E. Hockersmith, C. A. Duberstein, I. D. Welch, B. J. Bellgraph, C. A. McKinstry, P. S. Titzler, D. A. Ogden, B. P. Sandford, R. K. Kirkham, and M. D. Bleich. (2007). "Lower Monumental Reservoir Juvenile Fall Chinook Salmon Behavior Studies." *Battelle–Pacific Northwest Division*, PNWD-3800, Richland, Washington, July.

Cook, C. B., B. Dibrani, J. A. Serkowski, M. C. Richmond, P. S. Titzler, and G. W. Dennis. (2006). "Acoustic Doppler Current Profiler Measurements in the Tailrace at John Day Dam." *Pacific Northwest National Laboratory*, PNNL-15627, Richland, Washington, January.

Cook, C. B., B. Dibrani, M. C. Richmond, M. D. Bleich, S. P. Titzler, and T. Fu. (2006). "Hydraulic Characteristics of the Lower Snake River during Periods of Juvenile Fall Chinook Salmon Migration." *Pacific Northwest National Laboratory*, PNNL-15532, Richland, Washington, January.

Johnson, G. E., M. E. Hanks, F. Khan, C. B. Cook, J. Hedgepeth, R. P. Mueller, C. L. Rakowski, M. C. Richmond, S. L. Sargeant, J. A. Serkowski, and J. R. Skalski. (2005). "Hydroacoustic Evaluation of Juvenile Salmonid Passage at The Dalles Dam in 2004." *Pacific Northwest National Laboratory*, PNNL-15180, Richland, Washington.

Johnson, R. L., M. A. Simmons, C. A. McKinstry, C. S. Simmons, C. B. Cook, R. S. Brown, D. K. Tano, S. L. Thorsten, R. LeCaire, and S. Francis. (2005). "Strobe Light Deterrent Efficacy Test and Fish Behavior Determination at Grand Coulee Dam Third Powerplant Forebay." *Pacific Northwest National Laboratory*, PNNL-15007, Richland, Washington, February.

Cook, C. B., L. W. Vail, and D. L. Ward. (2005). "Report on the North Anna Early Site Permit Water Budget Model (LakeWBT) for Lake Anna." *Pacific Northwest National Laboratory*, PNNL-14944, Richland, Washington, January.

Cook, C. B. and M. C. Richmond. (2004). "Simulating the Flow Field Upstream of the Dworshak Dam Regulating Outlets." *Pacific Northwest National Laboratory*, PNNL-14591, Richland, Washington, March.

Cook, C. B. and M. C. Richmond. (2004). "Monitoring and Simulating 3-D Density Currents at the Confluence of the Snake and Clearwater Rivers", in <u>Critical Transitions in Water and Environmental Resources Management</u>, eds. G. Sehike, D. Hayes and D. Stevens, American Society of Civil Engineering Press, 2004.

Cook, C. B., C. L. Rakowski, M. C. Richmond, S. P. Titzler, A. M. Coleman, and M. D. Bleich. (2003). "Numerically Simulating the Hydrodynamic and Water Quality Environment for Migrating Salmon in the Lower Snake River." *Pacific Northwest National Laboratory*, PNNL-14297, Richland, Washington.

Cook, C. B., G. T. Orlob, and D. W. Huston. (2002). "Simulation of Wind-Driven Circulation in the Salton Sea: Implications for Indigenous Ecosystems." <u>Hydrobiologia</u>, 473: 59-75.

Cook, C. B., and M. C. Richmond. (2001). "Simulation of Tailrace Hydrodynamics using Computational Fluid Dynamics (CFD) Models." *Pacific Northwest National Laboratory*, PNNL-13467, Richland, Washington.

Cook, C.B. (2000). "Internal Dynamics of a Terminal Basin Lake: A Numerical Model for Management of the Salton Sea." Ph.D. dissertation, Department of Civil and Environmental Engineering, University of California, Davis.

Cook, C.B. (1993). "A One-Dimensional Model to Simulate Water Infiltration and Redistribution in Soils." M.S. thesis, Department of Civil and Environmental Engineering, University of California, Davis.

Abt, S. R., C. B. Cook, K. Staker, and D. Johns. (1991). "Small Parshall Flume Rating Corrections." Journal of Hydraulic Engineering, American Society of Civil Engineering, 118(5): 798-802.

Selected Conference Proceedings

Cook, C. B., G. A. McMichael, J. A. Vucelick, and B. Dibrani (2007). "Interactions between underflow conditions in a reservoir and emigration of juvenile fall Chinook salmon", *American Fisheries Society Annual Meeting*, San Francisco, September.

Prasad, R., L. W. Vail, C. B. Cook, and G. Bagchi. (2005). "Establishment of Safety-Related Site Characteristics Based on Consideration of External Sources of Flooding at Nuclear Power Plant Sites in the United States of America." In *Proceedings of International Workshop on External Flooding Hazards at Nuclear Power Plant Sites*, Kalpakkam, India, August.

Cook, C. B., M. C. Richmond, J. A. Serkowski, and L. L. Ebner. (2002). "Free-Surface Computational Fluid Dynamics Modeling of a Spillway and Tailrace: Case Study of The Dalles Project." *Hydrovision 2002*, Portland, Oregon, July.

Cook, C. B., D. W. Huston, M. R. Jensen, G. T. Orlob, and S. G. Schladow. (1998). "Internal Dynamics of a Large Saline Lake: Field Investigation and Monitoring of the Salton Sea, California." *1998 Ocean Sciences Meeting*, AGU and ASLO, San Diego, February.

Professional Affiliations

American Society of Civil Engineers
American Geophysical Union

CHAIRMAN BOLLWERK: I believe we have one piece of rebuttal testimony?

MR. MARTIN: Can you please up the staff's rebuttal testimony for EC 1.3? This time my questions will just be for Mr. Vail. Are you familiar with the testimony entitled "NRC Staff Rebuttal Testimony of Lance W. Vail Concerning Environmental Contention 1.3" dated February 6th, 2009, which has been provided to the Court Reporter in electronic format under file name "Vogtle ESP NRC Staff EC 1.3 Rebuttal Testimony"?

MR. VAIL: Yes, I am.

MR. MARTIN: Do you affirm that this testimony is true and correct, to the best of your knowledge and belief?

MR. VAIL: I do.

MR. MARTIN: The staff now moves to have its EC 1.3 rebuttal testimony placed into the record as if read.

CHAIRMAN BOLLWERK: All right. Thank you.

Any objections?

(No response.)

CHAIRMAN BOLLWERK: Hearing none, then the rebuttal testimony of Mr. Vail on contention EC 1.3 is admitted and inserted into the record at this point as if read as DDMS item ID 59142.

(NRC Staff Rebuttal Testimony (EC 1.3) (DDMS-59142) to be inserted at this point)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
SOUTHERN NUCLEAR OPERATING CO.	)	Docket No. 52-011-ESP
	)	
(Early Site Permit for Vogtle ESP Site)	)	

NRC STAFF REBUTTAL TESTIMONY OF LANCE W. VAIL
CONCERNING ENVIRONMENTAL CONTENTION 1.3

Q1. Please state your name.

A1. (LWV) My name is Lance W. Vail (LWV).

Q2. Have you previously submitted testimony concerning Contention EC 1.3 in this proceeding?

A2. (LWV) Yes. My direct testimony is provided in "NRC Staff Testimony of Dr. Michael T. Masnik, Rebekah H. Krieg, Jill S. Caverly, and Lance W. Vail Concerning Environmental Contention EC 1.3." (Jan. 9, 2009; as corrected and refiled February 2, 2009) (hereinafter "Staff EC 1.3 Direct Testimony"). A statement of my professional qualifications was attached to that filing.

Q3. Q3. Are you familiar with the direct testimony submitted by the Joint Intervenors concerning EC 1.3, "Revised Pre-Filed Direct Testimony of William Powers in Support of EC 1.3" (Feb. 2, 2009) ("Powers EC 1.3 Testimony").

A3. (LWV) Yes.

Q4. In their statement of position, the Joint Intervenors state with respect to Contention EC1.3 that the "NRC staff failed to satisfy the requirements set forth in" Regulatory Guide 4.2. See "Joint Intervenors' Initial Written Statement of Position and Prefiled Direct Testimony" at 17 (Jan. 9, 2009). Do you agree with this assertion?

A4. (LWV) No. Regulatory Guide 4.2 is directed to the Applicant and not the Staff's review. In performing its review of the proposed design alternatives, the Staff followed the guidance of the Environmental Standard Review Plan ("ESRP") Section 9.4.1. Exhibit NRC000010; Staff EC1.3 Direct Testimony at A6. However, while the Staff's review is not directed by Regulatory Guide 4.2, the Staff's review confirmed that the Applicant's environmental report is consistent with the guidance provided therein.

Specifically, the Joint Intervenors state that the Staff failed to comply with pages 10-1 through 10-3 of Regulatory Guide 4.2 (Exhibit NRC000010) because the Staff "should describe each alternative, present estimates of its environmental impact, and compare estimated impact with that of the proposed system. The assumption and calculations on which the estimates are based should be presented." Joint Intervenors' Statement of Position at 16. Further, the Joint Intervenors state that the Staff should provide "a textual description of the process by which the tradeoffs were weighed and balanced in arriving at the proposed design." *Id.* at 17.

In A15 and A16 of the Staff's EC 1.3 Direct Testimony, the Staff describes in detail the Staff's review of the alternatives in the FEIS. As mentioned in A13 of that testimony, the Staff determined that the impacts associated with the proposed cooling system were SMALL. If any impacts associated with the cooling system design had been determined to be MODERATE or LARGE, the Staff would have evaluated the alternatives in greater depth to ensure that the tradeoffs involved in an alternative design that might decrease the MODERATE or LARGE impacts to SMALL would be more completely articulated in the FEIS. The Staff clearly states in the FEIS and its Direct Testimony that dry cooling would eliminate the hydrological impacts and the aquatic ecology impacts; however, these are not the only considerations. Exhibit NRC000001 at 9-27; Staff EC 1.3 Direct Testimony at A10. In A14 of the Staff's EC 1.3 Direct Testimony, the Staff mentions some of the disadvantages of a dry cooling system. By following the guidance in ESRP 9.4.1, the Staff has confirmed that the Applicant's environmental report is consistent with Regulatory Guide 4.2.

Q5. In Answer 25 of Powers EC 1.3 Testimony, Mr. Powers states that the EPA's

> § 316(b) regulation does not require air cooling as the best available technology because the EPA:(1) overstated power losses for coal plants; (2) asserted that all the power loss would have to be made up by new plants, accordingly exacerbating air pollution problems; and (3) the supposed high cost of air cooling. Each of these statements and assertions are incorrect.

Do you agree with Mr. Powers's analysis of the EPA's §316(b) rulemaking?

A5. (LWV) The Staff is unable to evaluate Mr. Powers's assertions because his testimony provided no citations or explanation for his criticisms of EPA's rulemaking. The Staff maintains that without sufficient support for Mr. Powers's claims and a credible assertion that the EPA rulemaking does not cover this specific situation, it is appropriate for the Staff to accept the rule as provided by the EPA. The Staff does not reconsider another Federal agency's rule when complying with its NEPA obligations.

Q6. Does this conclude your testimony?

A6. (LWV) Yes.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
SOUTHERN NUCLEAR OPERATING CO.	)	Docket No. 52-011-ESP
	)	
(Early Site Permit for Vogtle ESP Site)	)	

AFFIDAVIT OF LANCE W. VAIL CONCERNING PREFILED
REBUTTAL TESTIMONY ON ENVIRONMENTAL CONTENTIONS 1.2 AND 1.3

I, Lance W. Vail, do declare under penalty of perjury that my statements in *NRC Staff Rebuttal Testimony of Dr. Michael T. Masnik, Anne R. Kuntzleman, Rebekah H. Krieg, Jill S. Caverly, and Lance W. Vail Concerning Environmental Contention EC 1.2*, and in *NRC Staff Rebuttal Testimony of Lance W. Vail Concerning Environmental Contention EC 1.3*, are true and correct to the best of my knowledge, information, and belief.

Executed in Accord with
10 C.F.R. § 2.304(d)

Lance W. Vail

Executed at Richland, Washington
This 6th day of February, 2009

CHAIRMAN BOLLWERK: I think we have a couple of exhibits.

MR. MARTIN: Two exhibits, yes. First we have exhibit NRC000046, which is excerpts from Richmond and Kynard, 1995 ontogenetic behavior of shortnose sturgeon.

CHAIRMAN BOLLWERK: Let the record reflect that exhibit NRC000046 has been marked for identification.

(Whereupon, the aforementioned document was marked for identification as Exhibit Number NRC000046-00-BD01.)

MR. MARTIN: And then we have NRC000047, which is excerpts from Hall, et al., 1991, movements and habitats of shortnose sturgeon in the Savannah River.

CHAIRMAN BOLLWERK: Let the record reflect that exhibit NRC000047 has been marked for identification.

(Whereupon, the aforementioned document was marked for identification as Exhibit Number NRC000047-00-BD01.)

MR. MARTIN: The staff moves to have exhibits 46 and 47 moved into evidence.

CHAIRMAN BOLLWERK: Any objection?

(No response.)

CHAIRMAN BOLLWERK: Hearing none, then NRC000046 and 47 are admitted into evidence.

(Whereupon, the aforementioned documents, having previously been marked for identification as Exhibits Number SNC000046-00-BD01 and SNC000047-00-BD01, was received in evidence.)

CHAIRMAN BOLLWERK: At this point I believe the panel is available. All right. Judge Trikouros?

JUDGE TRIKOUROS: Okay. I'll read to you again the question that I asked Dr. Coutant earlier. This is according to Dr. Young, "The EPA definition of extremely sensitive biological resources does not require that the species be subjected to significant risks."

How do you respond to that? What is the basis for your definition? I'm asking what the staff's definition of "extremely sensitive biological resources" is, basically.

DR. MASNIK: This is Mike Masnik. Actually, I am not sure that the staff does have a definition for "extremely sensitive biological resources" because it was not really defined in the rulemaking.

If you look through the 91 pages of the rulemaking, it's only mentioned once. There's no definition anywhere in the rulemaking. It doesn't seem to be defined in any other EPA documents.

I've looked through numerous documents and have not found it anywhere. And it's followed, the first introduction and the only introduction of this term in the rulemaking is followed, by a parenthetical expression that says, "(e.g., endangered species, specially protected areas)."

There's no further explanation. It's unclear as to whether or not it's both threatened and endangered species or just endangered species. We're not sure whether it's federal or federal and state protected species. And we're not sure what is meant by "specially protected areas." It could be anything possibly from state game lands to federally designated critical areas or critical areas.

JUDGE TRIKOUROS: So it doesn't even have to be an aquatic organism. It can be something else, like a spawning ground perhaps, or --

DR. MASNIK: Your Honor, I'm not sure. To be honest with you, it's not defined. The intervenors suggested the robust redhorse and the shortnose sturgeon as two species that would qualify for this status.

The staff is not taking issue with that simply because both of these species would be considered under our process of being an important species. And, as such, we recognize the presence of an important species.

And then we do an assessment of what the impact might be of this particular action on those important species. And that's what, in fact, we did.

JUDGE TRIKOUROS: Okay. Thank you. Thank you very much.

Going to your direct testimony, question 10, the question was, "Would dry cooling largely eliminate impacts on aquatic biota?" And the answer was yes, it would.

And I had a question regarding any chemical treatment requirements for air-cooled condensers. Did you identify any such requirement where air-cooled condenser fan shells would require any sort of chemical treatment similar to what we do with treating water condensers? Are you familiar with any such requirement that might lead to a release?

DR. MASNIK: I'm not familiar with it. I mean, what we looked at was primarily from the standpoint of impingement, entrainment in thermal and routine discharges. I didn't go any further than that.

JUDGE TRIKOUROS: In question 11, "If dry cooling would eliminate those impacts, what was the staff's basis for concluding that dry cooling would not be preferable to the proposed wet cooling system?" And there you looked at these other disadvantages of dry cooling systems.

In determining those and specifically land use area, additional spent fuel transport, additional spent fuel storage, those are the disadvantages quoted. In determining those, did you do a specific calculation that took into account some sort of a specific efficiency penalty for dry cooling versus wet cooling or were you doing it more qualitatively, just saying there will be a larger land use?

MR. VAIL: Your Honor, it was a qualitative assessment. It was not a quantitative calculation.

JUDGE TRIKOUROS: Okay. So you were just pointing out that there would be some penalty that would require some additional fuel to be utilized by the plant and also that there would be a larger land area. That's it?

MR. VAIL: That's correct.

JUDGE TRIKOUROS: Okay.

CHAIRMAN BOLLWERK: Can you be any more -- I mean, "some," that's a pretty indefinite term. "Some" like a lot? "Some" like a little? "Some" like some?

MR. VAIL: We're just saying there that it's more we did not get into doing a detailed quantitative assessment in this evaluation.

CHAIRMAN BOLLWERK: Just some?

MR. VAIL: Some.

CHAIRMAN BOLLWERK: Some. All right.

JUDGE TRIKOUROS: In Question 12, you indicate the FEIS stated that, even with those disadvantages that we just talked about, the staff might consider a dry cooling to be a preferable option if the proposed wet tower system would cause significant adverse impacts to water availability, water quality, or aquatic resources, et cetera.

The words "significant adverse impacts," how do they relate to the NEPA metrics of small, medium, large?

MR. VAIL: If we had determined that the impacts for the proposed alternative in the initial screening had shown either moderate or large impacts, then we would have gone back and done a detailed quantitative analysis of the dry cooling options.

JUDGE TRIKOUROS: So basically anything greater than small? Well, this is why I have a problem with the NEPA metric. Is there a range of small? I mean, this is just sort of a --

MR. VAIL: I understand --

JUDGE TRIKOUROS: -- qualitative in a sense, right?

MR. VAIL: Yes. I mean, we're both engineers. And I think the people who wrote the small, moderate, and large had some different backgrounds. But that's what we work with.

CHAIRMAN BOLLWERK: They wouldn't have been lawyers, would they?

(Laughter.)

MR. BLANTON: We're the only profession that hasn't been insulted yet.

(Laughter.)

JUDGE TRIKOUROS: All right. But what you specifically mean is if it were moderate, then that would have --

MR. VAIL: That would have triggered a different level of analysis, correct.

JUDGE TRIKOUROS: All right. Let's see.

You make a statement in question 14, in your answer to 14, you state that "The staff has not evaluated the technical feasibility or precise costs of using dry cooling for the AP1000 design at Vogtle and takes no position regarding the merits of either the joint intervenors' or the applicant's testimony concerning technical feasibility."

MR. VAIL: That's correct.

JUDGE TRIKOUROS: That is, then, your official position, that you have no comment whatsoever on any of the testimony that you have heard regarding the technical adequacy of dry cooling?

MR. VAIL: That is the staff's position.

JUDGE TRIKOUROS: You don't have any opinion about any of the things you have heard so far?

MR. VAIL: No.

JUDGE TRIKOUROS: It's okay to say no. You say that if the effects were moderate, you would then have done an analysis in greater depth. Could you give me some rough idea of what that would have entailed?

MR. VAIL: Well, I think the questions that we talked about trying to quantify the land use impacts, the fuel cycle costs, we basically would have had to have had a more detailed analysis to actually provide some bounds on those in order to enable ourselves to clearly articulate the trade-offs between these different impacts.

JUDGE TRIKOUROS: Is cost of the system a trade-off? Is that a figure of merit, the cost of a dry cooling system?

MR. VAIL: Well, in an early site permit analysis, the assessment of cost isn't weighed like it would be a normal COLA analysis.

Unfortunately, you're getting close to an area where it's probably outside of my expertise. That was my understanding, that we didn't really directly consider it because we didn't have detailed information on --

JUDGE TRIKOUROS: Well, let me be more specific about where I am coming from with the question. The intervenor might argue that the effects on Savannah River are not small, that they're, in fact, moderate or large. Is that the right term, "moderate or large"?

Would then the cost of a dry cooling system at Vogtle be a trade-off factor with respect to, let's say, a moderate impact on the Savannah River? So, for example, if the impact on the Savannah River were moderate but putting in this dry cooling system would be a 50 percent increase in the cost of the plant, would that be a viable trade-off consideration or would it be that if it were a moderate impact, there would be no trade-off consideration? It would simply be dry cooling or nothing or something else.

MR. VAIL: Let me see if I can sort of restate what I am thinking you're trying to get. And that's if the impact had been moderate with a wet cooling system --

JUDGE TRIKOUROS: Right.

MR. VAIL: -- and we did an evaluation, then we would have eliminated the wet cooling if it had been moderate. That wouldn't be the case necessarily.

JUDGE TRIKOUROS: No, that isn't precisely what I'm asking. What I'm asking is, if the impact were moderate and you determined that a dry cooling system should be considered, would cost of that system be a figure or merit in your determination?

MR. VAIL: Not in my particular area in the water impacts.

JUDGE TRIKOUROS: You know, it's a broad question to the panel if anyone has a comment. Go ahead.

DR. MASNIK: Judge, I don't think there's anyone here who can answer that question.

JUDGE TRIKOUROS: So there's been no experience along those lines in any other application anywhere?

DR. MASNIK: Not that I'm aware of.

JUDGE TRIKOUROS: Okay. And North Anna basically just came in with a hybrid system? No such consideration was made there?

MR. VAIL: Well, if you remember, the impacts on North Anna were considered moderate in dry year conditions for water use. So there actually was an elevated standard there. And in their original proposal, they had actually used a once-through design, which actually would consume less water.

And then they moved to a design -- they never considered, really, moving to a full wet system that I'm aware of because of the consumptive water use. It is important to keep in mind the differences in the sites, where North Anna in the summer is putting out maybe four ECFS as compared to the Savannah River as putting out 4,000 and stuff in low flow conditions.

JUDGE TRIKOUROS: All right. Well, you know, we're sitting here getting a lot of testimony regarding cost and difficulty of implementing. And this issue of how that can be utilized is not clear. Really, that is why I was asking the question.

Thank you very much. I appreciate that. I think that's it.

CHAIRMAN BOLLWERK: Do you have any questions, Judge Jackson?

JUDGE JACKSON: Yes, one quick question --

CHAIRMAN BOLLWERK: All right.

JUDGE JACKSON: -- on the rebuttal testimony for Mr. Vail. Mr. Vail, this just relates to your rebuttal testimony, a quick question.

To the best of your knowledge, do the requirements do the requirements of the Environmental Standard Review Plan, section 941 differ in any manner from the requirements of reg. guide 4-2?

MR. VAIL: Well, I don't think there's any inconsistency. There's just a lot more detail and guidance that's provided in the ESRP than there is within the reg. guides.

JUDGE JACKSON: So, to your knowledge, the reg. guide would be completely consistent?

MR. VAIL: Right. It's consistent with the ESRP. The ESRP just has more useful guidance in it.

JUDGE JACKSON: Okay. So basically if you followed the ESRP, then you would be in compliance with reg. guide 4.2?

MR. VAIL: Yes. I think the question there is due to the sort of difference between maybe a quantitative and qualitative trade-off assessment and, as we've stated, it leads to qualitative assessment. And we feel that is consistent with 14 as well as the ESRP.

JUDGE JACKSON: Okay. Thank you.

MS. KRIEG: And I would also like to add something. My understanding is regulatory guide 4.2 is aimed at the applicant and what information should be presented in the environmental report. The ESRP is our guidance for the staff developing the EIS.

JUDGE JACKSON: Okay.

MS. KRIEG: So they have slightly different purposes.

JUDGE JACKSON: Thank you.

CHAIRMAN BOLLWERK: I want to go back to what Judge Trikouros raised at the beginning of these questions. I think you all heard Dr. Coutant describe his view of what an -- the words, I'm going to get the words wrong -- an exceptionally -- hold on -- extremely sensitive biological resources.

How does that differ from what you heard from how you treated these as important species in terms of the analysis that he suggested applies under the EPA standard as to what you did, if at all?

DR. MASNIK: I think we did what he expected, and that was that we considered them and looked at what the impacts might be on these particular species by this action.

CHAIRMAN BOLLWERK: And so he characterized it as a situation where you don't look at the individual fish that might be involved, but, rather, you are looking at broader questions of where they spawn or the effect on their habitat in general?

DR. MASNIK: Well, actually, we have two categories of fish here. One is federally protected.

CHAIRMAN BOLLWERK: Right.

DR. MASNIK: One is not. If we look at the fish that's not federally protected, what we would typically do is look at what the impacts would be on that particular fish from the standpoint of the population.

The other particular species involved here, the shortnose sturgeon, is federally protected. And under those circumstances, even the loss of one individual may be important. And what typically would happen is we -- and what we did was we did an environmental assessment and a biological assessment, which we submitted to the National Marine Fisheries.

National Marine Fisheries came back with a letter. I think it's SNC000022. And they reach a conclusion at the end that basically states -- I'll read it. It says, "Based on the above information, National Marine Fisheries Service concludes that this proposed action is not likely to adversely affect shortnose sturgeon. Therefore, this concludes your consultation responsibilities under the ESA for species under National Marine Fisheries Service purview."

Now, if the plant took even a single species, let's say the plant is built and it's operating. At some time in the future a shortnose sturgeon shows up on the intake screens. And this has happened at other NRC facilities: the Salem plant, Indian Point, the old Maine Yankee plant. There's been a number of them.

The utility is responsible for notifying National Marine Fisheries. Under that notification, we, the staff, would be notified under 50.72 notification. And we would institute informal consultation with National Marine Fisheries, at least initially, and then ultimately likely if there were a taking and it was causally related to plant operation, we would probably begin formal consultation, which would then lead to another biological assessment, which could then lead to a biological opinion on the part of the service, which may put restrictions on the facility.

Since those restrictions are outside the restrictions of the Clean Water Act, we, the NRC, would, in fact, make those in some cases a condition of the license or require them to actually perform those actions to protect that species in the future.

CHAIRMAN BOLLWERK: So if I am understanding you -- and correct me if I am wrong -- basically if they were to impinge one of the sturgeon, the penalty, at least the way you have described it, is that there would be consultations and perhaps additional license conditions that might arise so they didn't do it again or at least try to prevent them from doing it again?

DR. MASNIK: That's correct. Actually, it's a criminal offense. So, I mean, --

CHAIRMAN BOLLWERK: Okay.

DR. MASNIK: -- and there's not that aspect of it, but it does put requirements on us that the issue is of a license to take this action under section 7. And that's the section 7 consultation.

CHAIRMAN BOLLWERK: Right. And I take it, then, in terms of the criminal side, that is nothing the NRC is concerned with?

DR. MASNIK: No.

CHAIRMAN BOLLWERK: But maybe the U.S. Attorney's office or someone else?

DR. MASNIK: Well, obviously in its incidental take, which is what typically happens, they don't pursue it. But they do pursue measures being taken by the applicant or by the licensee to minimize further takes. And, you know, we have requirements at a number of plants for sea turtles and other species as well.

CHAIRMAN BOLLWERK: All right. Thank you.

One other question, in terms of a discussion of moderate versus small versus large, when something is moderate and you begin this process of additional assessment, in this context, I mean, don't costs begin to play a role to some degree in terms of there is a balance that begins, isn't there, when you have something that has got a moderate impact potentially for how you assess it or am I overstating it? I mean, when it's moderate, then you're beginning to balance the cost-benefit that is involved with NEPA as a general rule.

DR. MASNIK: There is a cost-benefit analysis. But none of us are cost-benefit specialists.

CHAIRMAN BOLLWERK: All right.

DR. MASNIK: So sorry.

CHAIRMAN BOLLWERK: But it would be something, at least within the NRC, that the NRC would begin to look at because now you've got a moderate impact. You're going to have to take -- it's not small. It's moderate. You're going to have to begin to bring other factors into account that maybe you wouldn't have to consider if it were small?

DR. MASNIK: We would consider mitigation, I mean, mitigative actions.

CHAIRMAN BOLLWERK: Of some type?

DR. MASNIK: Of some type, yes.

CHAIRMAN BOLLWERK: And those, again, what? Maybe dry cooling, what does it cost? Hybrid cooling, what does it cost? Those are the things you begin to look at, among others?

MR. VAIL: You know, we actually just want to make clear sort of we typically consider the cooling system is sort of a large-scale component alternative, as opposed to sort of a mitigation that you might put like additional screens or something on intake and stuff.

So we do treat it at certainly a different level and stuff, but I think the economics and stuff would certainly come in to the overall cost-benefit analysis and probably potentially the need for power. But, like Mike said, you have two fish biologists and two engineers.

CHAIRMAN BOLLWERK: Right.

DR. MASNIK: You know, when we have had situations where there is a potential for impact for species, mitigation was discussed, things like return systems for traveling screenings, where fish that were impinged would then be returned to the water body. So, I mean, we do discuss those if they are warranted.

CHAIRMAN BOLLWERK: So there are ways that could go beyond what Southern even has in place now to further mitigate those impacts potentially.

DR. MASNIK: Beyond what they have now but short of dry cooling, I guess is what I am saying.

CHAIRMAN BOLLWERK: All right. Any other questions? No?

(No response.)

CHAIRMAN BOLLWERK: All right. Thank you

very much.

Let's take a 10-minute break. Fifteen?

MS. GOLDSTEIN: Ten is fine.

CHAIRMAN BOLLWERK: Fifteen or ten?

MS. GOLDSTEIN: Ten.

CHAIRMAN BOLLWERK: Ten? All right. Ten-minute break. And we'll see if there are any questions that have been generated. Thank you.

(Whereupon, the foregoing matter went off the record at 2:25 p.m. and went back on the record at 2:36 p.m.)

CHAIRMAN BOLLWERK: Let's go back on the record, please. We are back after a brief break to see if there were any additional questions for this panel generated by the parties. Ms. Bu doesn't have any, and we don't have any. So I suspect we at this point are ready to move on, then.

Thank you very much for your testimony. Your service to the Board is very much appreciated. And we'll see some of you again.

DR. COOK: Yes, you will.

CHAIRMAN BOLLWERK: All right. At this point I think we are ready to proceed with the intervenor panel for this particular contention, 1.3.

MR. SANDERS: Your Honor, Mr. Powers just ran to the restroom. He will be available in a moment.

CHAIRMAN BOLLWERK: Okay. We can wait. I think I caught our IT staff off guard. Sorry about that. Did we get that? Did I start before? We are still recording? Okay. I didn't know that. I generally always look over that way. You're always there, Andy or Mac.

MR. SANDERS: Your Honor, I have one minor minor administrative matter --

CHAIRMAN BOLLWERK: Okay.

MR. SANDERS: -- that we discussed yesterday morning about the one or two points in our testimony where we have a reference to Ms. Caverly. And we were just going to change that to Dr. Cook. That was in Powers' 1.3 rebuttal testimony. And I think there was just one reference to Ms. Caverly. And we have provided the Reporter and Andy with the corrected version.

CHAIRMAN BOLLWERK: Okay. I appreciate that. So we gave the applicant a pass on that, but I appreciate you doing what we had asked you to.

MR. SANDERS: For only one reference, it seemed hardly necessary, but, you know, we wanted to be brave.

CHAIRMAN BOLLWERK: I appreciate it. All right. We probably need to introduce at least one of these gentlemen to the Court Reporter.

MS. GOLDSTEIN: Right. I'll introduce all three of them for the record.

CHAIRMAN BOLLWERK: All right.

MS. GOLDSTEIN: To the far right is Mr. Barry Sulkin. To his left is Mr. Bill Powers. And to his left is Dr. Shawn Young.

CHAIRMAN BOLLWERK: All right. And I believe Dr. Young and Mr. Sulkin have already been sworn. Sir, if you would raise your right hand, please, and respond verbally when I ask the question? Do you swear or affirm that the testimony you will give in this proceeding is the truth, the whole truth, and nothing but the truth?

MR. POWERS: Yes.

CHAIRMAN BOLLWERK: Thank you very much. And let's see. I think we had some testimony to deal with here.

MS. GOLDSTEIN: Yes. If you could please pull up prefiled direct testimony for Bill Powers for contention 1.3? Mr. Powers, do you recognize this document as your prefiled direct testimony for environmental contention 1.3?

MR. POWERS: Yes.

MS. GOLDSTEIN: All right. I am going to ask you to affirm the following. The testimony entitled "Revised Prefiled Direct Testimony of William Powers in Support of EC 1.3" dated January 9, 2009, which has been provided to the Court Reporter in electronic format under the file name "Powers 1.3 Direct Testimony." It was prepared under your supervision and direction and is true and correct, to the best of your knowledge?

MR. POWERS: Yes.

MS. GOLDSTEIN: Let this testimony be admitted into evidence as if read.

CHAIRMAN BOLLWERK: Any objections?

(No response.)

CHAIRMAN BOLLWERK: Hearing none, then the direct testimony of William Powers relative to contention 1.3 is admitted and should be bound into the record at this point as if read as DDMS item ID 59073.

MS. GOLDSTEIN: Would you please pull up the rebuttal testimony for Bill Powers for contention EC 1.3? Mr. Powers, do you recognize this document as your prefiled rebuttal testimony on environmental contention 1.3?

MR. POWERS: I do.

MS. GOLDSTEIN: Could you please affirm the following: The testimony entitled "Revised Prefiled Rebuttal Testimony of William Powers Concerning Contention EC 1.3" and dated February 6, 2009, which has been provided to the Court Reporter in electronic format under file name "Powers 1.3 Rebuttal Testimony" was prepared under your supervision and direction and is true and correct, to the best of your knowledge?

MR. POWERS: Yes, but I do need to make one correction to this testimony, on page 9 of it.

CHAIRMAN BOLLWERK: Well, we almost made it, not quite.

(Laughter.)

CHAIRMAN BOLLWERK: All right. Well, now we get to balance the scales of justice here. What do you need to correct, sir?

MR. POWERS: In my original declaration, I indicated on page 9, it says, "The megawatt differential between a dry and a wet cooling system would only be 15 to 20 megawatts at peak conditions." That should be "average."

CHAIRMAN BOLLWERK: So what page? Is this the page that we're on? Have we got the right? Okay.

Make sure we've got the right testimony here. All right. That is the right rebuttal testimony, right?

MR. POWERS: It is.

CHAIRMAN BOLLWERK: Okay. And I'm sorry. The page number again?

MR. POWERS: The page number is 9.

CHAIRMAN BOLLWERK: Nine? All right. Let's go to page -- I only have seven pages. That's interesting.

MS. GOLDSTEIN: Are you looking at your direct maybe?

MR. POWERS: Okay. Revised prefiled direct testimony.

CHAIRMAN BOLLWERK: All right. Let's go to page 9. All right. And the changes to? I'm sorry. Could you give this to us again, please?

MR. POWERS: Under Q28, A28, the second line says, "megawatt at peak conditions." It should be "megawatt at average conditions."

CHAIRMAN BOLLWERK: So changing the word "peak" to "average"?

MR. POWERS: Yes.

CHAIRMAN BOLLWERK: Okay. Any objection to the change anyone has?

(No response.)

CHAIRMAN BOLLWERK: All right. Then let's have the record reflect that with respect to the prefiled direct testimony that we put into the record, that on page 9, we just put it into the record, page 9, the question 28, the answer, the second line of the answer, the word "peak" should be changed to "average" so that the sentence reads, "The megawatt differential between a dry and a wet cooling system would only be between 15 and 20 megawatts at average conditions."

That's correct, sir?

MR. POWERS: That is correct.

CHAIRMAN BOLLWERK: All right. And that is how it will read for the purposes of the record. All right. And I think we need to do the rebuttal.

MS. GOLDSTEIN: I'll start with the affirmation again.

CHAIRMAN BOLLWERK: All right.

MS. GOLDSTEIN: The testimony entitled "Revised Prefiled Rebuttal Testimony of William Powers Concerning Contention EC 1.3" and dated February 6, 2009, which has been provided to the Court Reporter in electronic format under file name "Powers 1.3 Rebuttal Testimony" was prepared under your supervision and direction and is true and correct, to the best of your knowledge?

MR. POWERS: It is true and correct with two revisions.

CHAIRMAN BOLLWERK: All right. These are beginning to add up. Where are we at?

MR. POWERS: Page 5, last full sentence. That sentence is just a redundant sentence. I think it was meant to be deleted and somehow stayed in the document.

CHAIRMAN BOLLWERK: What is it redundant to? Where is it repeated from? Up further?

MR. POWERS: Yes. In the middle of that same paragraph, there is a sentence that starts, "The GE-SBWR reactor." And the same sentence begins -- the one that I am saying should be deleted, the GE-SBWR reactor is larger. It's word for word identical. The reason it was meant for deletion is it had the wrong net output for the AP1000.

CHAIRMAN BOLLWERK: So you want only the second one deleted or --

MR. POWERS: Right. The first sentence is correct, but this sentence down here at the bottom is just an earlier version of that sentence that was left in the document inadvertently.

CHAIRMAN BOLLWERK: I see. So there is a difference between -- the first one has 1,117-megawatt net.

MR. POWERS: Correct.

CHAIRMAN BOLLWERK: And this one has 1,154-megawatt net.

MR. POWERS: Correct.

CHAIRMAN BOLLWERK: That is the change if I am reading it? That is the one difference between the two sentences?

MR. POWERS: Correct.

CHAIRMAN BOLLWERK: Okay. I should be writing this down here. Hold on one second. What page are we on? Page 7?

MR. POWERS: Five.

CHAIRMAN BOLLWERK: Page 5? Sorry. And this is question and answer 6? And that is the -- let me just count. Is that the sixth sentence in the paragraph? Can you confirm that for me?

MR. POWERS: Sixth sentence, correct.

CHAIRMAN BOLLWERK: Okay. All right. And then what is the second one?

MR. POWERS: On page 7, the bolded "Q8," the second full sentence begins, "However, you did not provide several examples." The word "not" should be removed.

CHAIRMAN BOLLWERK: Okay.

MR. POWERS: There are no other changes.

CHAIRMAN BOLLWERK: So that's in the second sentence of the question?

MR. POWERS: Yes.

CHAIRMAN BOLLWERK: Okay. Let's go ahead, then. And we'll go ahead and admit the testimony and then make these changes to it. Okay?

MR. LeJEUNE: Your Honor, we would like to place an objection on the record with regard to the portions of Mr. Powers' rebuttal testimony that discuss the cooling system for North Anna 3 because that cooling system is a hybrid cooling system, which is beyond the scope of this proceeding.

CHAIRMAN BOLLWERK: All right. And your objection is noted.

MR. LeJEUNE: Thank you, Your Honor.

CHAIRMAN BOLLWERK: All right. Putting aside that, does anybody have any objections to the other corrections he's asking we make, which are to delete the sixth sentence in the paragraph dealing with the answer to question 6 and then taking the word "not" out of question 8 in the second sentence? No?

(No response.)

CHAIRMAN BOLLWERK: All right. Let's go ahead, then. We'll admit the testimony. And then we'll reflect the revisions to it. When we're doing that, why don't you mention there are going to be changes to it afterwards so everyone can pick it up. And we'll know they need to read further.

MR. SANDERS: Your Honor, do you want us to refile with the corrected version or --

CHAIRMAN BOLLWERK: That would be better. I'm a little concerned about the timing for the Court Reporter. Let's see, sort of a question, when you can get it to him and how quickly this can be done.

MR. SANDERS: We could turn it around probably before he's done testifying if somebody wants to go out and do it. So we could do it right away.

CHAIRMAN BOLLWERK: How long would it take him? Can we do it right now?

MR. SANDERS: It would probably take about 10 or 15 minutes. I mean, if we could get to Mr. Sulkin while you're looking at him, we can get the corrected version back.

JUDGE TRIKOUROS: You won't have much time. It will be quick.

MR. SANDERS: Yes. I see that. I mean, we really could get it. It's very small edits. So we could do this very quickly. As I said, we could either take a ten-minute break or, if you wanted to move on to Mr. Sulkin --

CHAIRMAN BOLLWERK: I would prefer to have it all admitted at once. I think that makes the most sense in terms of the record. Let's go ahead and take a ten-minute break, have the corrections made, and get it in appropriate --

MR. SANDERS: I apologize for this.

CHAIRMAN BOLLWERK: It's not a problem.

MR. SANDERS: Didn't realize.

CHAIRMAN BOLLWERK: No problem. Let's take a ten-minute break. And we will correct this problem.

(Whereupon, the foregoing matter went off the record at 2:49 p.m. and went back on the record at 3:07 p.m.)

CHAIRMAN BOLLWERK: We are back from break. I think we have made some changes to the testimony and provided the file to our DDMS system. And, as I understand it, you have corrected both the direct and the rebuttal testimony.

MS. GOLDSTEIN: Correct.

MR. SANDERS: Yes, sir.

CHAIRMAN BOLLWERK: All right. Then the record at this point will reflect that the testimony, the direct testimony, of Mr. Powers that should be bound into the record is the corrected version. And do you have the file name for that in case there's a --

MS. GOLDSTEIN: It's "Powers 1.3 Direct."

CHAIRMAN BOLLWERK: Okay. It's the same file name.

MS. GOLDSTEIN: Yes.

CHAIRMAN BOLLWERK: All right. That will be provided to the Court Reporter. And the change that was made to it, if I remember correctly -- hold on one second. I don't know if I wrote that down. I don't know if I did.

It was to question 28. I'm sorry. The answer to question 28, the word "average" was inserted for what was the word before? I've forgotten now.

MR. POWERS: "Peak."

MS. GOLDSTEIN: "Peak."

CHAIRMAN BOLLWERK: "Peak." So this is a corrected version. So this is the one that will be bound into the record as if read as DDMS item ID number 59073.

(Powers Direct Testimony (EC 1.3) (DDMS-59073) to be inserted at this point)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

G. Paul Bollwerk, III, Chairman
Nicholas G. Trikouros
Dr. James Jackson

In the Matter of	Docket No. 52-011-ESP
SOUTHERN NUCLEAR OPERATING CO.	ASLBP No. 07-850-01-ESP-BD01
(Early Site Permit for Vogtle ESP Site)	Originally Filed: January 9, 2009 Revised: February 2, 2009

REVISED PREFILED DIRECT TESTIMONY OF WILLIAM POWERS IN SUPPORT OF EC 1.3

Q1: Please state your name and address.

A1: My name is William Powers, and my business address is 4452 Park Boulevard, San Diego, California, 92116.

Q2: What us your educational background?

A2: I received a Bachelor of Science from Duke University in Mechanical Engineering and a Masters of Public Health in Environmental Sciences from the University of North Carolina.

Q3: For whom do you work and in what capacity?

A3: I am the principal of Powers Engineering, an engineering firm that consults on power generation, pollution control, and cooling technology issues and implementation.

Q4: What is your professional background?

A4: I have over 25 years experience as a lead engineer and project manager for power generation, permitting, technical assessments, and emissions control projects for a number of clients.

Q5: Are you licensed to practice engineering?

A5: I have been a registered professional engineer (mechanical engineering) in California since 1986.

Q6: Have you received any academic honors or professional recognition in your fields of study and practice?

A6: In 1986, I received the "Engineer of the Year" award from the Naval Energy and Environment Support Activity, Port Hueneme. I also received the "Engineer of the Year" award from ENSR Consulting and Engineering, in 1991, and "Productivity Award of Excellence" from the US Department of Defense in 1985.

Q7: Have you testified as an expert previously in any jurisdiction or proceeding?

A7: I have provided expert testimony, conducted feasibility studies, and consulted on permitting regulations in a number of states including Alabama, Kentucky, Georgia, Pennsylvania, Montana, Massachusetts and California.

Q8: Do you have a written summary of your education, employment, experience and background, and papers and presentations you have made over your career?

A8: My professional and educational experience is summarized in the curriculum vitae attached to this prefiled direct testimony as JTI000044. In May of 2003, I co-authored and presented a paper entitled "Design Performance of Optimized Air-Cooled Condenser at Crockett Co-Generation Plant" at the EPA Symposium, Technologies Protecting Aquatic Organisms from Cooling Intake Structures. In 2005, I authored a study that compared the energy efficiency impact of using air cooling on a 500 MW supercritical coal-fired steam boiler, attached hereto as JTI000033.

Q9: What materials have you reviewed and actions have you taken in preparation for your testimony?

A9: I have reviewed Southern Nuclear Operating Company's ("SNC") application for an early site permit ("ESP") at the Vogtle Electric Generating Plant site (the "VEGP site"). I have reviewed excepts of the Final Environmental Impact Statement (NRC000001), SNC's feasibility study on the Air Cooling Condensation ("ACC") system, attached as JTI000034, and related documents submitted in this matter.

Q10: Have you given affidavits or declarations in support of or in connection with any of Joint Intervenors' contentions in this ESP proceeding?

A10: Yes, on November 12, 2007, I gave a declaration in support of Joint Intervenors' Response to SNC's Motion for Summary Disposition of EC 1.3, attached hereto as JTI000035.

Q11: What are the topics of your testimony?

A11: I will discuss the dry cooling alternative as a design alternative to the wet cooling tower system proposed in the ESP to a reasonable degree of scientific certainty.

Q12: Please summarize your conclusions regarding the dry cooling alternative as a design alternative to the wet cooling tower system proposed in the ESP.

A12: The dry cooling alternative is viable for proposed Units 3 and 4 because (1) the standard AP1000 design configuration accommodates both high and standard backpressure turbines, making dry cooling a reasonable alternative; (2) the current dry cooling system design is compatible with facilities like Plant Vogtle; (3) a dry cooling system is effective despite the impact of climate in the vicinity of the VEGP site; and (4) the potential financial, economic, and performance impacts upon facility design, construction, and operation do not favor a wet cooling rather than a dry cooling system.

The standard AP 1000 design configuration accommodates both high and standard backpressure turbines.

Q13: Please explain the Westinghouse AP1000 design regarding the cooling system.

A13: The standard design configuration of the Westinghouse AP1000 Nuclear Plant provides for steam to be passed across a steam turbine which turns a generator, creating electricity. The standard design accommodates any cooling system, wet or dry, as long as the cooling system maintains steam turbine backpressure within the design limitations of the steam turbine established by AP1000 design.

Q14: What is steam turbine backpressure?

A14: In a dry cooling system, backpressure is a function of the difference between the temperature of the outside air and temperature of the steam condensing inside the ACC units.

Q15: What is high backpressure?

A15: High backpressure means the steam turbine is capable of maintaining a rated steamflow with a backpressure of 8 HgA or greater.

Q16: What kind of backpressure can be used with the AP1000 design?

A16: High backpressure or standard backpressure can be used, and in fact, high backpressure turbines in combination with the ACC system may be even simpler and less expensive than standard turbines. It is not necessary to maintain the same backpressure with dry cooling at peak conditions that would be achieved with wet cooling.

Q17: What would be the annual average efficiency penalty of using dry cooling at Plant Vogtle?

A17: Using a 35° F ITD ACC, the estimated annual average efficiency penalty of using dry cooling at Plant Vogtle is approximately 1.5 percent.

Q18: Has a dry cooling system been used successfully at other steam-cycle power plants, including nuclear power plants?

A18: Yes, dry cooling is in common use at utility power plants in the United States. Midlothian Energy uses a dry cooling system at its 1,650 MW combined cycle plant located near Dallas, Texas. JTI000037. Air cooling has been used on a 330 MW coal-fired plant in Wyoming for over 30 years. Air cooling has been used on a 4,000 MW coal-fired power plant in South Africa for over 15 years. Dominion Resources is proposing a dry-cooling system for reactor 4 at their North Anna plant in Virginia. JTI000038.

<u>The current dry cooling system design is compatible with facilities like Plant Vogtle</u>.

Q19: Is the current dry cooling system design compatible with facilities like the proposed Vogtle plant?

A19: Yes, dry cooling would not require a substantial change to the AP1000.

Q20: What does the standard design accommodate?

A20: The standard design accommodates any cooling system, wet or dry, as long as the cooling system maintains steam turbine backpressure within the design limitations of the steam turbine established by Westinghouse Nuclear in its standard AP 1000 design.

Q21: Will there be space below the steam turbine to put in a dry cooling system?

A21: Yes, the surface condensers necessary with the wet cooling system in the proposed design are very large. No surface condensers are used within an ACC system. Removal of surface condensers will create adequate space for ACC steam ducts in the exact spot where these ducts need to be located below the steam turbine outlet.

Q22: How will these ACC steam ducts be installed?

A22: Openings will be designed into the turbine building wall to allow the steam ducts to be interconnected to the ACC. Accommodating 20-foot diameter openings in the wall of a large industrial building in no way rises to the level of reworking the entire turbine building. No other significant physical modifications will be required in or to the turbine building.

Q23: Does the modification to the plant interfere with the standard design?

A23: No, a standard design serves as a point of departure for customizing the design for a specific site with specific site constraints. The engineering teams at Westinghouse Nuclear and Toshiba who developed the standard AP1000 design have no knowledge of site constraints specific to Plant Vogtle or any other site-specific design issues. Moving boiler feedwater pumps to a slightly different location and providing openings in building walls to accommodate ACC steam ducts is a minor design engineering adjustment that does not present an engineering challenge.

Q24: Are you familiar with the EPA's regulations implementing Section 316(b) of the Clean Water Act?

A24: Yes, the Clean Water Act requires EPA to determine the Best Technology Available ("BTA") for eliminating impacts of cooling water intake structures, and then to set performance standards for facilities based on the BTA.

Q25: If dry cooling is a cost effective and practical alternative, why was it not designated as BTA by the EPA?

A25: The § 316(b) regulation does not require air cooling as BTA because in its rulemaking the EPA: (1) overstated power losses for coal plants; (2) asserted that all the power loss would have to be made up by new plants, accordingly exacerbating air pollution problems; and (3) the supposed high cost of air cooling. Each of these statements and assertions are incorrect. Moreover, the EPA's dry cooling analysis does not specifically discuss nuclear power plants, and is accordingly not entirely relevant to the ESP application. Perhaps most importantly, the fact that the EPA does not require air cooling as BTA does not mean that air cooling is not preferable in specific cases. For plants such as Vogtle, which are located in areas where the potential for drought could compromise the availability of water for cooling, a compelling argument can be made that reliance on water for cooling could compromise the reliability of the plant at times of greatest need (e.g. summertime high demand period). Finally, I note that the state of the art in cooling technology has changed since the EPA published its cooling water intake regulations in 2001.

<u>A dry cooling system is effective despite the impact of climate in the vicinity of the VEGP site.</u>

Q26: Can a dry cooling system be effective despite the impact of climate in the vicinity of VEGP?

A26: Yes, there are effective dry cooling systems in Texas, Wyoming, and South Africa. There are dozens of coal and natural gas-fired plants in the U.S. that use air-cooled condensers. The largest air-cooled plant in the U.S. is the 1,650 MW Midlothian Energy natural gas combined cycle plant near Dallas, Texas. The largest coal-fired air-cooled plant in the U.S. is the 330 MW

Wyodak plant in Wyoming. The largest air-cooled coal-fired plant in the world is the 4,000 MW Matimba power plant in South Africa. JTI000035 and JTI000037.

Q27: Please explain the temperature standards that you are using to reach the conclusion that dry cooling can be effective.

A27: During much of the year, the ambient temperature is less than 70° F and there would be relatively little differential in the MW output of wet or dry AP 1000 alternatives. Peak summertime design conditions generally occur less than 200 hours a year.

Q28: What would be the MW differential between a dry and a wet cooling system?

A28: The MW differential between a dry and a wet cooling system would only be between 15-20 MW at average conditions. A high backpressure turbine can be substituted for standard backpressure turbines in the AP1000 design to assure maximum output from a dry cooled plant at higher ambient temperatures.

Q29: Are temperature fluctuations a problem?

A29: No, temperature fluctuations neither create instability nor potentially harm the power plant grid as a whole. An ambient air environment absent temperature fluctuation does not exist. Considerations of swings in ambient temperature are incorporated in every plant design.

The potential financial, economic, and performance impacts upon facility design, construction, and operation do not favor a wet cooling over a dry cooling system.

Q30: What are the benefits of an ACC system over the standard AP1000 design?

A30: An ACC design system would be simpler than the standard AP100 design. It is generally considered desirable in the power plant design engineering world to simplify complex systems whenever possible. Simplification generally makes the system more reliable.

Q31: How does the backpressure turbine impact financing projections for Plant Vogtle?

A31: High backpressure turbines, rated to 8 inches of mercury (Hg) backpressure or greater, are normally specified with air-cooled installations. High backpressure turbines are simpler and less expensive than standard backpressure turbines. Accordingly, and based upon a telephone communication with Charles Jones and General Electric on July 26, 2002, I believe that SNC might save money on the steam turbine portion of the AP1000 design if an air-cooled system is selected.

Q32: Is the current evaluation of the ACC design set forth in JTI000034 accurate?

A32: No, SNC performed a flawed evaluation resulting in an ACC design oversized by at least 100 cooling modules. SNC selected a 20° F ITD ACC for the case study because it presumed that it is necessary to maintain the same backpressure with dry cooling at peak hot summer day site conditions as would be achieved with wet cooling.

Q33: How does this presumption affect the plant design?

A33: This presumption will always result in a spectacularly oversized ACC design. It makes no sense to build a 334 module ACC that costs $361 million and has a 44 MW parasitic fan load when a 230 module ACC with 30 MW parasitic fan load would result in the same annual energy penalty for the dry cooling option. ACC design is a balance between cost, size, and performance.

Q34: Would there be a difference between the output of a wet plant versus a dry plant?

A34: No, during most of the year, whenever ambient temperature is less than approximately 70° F, there would be relatively little differential in the MW output of wet or dry AP 1000 alternatives.

In accordance with 28 U.S.C. § 1746, I state under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed on January 9, 2009.

Executed in Accord with 10 C.F.R. 2.304(d)
William Powers
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CHAIRMAN BOLLWERK: Let's try one more time with the rebuttal.

MS. GOLDSTEIN: All right. So I am going to ask you to affirm the following statement.

MR. POWERS: Okay.

MS. GOLDSTEIN: The testimony entitled "Revised Prefiled Rebuttal Testimony of William Powers Concerning Contention EC 1.3" and dated February 6, 2009, which has been provided to the Court Reporter in electronic format under the file name "Powers 1.3 Rebuttal Testimony" was prepared under my supervision and direction and is true and correct, to the best of your knowledge?

CHAIRMAN BOLLWERK: Okay. One second. Hold on. Let's go back and let's look at the changes real quick and make sure before he says yes so we've got them in there. Okay.

We were going down to page 5, question 6 and answer 6. I think that was right. And we took out the sentence. It was the sixth sentence. Now it's not there. Is that correct, sir?

MR. POWERS: Correct.

CHAIRMAN BOLLWERK: It's been deleted. Okay. And then if we would go to page 7, please? And it was question 8, the word "not" has been removed from the second sentence. And that's correct, sir?

MR. POWERS: That is correct.

CHAIRMAN BOLLWERK: All right. So you're now affirming that this is your testimony?

MR. POWERS: Yes, this is my testimony.

CHAIRMAN BOLLWERK: All right.

MS. GOLDSTEIN: All right. Move to admit this testimony into evidence as if read.

CHAIRMAN BOLLWERK: All right. Any objections?

(No response.)

MR. LeJEUNE: Your Honor, we would like to renew our objection.

CHAIRMAN BOLLWERK: And noted for the record. Thank you.

MR. LeJEUNE: Thank you.

CHAIRMAN BOLLWERK: All right. Then at this point the rebuttal testimony of William Powers on contention EC 1.3 is admitted and will be entered into the record as if read as DDMS item ID number 60069.

(Powers Rebuttal Testimony (EC 1.3) (DDMS-60069) to be inserted at this point)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD PANEL

Before the Licensing Board:

G. Paul Bollwerk, III, Chairman
Nicholas G. Trikouros
Dr. James Jackson

In the Matter of	Docket No. 52-011-ESP
SOUTHERN NUCLEAR OPERATING CO.	ASLBP No. 07-850-01-ESP-BD01
(Early Site Permit for Vogtle ESP Site)	Originally Filed: February 6, 2009 Re-Filed: March 2, 2009

REVISED PREFILED REBUTTAL TESTIMONY OF WILLIAM POWERS CONCERNING CONTENTION EC 1.3

Q1: What materials have you reviewed and what actions have you taken in preparation for your prefiled rebuttal testimony?

A1: I have reviewed Southern Nuclear Operating Company's ("SNC") application for an early site permit ("ESP") at the Vogtle Electric Generating Plant site (the "VEGP site"). I have reviewed excerpts of the Final Environmental Impact Statement (NRC000001), SNC's feasibility study on the Air Cooling Condensation ("ACC") system, attached as JTI000034, and related documents submitted in this matter. I have also reviewed the prefiled direct testimony of SNC expert James W. Cuchens and Staff experts Lance Vail, Michael T. Masnik, and Jill S. Caverly, as they pertain to the dry cooling alternative.

Q2: Mr. Vail and Ms. Caverly, in answer 8 of their prefiled testimony, stated that "[t]he effect of the humidity ... makes it easier for wet cooling systems to obtain a lower temperature of cooling water being returned to the condenser in most conditions." Mr. Vail and Ms. Caverly further stated in answer number 9 of their prefiled testimony, that as a result of this lower cooling temperature, the wet cooling system will "operate at a higher electrical generation efficiency." Based on your knowledge and experience of power generation, and cooling technology issues and implementation, is this an accurate statement? What would the actual MW differential be between a wet cooling system and a dry cooling system? (Exhibit JTIR00049)

A2: There is a small difference in the output of closed-cycle wet cooled plants and dry cooled. This difference is most significant at high ambient air temperatures. As noted in my earlier testimony, using the example of a 500 MW coal-fired power plant, the average annual efficiency penalty would be 1.5%. Using a nuclear plant example, Dominion Nuclear has proposed to build the 1,560 MW (net) North Anna 3 reactor using a combination of wet and dry cooling. The Final Environmental Impact Statement for the North Anna 3 and 4 ESP states that "*Under favorable meteorological conditions, the entire excess heat load from Unit 3 would be dissipated using closed-cycle dry cooling towers.*" (Exhibit JTIR00050). The document goes on to state that *"Dominion's combination wet and dry cooling system would have an energy efficiency penalty of 1.7 to 4 percent."* (Exhibit JTIR00050). The maximum efficiency penalty identified for North Anna 3, presumably when operating with 100% dry cooling, is 4 percent. This is analogous to an automobile that achieves 25 mpg with a water-cooled engine achieving 24 mpg with an air-cooled engine. This is a relatively small change in overall plant efficiency.

Q3: Mr. Powers, in answer number 26 of Mr. Cuchens' testimony, he stated your evaluation of the thermal cycle efficiency "lacks merit." He further stated that "I do not say that the loss of efficiency at the AP1000 Nuclear Plants in Augusta, Georgia would amount to only 0.5 percent." Can you please explain how you derived a 1.5% efficiency penalty for the thermal cycle efficiency at Plant Vogtle?

A3: The standard in the industry when discussing the impacts on plant efficiency of different types of cooling systems is to the impact on heat rate. For example, if the annual average energy efficiency penalty of dry cooling is 1.5 percent on a plant with a wet tower design heat rate of 10,000 Btu/kW, the design heat rate with dry cooling would be 10,150 Btu/kW. However, a plant with a design heat of 10,000 Btu/kW only has a thermal efficiency of 34 percent (3,416 Btu/kWh/10,000 Btu/kWh). A 1.5% reduction in heat rate translates into a 0.5 percent reduction in the overall thermal efficiency of the plant [((34% x (1-0.015)) = 33.5%]. As Mr. Cuchens pointed-out, this is nothing more than semantics.

Q4: Mr. Powers, Mr. Vail, Ms. Caverly and Mr. Masnik, argued in answer number 11 of their prefiled testimony, that there are disadvantages of the dry cooling system, associated with "land use, fuel use, spent fuel transport, and spent fuel storage." The Staff argues that the cost of the implementation of the dry cooling system is prohibitive. Is dry cooling a cost effective and practical alternative to the proposed wet cooling system? (see A25, 31, 35 Powers Decl.)

A4: Yes, a dry cooling system is a cost effective and practical alternative to the proposed wet cooling system. The Staff has not performed a full evaluation of the cost and technical feasibility of implementation, as noted in answers 14 and 25 of their prefiled direct testimony. Overall, dry cooling is a practical alternative to the proposed wet cooling system, especially in light of the drought conditions in South Georgia. The potential for drought will likely compromise the availability of water necessary for a wet cooling system, especially during the summertime high demand period. This factor alone compromises the reliability of the wet cooling system, making dry cooling a more preferable system. Dominion Nuclear states that a particular advantage for a dry-cooled nuclear plant is its ability to continue to operate during periods of drought. Dominion states "*Resulting Performance – When you really need it, the system can perform – long droughts.*" (Exhibit JTIR00049)

Furthermore, simpler systems tend to be more reliable systems. In this case, an air-cooled condenser (ACC) design is simpler than the standard AP1000 design based on steam turbine surface condensers and wet cooling towers. An ACC design would incorporate high backpressure steam turbines. High backpressure turbines are simpler and less expensive than the proposed, standard backpressure turbines.

Q5: Mr. Powers, Mr. Vail, Ms. Caverly and Mr. Masnik, in answer number 11 of their prefiled testimony, stated "dry cooling systems involve very large heat-exchange surface areas that would require more land area than an equivalent capacity natural-draft or mechanical-draft cooling system." Is a natural/mechanical-draft system comparable to that of a wet cooling system in the land area it will require?

A5: A dry cooling system would require more surface area than a system based on wet cooling towers. For equivalent cooling capacity, the dry cooling system would require about three times as much surface area. (Exhibit JTIR00049). However, arguments against dry cooling at the Vogtle site are based on the presumption advanced by Mr. Cuchens that the dry cooling system would be spectacularly oversized at 324 cells. In reality, the best balance between cost and performance, an ACC with an ITD of 35 oF, would consist of approximately 200 cells and require only about 60 percent of the land area necessary for the 324-cell unit.

Q6: Mr. Powers, Mr. Cuchens claims in answer 13 of his prefiled direct testimony that a dry cooling system would be impractical and uneconomical when utilized with the AP1000's current standard plant design. Specifically he stated, "while I would not say that a high backpressure turbine and/or an air-cooled system could never theoretically be used with any kind of AP1000 plant design, I would say that it cannot be used with the current AP1000 standard plant design, as proposed ..." Based on your expertise and familiarity with the AP1000 standard design, does Mr. Cuchens' proposal outline the only possible design that could incorporate a dry cooling system? Is it indeed possible to substitute a high backpressure turbine in the standard AP1000 design? (see A28, A31, Powers, Decl. ¶13, Testimony A23)

A6: Mr. Cuchens' standard design with standard backpressure turbines, as proposed, is definitely feasible. However, he offers a flawed analysis of the feasibility of high backpressure turbines. Cuchens stated in answer 13, "I am not aware of any turbine manufacturer that offers a triple-exhaust turbine capable of handling the steam flows that would be associated with the current AP1000 steam cycle if the reactor used dry cooling", is in error. The GE-ESBWR reactor is larger than the AP1000, 1,560 MW net versus 1,117 MW net, and GE can provide a 100% air-cooled version of the GE-ESBWR nuclear plant. The GE_ESBWR steam turbine is a triple-exhaust turbine, just like the AP1000 steam turbine (Exhibit JTI000051). The GE-ESBWR reactor has been proposed by Dominion Nuclear for the North Anna 3 plant in Virginia. A condition of the NRC Early Site Permit for North Anna 3 and 4 is that North Anna 4, if built, will be 100% dry cooled at all times (Exhibit JTI000052). It is not credible that GE can design and build much larger nuclear plants using 100% dry cooling and Westinghouse can not apply air cooling on the AP1000.

Furthermore, high backpressure turbines are simpler in design, and in this case, simple means less expensive. Based on a conversation I had with Charles Jones of General Electric on July 26, 2002 regarding the adaptation of a standard backpressure turbine to a high backpressure turbine, it seems that the SNC will be able to save money on the steam turbine portion of their design if they implemented the triple-exhaust, high backpressure turbines. Finally, a high backpressure turbine can be easily substituted in the design of the AP1000, as it is shorter than the standard backpressure turbine and therefore requires less space, without constraining other engineering or financial feasibility aspects of the plant.

Q7: Mr. Powers, Mr. Cuchens stated in answer 13 of his prefiled testimony that in determining the feasibility of high back-pressure turbines, "Mr. Powers appear[s] to extrapolate from experience significantly smaller generating units." How do you respond?

A7: The fact that the 1,560 MW North Anna 3 steam turbine will be capable of operating on 100 percent air cooling negates Mr. Cuchens implication that there is a bright-line steam turbine size above which air cooling is impractical. Mr. Cuchens implies this bright-line is a steam turbine bigger than the 660 MW steam turbines at the air-cooled Matimba plant in South Africa, which have been operating on 100 percent air cooling for many years, but less than the 1,117 MW AP1000 steam turbine at Vogtle. This is wrong, as demonstrated by the NRC's Early Site Permit (ESP) for North Anna 3 and 4. Dominion Nuclear proposed to build North Anna 4 as a dry-cooled only plant. That is a condition of the NRC's ESP for North Anna 3 and 4 (Exhibit JTI000052).

Q8: Mr. Powers, in answer number 14 of Mr. Cuchens' prefiled testimony stated that you do not provide any examples of a nuclear power plant that utilizes a dry-cooling system. However, you did provide several examples of natural-gas and coal-fired power plants that have successfully implemented dry-cooling systems. Can you please explain why, though the examples you provided were not of nuclear power plants, the comparison is still relevant?

A8: Nuclear plants, coal plants, and natural gas combined cycle plants generate heat in different ways to boil water and create steam. Yet all three types of plants direct this steam to a steam turbine connected to an electric generator to generate power. The dry cooling system would serve the steam turbine, the common element to each plant type. As is clear in the case of North Anna 3 and North Anna 4, there are no scale-up issues related to the use of dry cooling on the AP1000 steam turbine.

In accordance with 28 U.S.C. § 1746, I state under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed on February 6, 2009.

Executed in Accord with 10 C.F.R. 2.304(d)
William Powers
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MS. GOLDSTEIN: All right. If you could please pull up the testimony of Barry Sulkin concerning environmental contention 1.3?

CHAIRMAN BOLLWERK: We'll have you out of here by 4:00, Mr. Sulkin.

MS. GOLDSTEIN: Do you recognize this document as your prefiled direct testimony for environmental contention 1.3?

MR. SULKIN: Yes.

MS. GOLDSTEIN: All right. I ask you to affirm the following: The testimony entitled "Revised Prefiled Direct Testimony of Barry W. Sulkin in Support of EC 1.3" and dated January 9, 2009, which has been provided to the Court Reporter in electronic format under the file name "Sulkin 1.3 Direct Testimony" was prepared under your supervision and direction and is true and correct, to the best of your knowledge?

MR. SULKIN: Yes.

MS. GOLDSTEIN: Move to admit this into evidence as if read.

CHAIRMAN BOLLWERK: All right. Any objections?

(No response.)

CHAIRMAN BOLLWERK: There being none, then the direct testimony of Barry W. Sulkin regarding contention EC 1.3 is admitted and should be entered into the record at this point as if read as DDMS item ID 59075.

(Sulkin Direct Testimony (EC 1.3) (DDMS-59075) to be inserted at this point)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD PANEL

Before the Licensing Board:

G. Paul Bollwerk, III, Chairman
Nicholas G. Trikouros
Dr. James Jackson

In the Matter of	Docket No. 52-011-ESP
SOUTHERN NUCLEAR OPERATING CO.	ASLBP No. 07-850-01-ESP-BD01
(Early Site Permit for Vogtle ESP Site)	Originally Filed: January 9, 2009 Refiled: February 2, 2009

REVISED PREFILED DIRECT TESTIMONY OF BARRY W. SULKIN IN SUPPORT OF EC 1.3

Q1: Please state your name and address.

A1: My name is Barry W. Sulkin, and my address is 4443 Pecan Valley Road, Nashville, Tennessee 37218.

Q2: What is your current profession?

A2: I am an environmental consultant.

Q3: What is your educational background?

A3: I received a Bachelor of Arts in Environmental Science in 1975 from the University of Virginia, where I was awarded a Du Pont Scholarship. I received my Masters of Science in Environmental Engineering in 1987 from Vanderbilt University, where I also attended on a full scholarship. My areas of study at Vanderbilt included chemistry, biology, limnology, and hydrology of streams and lakes.

Q4: What is your professional background?

A4: In 1976, I joined the Staff of what is now called the Tennessee Department of Environment and Conservation as a Water Quality Specialist, and continued to work for this agency for almost 14 years. I worked in the Chattanooga, Knoxville, and Nashville field offices and the central office of what is now called the Division of Water Pollution Control. I received on the job training in addition to formal education, in areas such as stream assessment. My duties included inspections and enforcement coordination for the water pollution programs, as well as work with the drinking water, dam safety, underground storage tank, and solid/hazardous waste programs. I also conducted investigations regarding fish kills, spills, and general complaints, including problems involving stream alterations and relocations. I was also involved in developing, implementing, and enforcing the state's Aquatic Resource Alteration Permit program, as well as activities related to the Corps of Engineers 404 permit program and the state's 401 certification component.

In 1985, I became state-wide manager of the Enforcement and Compliance Section for the Division of Water Pollution Control. In this capacity, I was responsible for investigating and preparing enforcement cases, supervising the inspection programs and permit compliance monitoring, and conducting special projects and field studies including water quality and assimilative capacity and permit modeling. While in this position I took an educational leave to obtain my Masters of Science in Environmental Engineering in 1987 from Vanderbilt University.

I returned to my position as manager of the Enforcement and Compliance Section in 1987, where I remained until mid 1990.

Since 1990, I have engaged in a private consulting practice specializing in water quality problems and solutions, regulatory assistance, National Pollutant Discharge Elimination System permits, stream surveys, and various environmental investigations primarily related to water. I have worked for many clients in my private practice over the past 18 years where I have been required to interact with state and federal environmental agencies.

Q5: Do you have a written summary of your education, employment, experience and background, and papers and presentations you have made over your career?

A5: My professional and educational experience is summarized in the curriculum vitae attached to this prefiled direct testimony as JTI000043.

Q6: What materials have you reviewed and actions have you taken in preparation for your testimony?

A6: I have reviewed excerpts of the Final Environmental Impact Statement (the "FEIS") (filed as NRC000001), the permit application and related documents submitted in this matter.

Q7: Have you given affidavits or declarations in support of or in connection with any of Joint Intervenors' contentions in this ESP proceeding?

A7: Yes, on November 12, 2007, I gave a declaration in support of Joint Intervenors' Response to SNC's Motion for Summary Disposition of EC 1.2, attached hereto as JTI000031.

Q8: What topics will be addressed in your testimony?

A8: I am testifying in support of Environmental Contention 1.3, which concerns whether dry cooling is a reasonable alternative to the proposed wet cooling system given its potential impacts on aquatic species.

Q9: Please summarize your conclusion.

A9: As I explain in my testimony in support of Environmental Contention 1.2, the FEIS's analysis of potential impacts is flawed and does not support a finding that impacts will be small. The discussion of alternative cooling systems is premised on the idea that alternative cooling systems need not be considered in detail because the FEIS had previously concluded that the impacts of the proposed cooling system would be small. Because there is no legitimate basis to find the impacts on aquatic species would be small, it is also illegitimate to eliminate dry cooling from further consideration.

In accordance with 28 U.S.C. § 1746, I state under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed on January 9, 2009.

Executed in Accord with 10 C.F.R. 2.304(d)
Barry Wayne Sulkin
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MS. GOLDSTEIN: We ask that you pull up the prefiled rebuttal testimony of Shawn Young regarding environmental contention 1.3. Dr. Young, do you recognize this document as your prefiled rebuttal testimony for environmental contention 1.3?

DR. YOUNG: Yes.

MS. GOLDSTEIN: I ask that you affirm the following: The testimony entitled "Prefiled Rebuttal Testimony of Dr. Shawn P. Young Concerning Contention EC 1.3" and dated February 6, 2009, which has been provided to the Court Reporter in electronic format under the file name "Young 1.3 Rebuttal Testimony" was prepared under your supervision and direction and is true and correct, to the best of your knowledge?

DR. YOUNG: Yes.

MS. GOLDSTEIN: We would like to move to admit this testimony into evidence as if read.

CHAIRMAN BOLLWERK: All right. Any objections?

(No response.)

CHAIRMAN BOLLWERK: Hearing none, then the rebuttal testimony of Dr. Shawn P. Young regarding contention EC 1.3 is admitted and will be bound into the record at this point as if read as DDMS item ID 59378.

(Young Rebuttal Testimony (EC 1.3) (DDMS-59378) to be inserted at this point)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD PANEL

Before the Licensing Board:

G. Paul Bollwerk, III, Chairman
Nicholas G. Trikouros
Dr. James Jackson

In the Matter of	Docket No. 52-011-ESP
SOUTHERN NUCLEAR OPERATING CO.	ASLBP No. 07-850-01-ESP-BD01
(Early Site Permit for Vogtle ESP Site)	February 6, 2009

PRE-FILED REBUTTAL TESTIMONY OF SHAWN P. YOUNG CONCERNING CONTENTION EC 1.3

Q1: In answer 15 of the Staff's prefiled direct testimony, Mr. Vail discusses how the Staff reached its conclusion that it did not need to consider the dry cooling alternative in more detail. How do you respond to the Staff's explanation?

A1: In answer 15 of his Pre-Filed Rebuttal, Mr. Vail utilizes the FEIS conclusion that impacts would be SMALL, in conjunction with the assessment that there would be some adverse impacts associated with the dry cooling alternative, as the basis for determining that there are no preferable heat dissipation systems. Mr. Vail's conclusion concerning the heat dissipation system is flawed because he equates SMALL as the phrase is used in the FEIS with "no adverse impacts" as that phrase is used in § 9.4.1 of the ESRP. Specifically, § 9.4.1 states that "[w]hen no adverse impacts have been predicted for the proposed system[,] . . . the reviewer should conclude that there are no environmentally preferable heat dissipation-system alternatives." On the other hand, SMALL is defined on page 1-4 of the FEIS as "environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attributes of the resource." Accordingly, it is possible that under a SMALL impacts situation, adverse impacts on aquatic species may still exist. In other words, SMALL incorporates numerous actions having some impacts and could potentially encompass a certain degree of adverse impacts as that phrase is used in § 9.4.1.

Q2: In answer 6 of his prefiled direct testimony, Dr. Coutant explains, "In my opinion, extremely sensitive biological resources means more than that endangered species such as the shortnose sturgeon or non-listed but sensitive species such as the robust redhorse are present in the Savannah River watershed (which they are) but that they are sensitive to alterations of the environment in the vicinity of the proposed cooling system. That is, the new cooling system would have to pose significant risks to these species. Is this the correct standard for assessing impacts?

A2: No, the SNC is utilizing an inappropriately high standard for assessing impacts to aquatic species. Instead of analyzing impacts using the FEIS term SMALL, defined on page 1-4 of the FEIS as "environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attributes of the resource" or a similar counterpart, SNC created a higher threshold for determining that extremely sensitive biological resources exist by introducing this "significant risks" threshold. SNC erroneously shifted the impacts standard, and in doing so, its conclusions are not necessarily consistent with the definition of SMALL impacts, as defined in the FEIS.

Q3: In answer 22 of the Staff's prefiled direct testimony, Dr. Masnik explains the process by which the Staff concluded that the impacts of the Vogtle 3 and 4 units would be

SMALL: "The Staff ...assessed the potential impacts that the design, location and operating parameters of the structures, systems and components of the VEGP Units 3 and 4 cooling water system would have on the populations of the important fish and shellfish. If the distribution, abundance, relevant life history, or past data collected in the Savannah River did not identify a causal link to a particular impact category (impingement, entrainment, or thermal effects) that could result in a population level impact to that species, then a SMALL impact was predicted." Does Dr. Masnik's SMALL impacts prediction necessarily follow from the Staff's findings regarding causal links?

A3: No, Dr. Masnik's prediction that impacts will be SMALL is not supported by the causal links identified by the Staff. The Staff considered whether a causal link could be identified between the design, location, and operation of Units 3 and 4 and individual impact category (impingement, entrainment, or thermal effects) that could result in a population level impact to a particular species, and ultimately concluded that no individual causal links could be identified. The flaw in Dr. Masnik's SMALL impacts prediction is that he overlooks the possibility that even though no population level impact may exist between operation of Units 3 and 4 and individual impact categories, when one combines the impacts of impingement, entrainment, and thermal effects cumulatively, the impacts exceed the SMALL threshold.

Q4: In answers 9-11 of Dr. Coutant's prefiled direct testimony, he summarizes his findings regarding the potential impacts of the proposed Vogtle 3 and 4 units on the shortnose sturgeon and robust redhorse. How do you respond to Dr. Coutant's findings?

A4: Dr. Coutant begins his analysis of the impacts on the shortnose sturgeon by explaining that Units 1 and 2 are not located in any critical zones of passage for that species, which means pre-spawning adult sturgeon can move upstream, spawned adults can move downstream, and juveniles can move downstream, all while in the presence of Units 1 and 2. He then concludes that since the Vogtle 1 and 2 units do not compromise any critical zones of passage for the shortnose sturgeon, similarly Vogtle units 3 and 4 will not compromise the movement of the shortnose sturgeon to and from the spawning site upstream of the Vogtle plant. However, Dr. Coutant's analysis fails to take into consideration the potential cumulative impacts that could occur as a result of the four Vogtle Units working in tandem. By definition in 40 CFR § 1508.7, "cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." Accordingly, just because an effective zone of passage may exist in the presence of Units 1 and 2, and Units 3 and 4, alone, is meaningless. These impacts must be considered in concert with each other.

Additionally, Dr. Coutant's testimony regarding the impacts on the robust redhorse is incomplete, because Dr. Coutant fails to discuss whether the robust redhorse will still have an effective zone of passage through the portion of the Savannah River following the addition of the Vogtle Units 3 and 4. In answer 12 of his prefiled direct testimony, Dr. Coutant concludes that the robust redhorse will not be affected by the Vogtle 3 and 4 units, specifically because there is no critical habitat for the robust redhorse near the Vogtle site. However, as I discuss in my testimony and rebuttal, robust redhorse utilize the Savannah River in the vicinity of VEGP and down river to approximately river mile 70 as summer, fall, and winter habitat, which necessitates spring migration upriver past VEGP to spawning areas. Therefore, Dr. Coutant should have discussed whether the robust redhorse would also have an effective zone of passage through the water affected by the Vogtle 3 and 4 units.

Q5: In answers 18-20 of his prefiled direct testimony, Dr. Coutant explains the contents of the National Marine Fisheries Service ("NMFS") Letter: "As the letter states,

the NMFS found the impacts insignificant and the Vogtle reach of the river to not contain essential fish habitat. The letter is the formal document providing the legal concurrence by NMFS." What do you think about the NMFS letter?

A5: Dr. Coutant contends that this letter provides additional support for the Staff's finding that the shortnose sturgeon will not likely be affected by the addition of the Vogtle Units 3 and 4. However, this letter is potentially unreliable, because it does not analyze year-round impacts. Additionally, the letter contains a number of overly broad generalizations as illustrated in SNC 1.3 Position Statement at 20. Specifically, in the Position Statement, SNC supports this conclusion by citing the Letter's finding that shortnose sturgeon "generally do not inhabit this section of the Savannah River at this time of year" and that "sturgeon are generally found upstream from the site during the proposed construction months." Therefore, the NMFS letter at most, tenuously supports the Staff's conclusion that the Vogtle 3 and 4 units will not adversely impact the shortnose sturgeon population. Further, I have personally witnessed sturgeon species breaching the river surface from below New Savannah Bluff Lock and Dam down to the vicinity of VEGP and SRS throughout the year in contrary to information fisheries agency biologists have relayed to me in personal communications.

Q6: In answer 7 of his prefiled direct testimony, Dr. Coutant states that there are no "extremely sensitive biological resources" necessary for the maintenance of the shortnose sturgeon or robust redhorse in the Savannah River near the Vogtle site. Do you agree with his findings?

A6: I do not agree with Dr. Coutant's conclusion that there are no "extremely sensitive resources" in the vicinity of the Vogtle site as that phrase is used in answer 7. Dr. Coutant is misinterpreting the EPA's definition of "extremely sensitive resources." In answer 6 of his prefiled direct testimony, Dr. Coutant explains that "the new cooling system would have to pose significant risks to these species" in order to support a finding that there are extremely sensitive resources present. However, the term extremely sensitive resources as used by the EPA, does not require that the federally protected species be subjected to "significant risks" by the proposed cooling system. In contrast, federally and state protected species are inherently extremely sensitive resources, which is why they are formally protected. Additionally, it is undisputed by several studies that robust redhorse and shortnose sturgeon inhabit the Savannah River in the vicinity of plant Vogtle. In fact, SNC's expert Dr. Coutant, in answer 9 of his prefiled direct testimony, references a prior study where 13 larval shortnose sturgeon were collected at the Vogtle site. Because shortnose sturgeon and the robust redhorse are present in the stretch of the Savannah River near the Vogtle site and are either federally or state protected, they are extremely sensitive biological resources as that phrase is used by the EPA.

Q7: Dr. Young, do SNC's expert witnesses conduct a complete inquiry regarding the impacts on fish species within the vicinity of the Vogtle site?

A7: No, the SNC unnecessarily restricts the inquiry to the impacts on the shortnose sturgeon and the robust redhorse. The EPA rulemaking provision referring to "extremely sensitive resources (e.g. endangered species, specially protected areas)" represents a non-exhaustive list. For example, the Atlantic sturgeon is a federal candidate species and SNC should have considered the impacts on this species. In fact, Staff expert Krieg at Answer 20 states that the "Atlantic sturgeon should have been included in the FEIS under the definition of "important species" as provided in ESRP 2.4.2." Instead, SNC completely omits an analysis of how the proposed Vogtle site could affect this important species by applying its narrow definition of extremely sensitive biological resources. The Staff did address the Atlantic sturgeon, but as evidenced by Answer 8 below, this analysis was inadequate, thus SNC failed to supplement the record regarding the Atlantic sturgeon.

Q8: In answer 20-21 of the Staff's pre-filed direct testimony, Staff experts the potential impacts of Vogtle Units 3 and 4 on the Atlantic sturgeon, shortnose sturgeon and robust redhorse.. Do you agree with the Staff's analysis?

A8: No, the Staff fails to analyze important periods of each species' development. With regard to the Atlantic Sturgeon (discussed in answer 20 of the Staff's testimony), the Staff fails to address the period of time between when the larvae's yolk sac is fully absorbed and when the fish reaches the juvenile stage. This omission is significant because during the period of time between the embryo stage (age 1-8 days old) and the young juvenile stage (greater than 40 days old), the adhesive eggs are no longer adhered to the bottom, yet have not developed the strength to avoid dangers such as entrainment and the thermal heat plume of Units 3 and 4. Thus, during this approximately 30 day period, the Atlantic sturgeon would face an elevated risk of adverse impacts due to their dependence on the current flow of the Savannah River.

With regard to the robust redhorse (discussed in answer 21 of the Staff's testimony), the Staff fails to address the period of time between when the larvae's yolk has been fully absorbed and adulthood. This omission is significant because the Staff fails to address the potential exposure of the robust redhorse during the larval, juvenile, and young adult stages in which the species would be especially vulnerable to impingement and the thermal plume of Units 3 and 4. Although the adult robust redhorse may be a relatively strong swimmer as the Staff asserts, the Staff fails to analyze these two important developmental periods in which the robust redhorse is not yet a strong swimmer and would face an elevated risk of exposure to impingement and the thermal plume.

Additionally, with regard to the impacts on the shortnose sturgeon (discussed in answer 21 of the Staff's testimony), the Staff fails to address the period of time when the larvae's yolk sac is fully absorbed and when the fish reaches the juvenile stage. This omission is significant because during the period of time between the embryo stage (age 1-8 days old) and the young juvenile state (greater than 40 days old), the adhesive eggs are no longer adhered to the bottom, yet the fish would not have developed the strength to avoid dangers such as entrainment and the thermal heat plume of Units 3 and 4. Thus, during this approximately 30 day period, the shortnose sturgeon would face an elevated risk of adverse impacts due to their dependence on the current flow of the Savannah River.

Q9: In answer 7 of Dr. Coutant's prefiled direct testimony, in reference to the robust redhorse, he states that "this species also has been found to spawn in limited gravel habitats near Augusta and is merely presumed to be distributed elsewhere in the Savannah River (none have been collected near Vogtle)." Is this statement made by Dr. Coutant factually correct?

A9: No. This statement is wrong. Robust redhorse are known to utilize the Savannah River in the vicinity of VEGP and down river to approximately river mile 70 as summer, fall, and winter habitat. The individuals residing in this area undertake spring migrations up-river past VEGP to spawning areas near river mile 185, just below New Savannah Bluff Lock and Dam, and the Augusta Shoals if they are able to pass the lock-and-dam. These facts were the results of an extensive telemetry study of which I participated. Exhibit NRC 000017.

Also, as I explained in answer 15 of my prefiled direct testimony, members of the drift community will be affected by the proposed Vogtle 3 and 4 units, and the larval fish of the robust redhorse are part of the drift community. Since the drift community constantly changes location within the Savannah River, it is appropriate to conclude that the larval fish of the robust redhorse will also redistribute itself within the Savannah River. It is therefore likely that young robust redhorse will redistribute closer to the proposed Vogtle site. Since the drift community is susceptible to human-induced environmental changes, it is likely that the larval fish of the robust redhorse will be adversely impacted by the proposed cooling system at the Vogtle 3 and 4 units.

Q10: In answer 16 of Dr. Coutant's prefiled direct testimony, he states that "NRC Staff determined that design and operation of the proposed cooling water intake system are not likely to adversely impact shortnose sturgeon because the area affected by thermal discharge is small in comparison to the width of the Savannah River at the Vogtle site." How do you respond?

A10: Even though the thermal discharge will not affect the entire width of the Savannah River at the Vogtle site, it is likely that the shortnose sturgeon, particularly the larval and early juvenile fish, will be adversely impacted by the proposed wet cooling system. Since the larval and early juvenile fish cannot swim as quickly as their adult counterparts, they will likely have a difficult time avoiding the thermal plume. Also, thermal resistance changes with maturation. Rapid temperature change affects early life stages much more than adults.

Q11: Will fish eggs and larval fish likely be affected by the thermal discharge as they travel downstream after the spawning season?

A11: Yes. These youngest life history stages are the most vulnerable to rapid temperature change. Thermal resistance changes with maturation, and also varies from species to species. At no point other than Dr. Coutant's testimony does anyone discuss the potential exposure time of ichthyoplankton in the thermal plume. Dr. Coutant does not cite the origin of the data he uses in his calculation.

In accordance with 28 U.S.C. § 1746, I state under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed on February 6, 2009.

<u>Executed in Accord with 10 C.F.R. 2.304(d)</u>

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CHAIRMAN BOLLWERK: I think I count 11 exhibits. I don't know if that's --

MS. GOLDSTEIN: Yes, that's right.

CHAIRMAN BOLLWERK: All right. Let's do those quickly. And then we can move on. We first have some questions for Mr. Sulkin, I believe.

MS. GOLDSTEIN: I'll read them all first.

CHAIRMAN BOLLWERK: All right.

MS. GOLDSTEIN: JTI000032 entitled "Excerpts From NUREG-099, Regulatory Guide 4.2, Revision 2, Preparation of Environmental Reports for Nuclear Power Plants."

CHAIRMAN BOLLWERK: All right. The record should reflect that exhibit JTI000032 is identified for the record.

(Whereupon, the aforementioned document was marked for identification as Exhibit Number JTI000032-00-BD01.)

MS. GOLDSTEIN: JTI000033 entitled "Peak and Annual Average Energy Efficiency Penalty of Optimized Air-Cooled Condenser on 515-Megawatt Fossil Fuel-Fired Utility."

CHAIRMAN BOLLWERK: The record should reflect that exhibit JTI000033 has been identified for the record.

(Whereupon, the aforementioned document was marked for identification as Exhibit Number JTI000033-00-BD01.)

MS. GOLDSTEIN: JTI000034 entitled "Feasibility of Air-Cooled Condenser Cooling System for the Standardized AP1000 Nuclear Plant."

CHAIRMAN BOLLWERK: The record should reflect that exhibit JTI000034 has been identified for the record.

(Whereupon, the aforementioned document was marked for identification as Exhibit Number JTI000034-00-BD01.)

MS. GOLDSTEIN: JTIR00035 entitled "Declaration of Powers in Support of Joint Intervenors' Motion for Summary Disposition of EC 1.3."

CHAIRMAN BOLLWERK: The record should reflect that exhibit JTIR00035 has been identified for the record.

(Whereupon, the aforementioned document was marked for identification as Exhibit Number JTIR00035-00-BD01.)

MS. GOLDSTEIN: JTI000037 entitled "Photograph of Dry Cooled 1,650-Megawatt Midlothian Energy and 4,000-Megawatt Matimba."

CHAIRMAN BOLLWERK: The record should reflect that exhibit JTI000037 has been identified for the record.

(Whereupon, the aforementioned document was marked for identification as Exhibit Number JTI000037-00-BD01.)

MS. GOLDSTEIN: JTIR00038 entitled "The Advanced Tower System Technical Features and Characteristics."

CHAIRMAN BOLLWERK: The record should reflect that exhibit JTIR00038 has been identified for the record.

(Whereupon, the aforementioned document was marked for identification as Exhibit Number JTIR00038-00-BD01.)

MS. GOLDSTEIN: JTIR00044 entitled "Curriculum Vitae of William Powers.

CHAIRMAN BOLLWERK: And the record should reflect that exhibit JTIR00044 has been identified for the record.

(Whereupon, the aforementioned document was marked for identification as Exhibit Number JTIR00044-00-BD01.)

MS. GOLDSTEIN: JTIR00049 entitled "Thermal Issues in Hybrid Cooling Technology in Siting

North Anna Unit 3."

CHAIRMAN BOLLWERK: The record should reflect that exhibit JTIR00049 has been identified for the record.

(Whereupon, the aforementioned document was marked for identification as Exhibit Number JTIR00049-00-BD01.)

MS. GOLDSTEIN: JTI000050 entitled "Excerpts From NUREG-1811, Environmental Impact Statement for an Early Site Permit at the North Anna ESP Site."

CHAIRMAN BOLLWERK: That has an R in it, right, JTI-R?

MS. GOLDSTEIN: I don't have that on mine.

CHAIRMAN BOLLWERK: Okay. I believe that's what I have. It has an R. All right. We'll mark it with the R. It is what it is, frankly. Exhibit number JTIR00050 is identified for the record.

(Whereupon, the aforementioned document was marked for identification as Exhibit Number JTIR00050-00-BD01.)

MS. GOLDSTEIN: JTI000051 entitled "Excerpts From 26A6642AD, Revision 4, ESBWR Design Control Document."

CHAIRMAN BOLLWERK: And the record should reflect that exhibit JTI000051 has been identified for the record.

(Whereupon, the aforementioned document was marked for identification as Exhibit Number JTI000051-00-BD01.)

MS. GOLDSTEIN: JTI000052 entitled "Excerpts From ESP Number ESP-003 for the North Anna ESP Site."

CHAIRMAN BOLLWERK: And the record should reflect that exhibit JTI000052 has been identified for the record.

(Whereupon, the aforementioned document was marked for identification as Exhibit Number JTI000052-00-BD01.)

MS. GOLDSTEIN: We would like to move to admit all of the following exhibits into evidence.

CHAIRMAN BOLLWERK: All right. Let me go back here and make sure that we -- I believe we started with 32. Is that right?

MS. GOLDSTEIN: Correct.

CHAIRMAN BOLLWERK: All right.

MR. LeJEUNE: Your Honor, we would like to place an objection on the record with regard to Joint Intervenors' exhibits 49 and 50. Those exhibits contain information regarding the North Anna hybrid cooling system, which is beyond the scope of EC 1.3.

CHAIRMAN BOLLWERK: Okay. And your objection is noted for the record. We are going to deny it.

MR. LeJEUNE: Thank you.

CHAIRMAN BOLLWERK: All right. Any other objection to these exhibits?

(No response.)

CHAIRMAN BOLLWERK: All right. Then we'll go through these exhibits: JTI000032, 33, 34, JTIR00035, JTI000037, JTIR00038, JTIR00044, JTI000046, JTI000047, JTI000048 --

MS. GOLDSTEIN: I don't know if 46 -- 46, 47, and 48 were already admitted.

CHAIRMAN BOLLWERK: You are right. I am in the wrong place. Okay. Let's just strike that. Let's go back. Let's start again with JTIR00045.

MS. GOLDSTEIN: Forty-four?

CHAIRMAN BOLLWERK: Forty-four. All right. Let's recap here a second. Okay. We're going to start one more time. JTI000032, JTI000033, JTI000034, JTIR00035, JTI000037, JTIR00038, JTIR00044, JTIR00049, JTIR00050, JTI000051, JTI000052. Is that it?

MS. GOLDSTEIN: Yes.

CHAIRMAN BOLLWERK: Those as just read are admitted into evidence.

(Whereupon, the aforementioned documents, having previously been marked for identification as Exhibits Number JTI000032-00-BD01 through JIT000034-00-BD01, JTIR00035-00-BD01, JTI000037-00-BD01, JTIR00038-00-BD01, JTIR00044-00-BD01, JTIR00049-00-BD01, JTIR00050-00-BD01, JTI000051-00-BD01, and JTI000052-00-BD01, respectively, were received in evidence.)

CHAIRMAN BOLLWERK: I apologize it took me a second there. We are still going to get you out of here by 4:00 o'clock, Mr. Sulkin.

All right. At this point, if there is nothing else in terms of the admission of any exhibits and testimony, then we will turn again to Judge Trikouros.

JUDGE TRIKOUROS: Thank you.

Mr. Sulkin, I only have one question. I know that your testimony was only one paragraph long. This was your testimony at direct testimony A9 that said, "Because there is no legitimate basis to find the impacts on aquatic species would be small, it is also illegitimate to eliminate dry cooling from further consideration."

First of all, what do you mean by "further consideration" in this context?

MR. SULKIN: It's an alternative to be looked at and used or dismissed accordingly.

JUDGE TRIKOUROS: It was looked at. When you say, "further consideration," do you mean looked at in more detail --

MR. SULKIN: Yes.

JUDGE TRIKOUROS: -- pursuant to further? Can you be any more specific than that?

MR. SULKIN: Well, they defined small incorrectly. And once they made that distinction, they dismissed anything that would mitigate any impacts that could be small, medium, or large.

What they were using was this EPA language that talked about what is an inappropriate location. Anything less than that could still be pursued but might have impacts of varying degrees.

They incorrectly interpreted that to mean small, so, therefore, did not pursue any less impacting cooling options. And my point is that shouldn't be dismissed for that basis.

JUDGE TRIKOUROS: Let me ask you, is there any level of impact other than small that would justify the exclusion of dry cooling? In other words, would a moderate impact in your opinion require dry cooling, period?

MR. SULKIN: Not quite. First of all, this definition of small is inappropriate the way it was developed. And under NEPA, it doesn't mean that you can't have impacts.

NEPA isn't a pass/fail test in terms of projects. It's an evaluation process. So you could have a moderate impact or even a high impact and then proceed to justify it through mitigation or other factors and reach a decisions.

But to inappropriately dismiss something as small or, other Clean Water Act terms, de minimum, insignificant, minuscule needs some basis. And the basis they chose was this five percent cutoff of a flow based on the Thurmond Dam, which I discussed this morning, which I found to be incorrect and inappropriate. That's why I made the statement.

JUDGE TRIKOUROS: All right. Thank you.

Would cost be a factor in your opinion?

MR. SULKIN: It's a factor, yes.

JUDGE TRIKOUROS: It would?

MR. SULKIN: It could be. I mean, I'm not really giving an opinion one way or the other, but it could be discussed.

JUDGE TRIKOUROS: All right. Well --

MR. SULKIN: I mean, the Clean Water Act, you can't just say, "It costs too much. Therefore, I am going to pollute." But there are provisions in the Clean Water Act to incorporate cost as a consideration.

JUDGE TRIKOUROS: So, really, what you are saying is that any impact, even small, is not an adequate justification for excluding a more detailed look at alternatives?

MR. SULKIN: Depending on how you define small. In this case, the way it was defined was inappropriate. If you are defining small as more the de minimis aspect of the Clean Water Act, perhaps. But because of the way they define small that I discussed earlier, it was not properly excluded.

And I have worked on one other facility, one we have discussed today, North Anna, where it was considered. And I noticed it was absent in this matter.

JUDGE TRIKOUROS: This cross-definition between EPA and NRC can get very confusing to especially the nonlawyers, but the definition of small, as I understand it, is defined in NEPA, not in the Clean Water Act. Is that correct?

MR. SULKIN: I don't think it is defined in the Clean Water Act or in the 316 rules. We looked at that earlier. I don't know if it's defined in NEPA or not.

JUDGE TRIKOUROS: Okay. I believe that it is defined in NEPA and that the staff in preparing the FEIS would have little alternative but to consider it in the light that it is defined.

I mean, could you tell me again? Maybe I am not understanding your comment. Just tell me again what you meant by your A9 statement.

MR. SULKIN: In the documents I was responding to, small was defined as less than five percent of a given flow. And it was attributed to EPA regulations. I followed that trail and found it was done improperly.

JUDGE TRIKOUROS: All right. I believe that what the staff was referring to was that the impact was small overall, not only because of a five percent impact on the river but that it was a finding of small that included that as one consideration.

MR. SULKIN: Let me just respond to that as if it were a question. I looked for other indications of what I would consider insignificant or small, such as monitoring requirements on the existing facility. And, as was pointed out yesterday, for example, with temperature, there are none. I found that a bit surprising but not unusual.

So to conclude something as small, particularly when you have a permit that has been expired for almost five years for no particular reason, it's a pretty loose ship.

JUDGE TRIKOUROS: I think I understand where you are coming from. I don't think we need to pursue it any further. Thank you very much.

CHAIRMAN BOLLWERK: All right. That's your only question?

JUDGE TRIKOUROS: That's it.

CHAIRMAN BOLLWERK: Okay. Judge Jackson, do you have any?

JUDGE JACKSON: I would like to pursue that just a little bit. In the staff's testimony yesterday, I remember that they listed several things that they said went into this decision, velocity, through the screens, the design of the intake canal, walls, a number of factors.

I recall them explicitly saying that it wasn't just the five percent cutoff. Did I miss something or did you discount those other factors somehow?

MR. SULKIN: My task was to review the areas of their documentation that specifically related to the flow issues. And in there they defined small and used it in capital letters or as a defined term many times. I was targeting that.

I don't dismiss the other factors. And one of my colleagues or both of them have commented on that. And I have read some of their writings and rely partially on their view.

JUDGE JACKSON: I guess I understand your answer. Thanks.

CHAIRMAN BOLLWERK: Anything further?

(No response.)

CHAIRMAN BOLLWERK: All right. Let me then turn to the parties and see if either of them, any of them, have any additional questions they want the Board to ask Mr. Sulkin. No?

(No response.)

CHAIRMAN BOLLWERK: All right. Sir, you can take your choice. You can sit there until you want to leave or we can let you go now.

MR. SULKIN: I'm going to go out and play in traffic.

CHAIRMAN BOLLWERK: Okay. Sir, I

appreciate very much, then, your having appeared before us and your service to the Board. Thank you. You are excused.

All right. Judge Trikouros, I think we're --

JUDGE TRIKOUROS: All right. I think we'll move on to Mr. Powers' testimony. This idea of standard design comes up in a lot of testimony. Could you give me an appreciation for what you consider to be standard design in terms of the balance of plant that we're discussing right now? And specifically would you consider that Southern Nuclear's exhibit 28, which is, if you could bring that up, SNC-28?

Mr. Powers, have you had occasion to look at this document at all?

MR. POWERS: I think I have. Could whoever is controlling this move the screen?

JUDGE TRIKOUROS: This is section 10.2 from the AP1000 DCD. I believe this is rev. 16.

CHAIRMAN BOLLWERK: Actually, for identification, it indicates it is rev. 17.

MR. POWERS: Yes. I have had an opportunity to look at it, yes.

JUDGE TRIKOUROS: Would you agree that this basically defines a standard design for the term "generator system"?

MR. POWERS: I would agree that it, yes, provides their base case standard design. Yes.

JUDGE TRIKOUROS: Would you agree that the standard design that's discussed in here that is the standard design for the AP1000 is the wet cooling system?

MR. POWERS: Yes.

JUDGE TRIKOUROS: In your direct testimony, question 12, what is your basis for saying that the standard AP1000 design configuration accommodates both a high and a standard backpressure turbine? Was this based on a review that you did of the AP1000 DCD or do you have some other reference that you could point us to that allows you to make that conclusion?

MR. POWERS: This is comment 12?

JUDGE TRIKOUROS: Yes, it was question 12 in your direct testimony. The question was, "Please summarize your conclusions regarding the dry cooling alternative as a design alternative to the wet cooling tower system proposed in the ESP."

And you indicate in there that "standard AP1000 design configuration accommodates both high and standard backpressure turbines."

MR. POWERS: Yes. And that is not clearly written. It should say the "design" and not the "standard design" because my point was that the design could accommodate both. But my point was not to imply that the standard, as is literally stated here, that the standard design is intended to accommodate a high backpressure turbine.

JUDGE TRIKOUROS: I see. Okay. One could not determine that by reading it. It sounded like you were saying that it was part of the standard design.

MR. POWERS: Right. I should not use the word "standard" in that sentence.

JUDGE TRIKOUROS: All right. That's fine. So it's basically your opinion that the standard design could accommodate a high backpressure turbine?

MR. POWERS: It's my opinion that design could be modified from the standard to accommodate a high backpressure turbine.

JUDGE TRIKOUROS: You mean that it could be modified to --

MR. POWERS: Yes.

JUDGE TRIKOUROS: All right. Thank you.

Could you elaborate on the word "compatible" that you used in there? It's in the statement that the current dry cooling system design is compatible with facilities like Plant Vogtle?

MR. POWERS: Could you direct me to that?

JUDGE TRIKOUROS: Yes. It should be also in question 12. It's --

CHAIRMAN BOLLWERK: I think it's on the screen in front of you, too. Take a look. It's answer 12, about the fourth line down.

MR. POWERS: My point there is somewhat repetitive in the sense that this design can accept it is technically feasible to accept an air-cooled condenser for the application at Vogtle 3 or Vogtle 4.

JUDGE TRIKOUROS: So your item 1 and item 2, they actually are the same? You're saying the same thing in item 1 and item 2?

MR. POWERS: Right, yes.

JUDGE TRIKOUROS: Okay. You also used the word "effective" in your statement that "A dry cooling system is effective, despite the impact of climate in the vicinity of the Vogtle site." What do you mean by "effective" there?

CHAIRMAN BOLLWERK: Same question.

MR. POWERS: What I mean by "effective" is what I go into in much more detail in the technical elements of this, that the application of a properly sized or I think Southern Company is using the same term I used, "state-of-the-art air-cooled condenser" would have a -- is completely viable, would function -- this is my opinion -- is completely viable. Yes, it would impose a slightly efficiency penalty but that there are no impediments to deploying it at the site.

JUDGE TRIKOUROS: So when you are talking about a dry cooling system in that context, are you talking about the standard turbine that is in the AP1000 DCD connected to basically air-cooled condensers? Is that what you are talking about?

MR. POWERS: I'm talking about both configurations, that if they use a state-of-the-art air-cooled condenser, they could use their standard turbine. I disagree with the statements that air-cooled condenser manufacturers provide performance based on optimum perfect site conditions. That is not the case.

If that unit is guaranteed to provide the performance at 4.5 inches of mercury at 95 degrees Fahrenheit, it is far more likely or very likely that you will do significantly better than that.

But a manufacturer has to meet site conditions. And, as is noted in the write-up by Mr. Cuchens, the alarm point for the standard design is five inches. The trip point is six inches.

The case being presented is that the manufacturer of the air-cooled condenser is going to provide them with something that will only perform as designed at perfect conditions. That is not correct. They could employ the air-cooled condenser with a 35 percent ITD on the standard unit.

However, they could also employ an air-cooled condenser that isn't quite as large that would, in fact, have within the normal operating envelope. If we define that as 95 degrees Fahrenheit at the design point, there would, in fact, be at or above five inches backpressure at that point.

In that case, it would be sensible to use a high pressure steam turbine to avoid any issues of running up against that alarm point.

JUDGE TRIKOUROS: So with the 4.5-inch number as the criterion, your position is you don't need a high pressure turbine as long as that 4.5 inches can be met?

MR. POWERS: Correct.

JUDGE TRIKOUROS: The alarm setpoint or the action point would be five inches mercury, right?

MR. POWERS: Correct. That's the alarm point.

JUDGE TRIKOUROS: So you believe that a

nuclear plant could actually operate within a half-inch of an alarm point?

MR. POWERS: Southern defines the normal operating range of the turbine at one inch to five inches. And based on how they present the operating range of the standard turbine, the envelope of operation with a 35-degree ITD air-cooled condenser would be within that envelope.

In terms of does the NRC have some additional safety margin they want to see between the alarm point and the design point for the steam turbine? I'm not familiar with those regulatory requirements.

JUDGE TRIKOUROS: So when you provide testimony that says they can use a standard turbine with the understanding that at 95 degrees there will be a 4 and a half-inch backpressure, you are not taking into account realistic operating requirements of nuclear power plants that have the significant margins to any trip setpoints.

It is unacceptable to trip a nuclear reactor, especially two of them in this particular case, just because it got a little warm outside.

MR. POWERS: Well, I think it is important to distinguish between the alarm point and the trip point. The alarm point is five inches. The trip point is six inches.

And so they are not knocking up against the trip point at 95 degrees Fahrenheit. And they do indicate that they cannot operate continuously at five inches of backpressure. I accept that. Really, what I am simply reflecting is the design document that was prepared by Southern Nuclear.

JUDGE TRIKOUROS: What I am trying to get at is, do you really believe that we would not need a high backpressure turbine for this dry cooling system at Vogtle? Is that a realistic evaluation that it would not be required?

MR. POWERS: As a first cut, it can meet the requirements. Whether it is the most secure approach, I can't comment on as far as having gone into more detail.

But the reality is that in this particular situation, if it did meet those nuclear safety margins, at least within the operating envelope of the steam turbine, they could do it with the standard turbine.

I don't feel comfortable making a recommendation about excluding the use of air-cooled condensing of the standard turbine at this point:

one, for lack of familiarity with any additional cushion regulations on that steam turbine backpressure the NRC might have. All I know is that it can operate within the envelope they defined as normal for the unit.

JUDGE TRIKOUROS: Now, what is this one percent design criterion? That means that 99 percent of the time the turbine would operate effectively if I use your term, meaning up to 4 and a half inches of mercury, about one percent of the time it would not?

MR. POWERS: It's the one percent summer design point is a standard design point for these types of systems. And what it means is that one percent of the 4 months that are defined as summer months are 29 hours out of the year. And I noticed that in --

JUDGE TRIKOUROS: I'm sorry? How many hours?

MR. POWERS: Twenty-nine.

JUDGE TRIKOUROS: Twenty-nine hours a year?

MR. POWERS: Yes. The one percent design is 29 hours a year, one percent of the summertime hours. And it has no identifier on it, but maybe just as with my binder, but the document includes the temperature profile for Augusta, Georgia. And it indicates that 18 hours a year, the temperature is above 95 degrees at the site.

So, in reality, the site is about .7 percent of the summertime hours above 95 degrees.

JUDGE TRIKOUROS: I have actually been here 140 of those 29 hours.

(Laughter.)

JUDGE TRIKOUROS: I understand. Okay. So with the understanding that when the temperature does go above that, basically this plant has to shut down?

MR. POWERS: Not quite correct. When the temperature goes above 95 degrees Fahrenheit, the exhaust backpressure on the turbine goes above 4.5 inches. That is not a trip point. The trip point is six. The alarm point is five.

And so based on the data that I see here, they show no hours above 100 degrees Fahrenheit. So that means that the upper hours are close to 95. It isn't clear that they would even hit five inches of backpressure at any hours of the year.

JUDGE TRIKOUROS: But it is your position that if the standard turbine were not a viable choice for Southern, that a high backpressure turbine would be available?

MR. POWERS: Yes. High backpressure option is a simple, readily available option, yes.

JUDGE TRIKOUROS: The same question again, your question 12. You are using a phrase, "do not favor" in your statement that "the potential financial, economic, and performance impacts upon facility design, construction, and operation do not favor a wet cooling rather than a dry cooling system."

Do you mean there that a dry cooling system is economically superior to a wet cooling system, meaning that it costs less? Is that what you're saying?

MR. POWERS: No. This comment is accurate in the context of the impacts of the alternative wet cooling system.

JUDGE TRIKOUROS: Could you explain that better? I'm sorry. I didn't --

MR. POWERS: Well, it's accurate in the context of if the use of a wet cooling tower is going to have impacts on reliability due to drought or if the wet cooling tower is going to have impacts, which one of these -- the word does not include environmental but the issue related to impacts on marine creatures. That is where it favors dry cooling.

JUDGE TRIKOUROS: So in this statement, you are actually saying that dry cooling is more reliable than wet cooling?

MR. POWERS: Yes.

JUDGE TRIKOUROS: Okay. We will come back to that, but I just wanted to make sure I understood.

Same. One more question on your question. All right. Well, let me address it right here. Could you explain to me how the dry cooling or what the basis is of saying that dry cooling has improved performance impact on facility design over a wet cooling system? What is your basis for saying that?

MR. POWERS: Could you point me to the statement you are reading?

JUDGE TRIKOUROS: It is just a question I am asking as a follow-up to the one I just asked.

MR. POWERS: Oh, you mean improved reliability, the issue there? Is that it?

JUDGE TRIKOUROS: Say it again.

MR. POWERS: This is a question about improved reliability of the dry cooling system?

JUDGE TRIKOUROS: Right. Yes. I am going to attack it at this point with you. Okay.

MR. POWERS: That goes to the issue of water availability. And the big advantage of, I think, in one of the rebuttal testimonies that I prepared, I had a statement from the North Anna documents, where they point out the obvious, that if you've got a water reliability issue, you do not have that reliability issue if you are using air cooling because you are not relying on water.

And so it is all directly related back to the availability of water.

JUDGE TRIKOUROS: So you are saying that in your testimony, there is not sufficient water in the Savannah River to ensure constant supply of 110 cubic feet per second to a wet cooling system?

MR. POWERS: No, that is not my testimony directly. What I am saying is that if you have abundant water resources for the projected life of the plant and you cannot see any scenario where your water resources are going to be compromised, you've got no marine impacts, then we wouldn't be talking about dry cooling. That is the point that I am trying to make.

JUDGE TRIKOUROS: You are limiting the connection to water here?

MR. POWERS: Yes.

JUDGE TRIKOUROS: All right. I understand what you are saying.

Could you give me some idea of what impact there might be on the likelihood of any kind of transient perturbations in a dry cooling system versus a wet cooling system, the likelihood for any sort of rapid changes in backpressure that could result in a scram? Is it any less likely or more likely with a dry cooling system than a wet cooling system?

I am really addressing your question 13 here, but you could take my question just on its face.

MR. POWERS: It's a good question. I haven't looked at statistical data to determine if this issue of rapid temperature swings causing trips in a power plant equipped with an air-cooled condenser -- the first time I have heard that claim has been in this proceeding.

I appreciate what the engineer from Southern Nuclear said about his visit to South Africa, that they did have problems 15 years ago when some of those big units started up. They employed countermeasures. And they don't have those problems anymore.

And I know the issue of cross-winds for cooling towers is if you are in a situation like that, you add skirts around those towers to provide a relatively quiescent zone for that air, even in high wind speeds.

And so the issue of air changing, yes, air temperature is more variable than the wet bulb temperature, but the air temperature is not changing on a second-by-second basis. There is information available to track how it is performing.

In terms of a nuclear plant, when you are limited by what that air temperature is with an air-cooled condenser, on a hot day you might see, for example, in this case, we're talking about having a gross output of nearly 1,200 megawatts. Maybe at 3:00 p.m., when it's 98 degrees, it's putting out 1,120 megawatts. And at 3:00 a.m., when it's 86 degrees, it's putting out 1,150.

But it's following a very gradual change in output. There is no catastrophic incident from an air-cooled condenser that I am aware of that would lead to a precipitous trip of the system.

JUDGE TRIKOUROS: Okay. I have a couple of more questions on backpressure, but I think I don't need to ask them at this point.

Let's go on to question 17. You are being asked there what the annual average efficiency penalty is of using dry cooling at Vogtle?

MR. POWERS: Yes.

JUDGE TRIKOUROS: And your answer says

that with a 35-degree ITD air-cooled condenser, that the estimated annual average efficiency penalty is approximately 1.5 percent?

MR. POWERS: Yes.

JUDGE TRIKOUROS: Is that 1.5 percent number in general agreement with prevailing literature? Would you be able to quote me any reference anywhere that comes up with the same conclusion?

MR. POWERS: There are -- it depends on what you mean by the "literature."

JUDGE TRIKOUROS: Any paper other than your own, any independent evaluation that was done of this that would -- and I don't necessarily mean Plant Vogtle -- have an average annual energy penalty of 1.5 percent or even in that vicinity?

MR. POWERS: The DOE held a conference back in 2003 in Washington: 316(b) conference. And many of the papers that were presented there looked at, I would say, a number of papers that were presented there, including one that I gave at that conference, looked at, the actual energy efficiency penalty of air-cooled condensers and operating systems.

The paper I gave was looking at

essentially a combined cycle gas-driven plant. I think a couple of others were as well. In that case, the numbers were less than one percent or out one percent. And the --

JUDGE TRIKOUROS: Let me stop you there. I would exclude combined cycle plants, especially a combined cycle plant under favorable weather conditions. Let's stick to something more along the lines of a typical power plant.

MR. POWERS: Given that we have spent a fair amount of time talking about the EPA and I think you did use that range of eight to ten percent, the most recognized study on backpressure has been the EPA study. That was done back in 2001, nearly a decade ago.

And the point of writing the paper that I wrote, the reason for writing it, was because I thought that the EPA approach had been an apples-to-oranges comparison that bore no relation to state-of-the-art air-cooled condensers.

So let me explain that for a moment because I say in the body of the paper I am writing this paper because the EPA's estimates of energy efficiency penalty are dramatically higher than they should be. And here is why.

Even though the EPA documentation is voluminous for that, they have got one page on how they came up with the backpressure. And so I am responding to that, explain it in one paragraph.

And they say we went to a vendor, who happens to be the most prolific vendor of air-cooled condensers in the world, said, "Tell us the initial temperature differentials that you have specified for recent energy bill." So they gave them a data dump of some units.

And the EPA looked at it. And they put a curve fit through it and said, "This is higher than the -- a couple of -- one check we made with one other unpublished piece of documentation." And even though when we do this curve fit it's quite a bit higher than what we got from the low end, that is conservative. And so we are going to put that in the document.

So the state-of-the-art has nothing to do with what the EPA curve fit in that report. And then off of that one questionable exercise, they run all of these numbers, nuclear plants, coal plants. These are the kind of efficiency hits that you will see.

And the result of that was I would agree if I am looking at an eight to ten percent efficiency penalty, that is a big deal. That would tend to cause me plenty of pause before specifying air-cooled condenser.

But if I put a state-of-the-art air-cooled condenser on there and I do simple things, like, instead of just comparing the fans on a wet cooling tower to the fans on an air-cooled condenser -- and there are quite a bit fewer fans on a cooling tower -- I do that comparison, I see a big gap.

What is the biggest parasitic load in the whole plant? Pumping water through the surface condenser. What do I eliminate when I put an air-cooled condenser in a plant like this? The surface condenser.

And so when I eliminate that surface condenser, suddenly the parasitic load difference gets very small. And I am not sure the EPA folks that were assigned to this understood the significance of doing that curve fit on the air-cooled condenser when, to be fair to the industry, air-cooled condensers have really only been a common card since the mid to late 1990s. EPA wrote that report, probably did the research in the late '90s, and published it in 2001.

The state-of-the-art today -- and I appreciate what Southern Nuclear did. They used the state-of-the-art example. 35-degree ITD is not what the EPA utilized to come up with those numbers.

And another problem with that study is they used a very conservative design. In fact, this is how the word "conservative" can get confusing. They say, "We used a conservative number for the air-cooled condenser by using a high backpressure." Then they say, "We used a conservative number for the wet tower by using approach temperature ten degrees out." So you've got a very robust wet tower and an under-designed air-cooled condenser. And then you apply that to the entire industry.

And, admittedly, too, this whole what we're talking about now, turbine backpressure impacts of air-cooled condensers, impact of pumps through surface condensers is pretty arcane.

There has been back and forth between a few of the yes, this is one paper, but the technical reviewer of this paper is the Electric Power Research Institute's lead on cooling systems, Dr. John Maulbetsch.

And so the fact that there may not be a large body of work that is supporting one side or the other isn't necessarily a surprise given the relatively arcane nature of this, but I stand by this paper completely.

And if we get the opportunity, I would be happy to walk through an exercise using Southern Nuclear's most recent analysis to show that the parasitic load difference between a 35-degree IPD air-cooled condenser on this plant, there is almost no parasitic load difference between that and the wet towers that they are proposing.

JUDGE TRIKOUROS: Well, let's explore this for a little bit. For a plant with a standard turbine operating at a given backpressure of, let's say, three inches, whether that backpressure is being created by an air-cooled condenser or a steam condenser, would there be any difference in efficiency of the turbine?

MR. POWERS: If it was three inches, whether it was either type of technology?

JUDGE TRIKOUROS: Right.

MR. POWERS: No.

JUDGE TRIKOUROS: And, yet, we discussed earlier how typically an air-cooled condenser would operate at a higher backpressure than a standard condenser, but it wouldn't be high enough to cause trips or even alarms. But it would be higher, say, 4 and a half versus 2.9.

MR. POWERS: At the design point, yes.

JUDGE TRIKOUROS: Right. Do you have a

feel for what the efficiency reduction is for 4 and a half versus, say, 2.9 inches in the standard turbine? Is there a --

MR. POWERS: The efficiency reduction at that point I would guesstimate based on the paper would be in the range of three to four percent.

JUDGE TRIKOUROS: Three to four percent? Okay. And that doesn't include parasitic loads?

MR. POWERS: It does.

JUDGE TRIKOUROS: It does?

MR. POWERS: Yes. What I am talking about is a net heat rate penalty. I did hear the comment earlier about the 20 to 30 megawatts being backpressure and not including parasitic load. That's not my point of view.

This paper was done based on heat rate penalty, which includes parasitic and backpressure.

JUDGE TRIKOUROS: What method did you use to do this calculation?

MR. POWERS: There was a design tool used. The most commonly used design tool is a tool put out by a company called Thermoflow. It is called STEAM PRO. And it is what is used by engineering firms to design coal plants.

And I contracted with their West Coast

representative to model a plant, a coal plant, that was built in Wisconsin, Weston unit 4. And it was based on the -- because there was a large amount of engineering information publicly available on that plant to model it on that plant.

JUDGE TRIKOUROS: You independently modeled that plant or you took a model that was already built of that plant?

MR. POWERS: They indicated components of what the plant had, what the heat rate of the plant was. And so the first step was to match, set up the model so that it mimicked as closely as possible the performance indicated for the plant by the proponent.

JUDGE TRIKOUROS: I could go into a lot of time here with model validation issues, but I don't think it's necessary at this point. You calculate 1.5 percent, and the EPA reports 10 percent, actually, and 10.9 percent in Jacksonville, Florida for dry versus wet for a nuclear plant operating at -- I think they use 100 percent capacity, but that's really not that far off from the way nuclear plants operate, over 95 percent nowadays. The 67 percent might be more appropriate for a fossil plant but not a nuclear plant.

Is there a third data point anywhere?

MR. POWERS: I could provide you data points from California. That state is involved in a pretty detailed process of doing -- I take that back because that would be from once through to a wet cooling. The manufacturers of the equipment can provide those data points as well.

JUDGE TRIKOUROS: The North Anna COL, North Anna 3 -- in fact, I'm sorry; it may be the ESP, I'll have to check that -- quotes numbers that are significantly higher than that. They talk about numbers that I think are closer to 12 percent, but it all depends on how you read the document. The least you could read is four percent. And we do have an exhibit that provides that information.

So I am having trouble understanding. Now, they do quote 1.7 percent, but that's for basically mostly wet cooling operations, just a little bit of dry cooling.

Are you familiar with any of that?

MR. POWERS: Yes. I would like to address that. In this document, there is an excerpt from North Anna where they talk about 150 megawatts of parasitic load associated with the fans.

CHAIRMAN BOLLWERK: What document are we talking about here?

MR. POWERS: It is -- I presume that it is a -- it was in this binder.

CHAIRMAN BOLLWERK: Okay.

MR. POWERS: And it's NUREG-1811, volume 1, page 8-4.

CHAIRMAN BOLLWERK: Okay. Hold on one second here.

MR. LeJEUNE: It's SNC000095, Your Honor.

CHAIRMAN BOLLWERK: Okay. SNC000095. That's one we talked about a little earlier. There it is.

JUDGE TRIKOUROS: Okay. And as we are doing this, let's relate it to your rebuttal question 2 because I think it is applicable.

CHAIRMAN BOLLWERK: I think the provision we were looking at -- was it down at the bottom of the page maybe, down in there? Have I got the right place or not?

JUDGE TRIKOUROS: Look at page 8.2.3.

MR. POWERS: That is correct.

CHAIRMAN BOLLWERK: Okay.

JUDGE TRIKOUROS: Oh, no. I'm sorry. I'm looking at JTI-50.

CHAIRMAN BOLLWERK: Do you want to discuss this document or do you want to go somewhere else?

MR. BLANTON: Your Honor, I think JTI -- excuse me. Southern Nuclear 000095 is additional pages of JTI --

CHAIRMAN BOLLWERK: Fifty?

MR. BLANTON: With both of those together, you have everything.

CHAIRMAN BOLLWERK: Okay. Thank you.

JUDGE TRIKOUROS: Did you want to use JTI-50 or the additional --

CHAIRMAN BOLLWERK: They're not -- you have to put two of them together to get all of the information.

JUDGE TRIKOUROS: Right. Well, why don't we go to JTI-50 and look at that? That's North Anna ESP. Why don't we look at page 3-12?

MR. POWERS: Go a little bit lower on the page. Right, right there. Are you referring to --

JUDGE TRIKOUROS: Yes. Now, here they reference a 12 percent number. And they give an EPA reference to that.

MR. POWERS: Which is correct. We were just talking about the 316(b) report, where they had that reference. And in this, in North Anna -- and we discussed that already, but in this sheet here, they give us a number, which is helpful because it says, "Dominion estimates that the power needed to operate dry cooling towers would be 8 and a half to 11 percent of the plant power output." Well, that is useful information. That is similar to what the EPA said.

Then they say, "The power needed to operate a dry tower for unit 3 would be about 150 megawatts." Okay. Well, Southern Nuclear in SNC000024 revised report, if you were to go to page 22 of that, they have the --

CHAIRMAN BOLLWERK: You're going way --

JUDGE TRIKOUROS: SNC000024, please.

MR. POWERS: Page 22. I think that's page 21.

CHAIRMAN BOLLWERK: One more.

MR. POWERS: Actually, a page of text. At least in mine it's page 22. A page of text that begins, "Analysis of an ACC design for a 35-degree F ITD." That's it. Okay. Stop right there.

You can see as you go into this list of items total number of modules, modules per row, total ACC fan power. Then it has two numbers: horsepower, and then it has kilowatts, 28,915 kilowatts. Well, that is just under 29 megawatts, for a net 1,117-megawatt plant. Okay.

North Anna is bigger, about 40 percent

bigger. And even though it's a different type of nuclear plant design, if we just for the sake of simplicity do a linear scale-up, 28.9 megawatts, we scale it up 40 percent, we get about 40 megawatts of fan power.

Yet, what Dominion is saying for North Anna 3 is that we would need 150 megawatts of fan power. Well, there is no supporting documentation for that. And it's just a wildly high number with no supporting documentation.

The EPA provides no documentation for the high backpressure numbers other than the information on the curve. And so I wouldn't -- because we have Southern Nuclear referencing the 316(b) document, which I wrote that paper to respond to, we have Dominion using a similar percentage. But when you look at what they assert is the reason for that, it doesn't add up, way too much fan power, even for a state-of-the-art unit.

JUDGE TRIKOUROS: Well, let's try this. You have 1.5 percent calculated. You have it calculated for a plant that is, what, 500 megawatts?

MR. POWERS: Correct.

JUDGE TRIKOUROS: Where? In Montana somewhere? Where is it?

MR. POWERS: Wisconsin.

JUDGE TRIKOUROS: In a cold climate? I'm sorry?

MR. POWERS: Wisconsin.

JUDGE TRIKOUROS: And if you were to translate that plant to a 1,200-megawatt AP1000 in Georgia, what would be your guess as to what that 1.5 percent would become?

MR. POWERS: Two.

JUDGE TRIKOUROS: That's it?

MR. POWERS: That's it. A design point in Wisconsin is 90 degrees. The design point here is 95 degrees. Design point is different, but it's not a dramatic jump. You would need incrementally more fan capacity. And so you would have incrementally more parasitic load. The ACC wouldn't perform quite as well at 95 degrees.

And so you would get a little bit more than efficiency penalty at the top end. But over the course of 8,760 hours of operation, it isn't going to provide a dramatic bump in efficiency.

JUDGE TRIKOUROS: Yes. But in the end, what we have here is one calculation that you have performed, non independently verified, that provides a number that is significantly lower than what has been published. And you may have some explanations, but it is a non independently verified calculation. And it's significantly -- it is basically an outlier to what other people use.

MR. POWERS: It was independently verified by the Electric Power Research Institute's lead on cooling towers. And he is listed on that paper as the technical reviewer.

JUDGE TRIKOUROS: I don't know. He is a co-author of the paper?

MR. POWERS: I wouldn't say he is a co-author. He reviewed it technically and put his name on it. He has also written papers or he has written studies for the performance of air-cooled condensers on combined cycle gas plants. I do not know if he has written similar studies for coal plants.

JUDGE TRIKOUROS: Okay. Well, I guess at this point why don't we just move on.

JUDGE JACKSON: Judge Trikouros? Could I just ask a question? In the testimony earlier today, I think it was Mr. Cuchens was talking about an analysis in this area. And, if memory serves, he was talking about something like 80-megawatt parasitic losses. Were you here during that?

MR. POWERS: Yes.

JUDGE JACKSON: And we had talked about comparing that to the parasitic pumping power for a wet tower. And I think he testified that he thought that was 13. So that difference is around 70.

Do you dispute that 80 megawatts? And if so, on what basis?

MR. POWERS: Do I dispute that there's an 80-megawatt delta between a wet cooling tower and an air-cooled condenser?

JUDGE JACKSON: It would have been more like a 70-some odd because it was 13 versus 80, as I recall. So say 65 megawatts different.

MR. POWERS: I would say the parasitic difference, which I would be happy to demonstrate, would be maybe seven, eight megawatts, almost de minimis.

JUDGE JACKSON: Do you have a reason why you think that analysis came out to be 80, then, instead of 20?

MR. POWERS: Yes. And I don't recall seeing an analysis by Mr. Cuchens that came up to that number, but I do have information from this revised report that was prepared.

And I mentioned that number for a fan, for power consumption for the air-cooled condenser, which was just under 29 megawatts. And in the same revised report, he indicates that the fan power consumption for the cooling towers, which is in this exhibit, 000024.

CHAIRMAN BOLLWERK: There should be an R, SNCR00024.

MR. POWERS: On page 7 of that document, a little bit further down, right there, the last line in the outline is "Total tower fan power," 7,162 kW or 7.2 megawatts.

So the difference between the fan power of those two options is about 20 megawatts, a little over 20 megawatts. What we're going to eliminate by using that air-cooled condenser is the surface condenser.

And the paper that we were just talking about that I wrote about performance comparison, that was for a plant that has a circulating water flow rate of 250,000 gallons a minute. In this first line item here is design cooling water flow, 600,000 gallons per minute.

The power demand or parasitic power draw of the surface condenser in the paper that I wrote was just over 5 megawatts, about 5.1, 5.2 megawatts.

If we were just to scale that up

linearally, okay. Here we've got 600,000 in that. We had 250,000. That would become about somewhere between 12 and 13 megawatts. So we get rid of the surface condenser on the AP1000. We eliminate 12-13 megawatts of parasitic load. Combined that surface condenser parasitic load with the cooling tower fan load is about 20 megawatts.

Using SNC's estimate of the fan power for the ACC option, in this case 29 megawatts, we're looking at a difference of 9 megawatts. That is without refinement.

And so if someone is stating that the parasitic delta between a cooling tower and an air-cooled condenser is 65 megawatts, they are wildly off the mark. It is in the single digits.

JUDGE JACKSON: This reference that we have up here is talking about -- oops. It disappeared.

CHAIRMAN BOLLWERK: Can you put it back up again?

JUDGE JACKSON: A mechanical draft. It said a mechanical draft tower. Did I read that right? Mechanical draft tower. I thought at issue was a wet tower. The mechanical draft tower is what you have been talking about, right? I just wanted to make sure there wasn't --

MR. POWERS: I have been responding to the analysis that was done here.

JUDGE JACKSON: Okay. That's all you were doing. So you think that the difference would be several megawatts? That is your testimony, then, between a wet tower and the mechanical ACC units?

MR. POWERS: If several means a few, yes.

JUDGE JACKSON: A few megawatts. Interesting. Okay. That seems like something that could be checked. I just wanted to make sure I understood where you were coming from. Thank you.

CHAIRMAN BOLLWERK: The paper you're referring to, that's exhibit JTI000033 if I've got the right --

MR. POWERS: I do not have that paper in my binder, but --

CHAIRMAN BOLLWERK: I don't want to confuse this. It's entitled "Peak and Annual Average Energy Efficiency Penalty to Optimize Air-Cooled Condenser"?

MR. POWERS: Yes.

CHAIRMAN BOLLWERK: That's it?

MR. POWERS: Yes.

CHAIRMAN BOLLWERK: It was done at EPRI

CEC Cooling Strategies Conference June the 1st through 2nd, 2005?

MR. POWERS: Yes.

CHAIRMAN BOLLWERK: Okay. So that's JTI000033 that we were talking about or is it 24? Have I got the wrong -- this is the SNC report here?

MR. POWERS: That is the SNC report, right.

CHAIRMAN BOLLWERK: Okay.

JUDGE TRIKOUROS: In your question 6, you refer -- it's an extremely long answer referring basically to the fact that ESBWR being proposed at North Anna 3 and 4 that provides some sort of example of the feasibility of dry cooling for a large plant, a large nuclear plant, do you have any feel for the cost factors associated with that, the cost penalty associated with that for Dominion?

MR. POWERS: For unit 4?

JUDGE TRIKOUROS: I'm sorry?

MR. POWERS: For the all dry-cooled unit 4?

JUDGE TRIKOUROS: Yes. You're pointing to those units and saying that you see these are feasible because this company is actually proposing this at North Anna 3 and 4.

Do you have any feel for the cost penalty associated with their doing that? Is that something that you have any idea about? Is it a 10 percent, 20 percent, 30 percent factor?

MR. POWERS: In terms of the overall capital cost of the project?

JUDGE TRIKOUROS: Right. Did you have any feel at all for the penalty they're paying for that or do you feel that they're not, possibly not, paying any penalty at all?

MR. POWERS: Well, I think that I would prefer to use Southern Nuclear's provided costs that I think are reasonably accurate. I would like to refer to those. They have -- in the SNCR00024, they have their cost comparison. They're natural draft tower, mechanical draft tower, and the 35-degree F ITD.

And they show a delta of approximately 200 million. So you would be paying an additional 200 million, plus or minus, for the air-cooled condenser on -- one bit of information that isn't in this document that I think would be helpful to put it in perspective, it is my understanding that the cost estimates for nuclear plants at this point are above $8,000 a kW.

If that's the case, $8,000 a kW is typical of what you would expect for an AP1000 standard design and you go with an air-cooled condenser that adds 200 million, then you are going to boost your overall capital costs 2 or 3 percent. And I think that is the perspective that it has to be viewed in.

JUDGE TRIKOUROS: All right. And, of course, I should mention that Dominion is no longer pursuing the ESBWR. They have announced in the public domain that they're pursuing other options right now, not to say that the other options wouldn't be dry cooling, --

MR. POWERS: Yes.

JUDGE TRIKOUROS: -- but they're not going with the ESBWR, at least as of this moment. Okay.

CHAIRMAN BOLLWERK: Just for purposes of the record, you just referenced exhibit SNC000024. What page are we talking about?

MR. POWERS: Page 26.

CHAIRMAN BOLLWERK: Right. Thank you, sir.

JUDGE TRIKOUROS: I'm on question 8. You state, "As is clear in the case of North Anna 3 and North Anna 4, there are no scale-up issues related to the use of dry cooling on the AP1000 steam turbine." Could you explain what you mean by that?

MR. POWERS: Much of the SNC testimony has been about what I call the bright line, that there is some magic megawatt level between the existing air-cooled plants in the world, which the biggest is approximately 700 megawatts, and the 1,117-megawatt net AP1000.

And the point of mentioning North Anna 3 and North Anna 4 is, one, the turbine, I think the -- one of these exhibits talks about the turbine. This is JTI000051. This is the design control document for the GE-ESBWR.

And the next page, about two-thirds of the way down, right there, main turbine, the revised report, written by SNC, goes into great detail about the turbine, steam turbine, design and the condenser design.

It's three different pressure levels. And this is corroborating that it's the same turbine design for North Anna for one high pressure turbine and three low pressure turbines.

And since I'm on this page, it's also worth noting that this is their design control documents here, too. And the next sentence says other turbine configurations may be selected for plant-specific applications, the order to obtain optimal thermal performance of the turbine plant at the site-specific conditions.

At least this design control document doesn't seem at all intimidated by the possibility of modifying the turbine design. But the point of going to this page was to point out that the turbine design for the GE turbine design and the AP1000 turbine design are foundational the same.

They have proposed a unit, which I was unaware that they may be moving to a different design, but they're indicating that unit 3 can operate as an exclusively dry-cooled unit under some climate conditions at the site. Turbine is the same. That is a 1,500-plus megawatt unit.

And that was my point, that there is no bright line on how big a unit can utilize a air-cooled condenser or in the case of North Anna, they're using a somewhat different air-cooling system. They're using air cooling.

One, there's no bright line on size. And, two, there are no issues about the applicability of air cooling to this type of turbine, a high pressure turbine and three low pressure turbine extractions.

JUDGE TRIKOUROS: Okay. So basically you're saying that the line between the 700 and the

1,100 is sort of artificial?

MR. POWERS: Yes.

JUDGE TRIKOUROS: In A21 of your testimony, you talk about the removal of the surface condensers from the AP1000 that would create the room that would be needed for the air-cooled condenser steam ducts. What design information for the AP1000 did you use to come up with that testimony?

MR. POWERS: I'm looking for that statement. And I hopefully used the word "should" or "would," as opposed to "will."

JUDGE TRIKOUROS: You can pull that up. This is --

MR. POWERS: I did use the word "will."

JUDGE TRIKOUROS: Right.

MR. POWERS: And it should provide enough space. I say "should" because I have not had an opportunity to go through the dimensioning exercise. But the point I would like to make here is I know in the revised report, Southern Nuclear, we see these 30-foot round ducts.

And that is presented as the only takeoff that you would see coming from under the steam condenser or under the turbine and then moving at the air-cooled condenser.

The duct work coming off of that from beneath the steam turbine can be designed to accommodate whatever the current configuration is, meaning that they have got structural columns every 30 feet in a space 20 feet high. You've got six or eight of them. You can potentially utilize that space and conform it with square ducts that go into a round transition.

Anyone who has any experience working with duct work, even though this is large duct work, knows that you can go from square to round and fit it where you need to fit it. You would have to do a more detailed study of the standard plant design to see how you would arrange those takeoffs and just do a cost-benefit.

Does it make sense for us to leave the structural steel where it's at and go from square to round or should we go with 30-foot ducts because that works? And it requires no modification.

JUDGE TRIKOUROS: All right. Well, I just wanted to make sure that I understood the answer to your question. And I do. You didn't use any design information. You were using your best judgment as to what the effects would be.

MR. POWERS: I would also like to point

out that Mr. Cuchens also points out that that could, in fact, be the case that removal of the surface condenser opens up sufficient space for the air-cooled condenser.

But Southern Nuclear has not studied that. And so that remains an open question based on the sheer size of the surface condenser. There should not be any technical issue to getting sufficient cross-section to move that exhaust steam out to the air-cooled condenser.

JUDGE TRIKOUROS: Okay. With respect to the turbine building that is discussed, described in the standard design section 10.2, Mr. Cuchens discussed an extensive set of modifications that would be needed for that turbine-building design to accommodate dry cooling. Would you agree that extensive modifications would be needed to that turbine to accommodate dry cooling, the turbine-building design?

MR. POWERS: I think it is completely qualitative in that my statement is that putting -- I was using the term "20-foot diameter" or "20-foot diameter penetrations into the wall of the building."

Given the scope of the project, to me that is a relatively minor modification to that building.

SNC asserts that it is a major modification. It is a qualitative judgment on what comprises a major modification.

They talk about further feedwater heaters that would have to be relocated since they're currently sitting on top of the surface condenser. Well, they could be relocated into the ducts going off the steam turbine to the air-cooled condenser.

It's the same steam. And so all of these problems or at least the ones I looked at on their list seemed to be relatively straightforward modifications. I would refer back to the GE design control document, where they seem to think that we will put in the turbine that we think we need for site-specific conditions, that these documents are relatively high-level standardization.

I would agree that standardization at a point to the degree it makes sense is a good idea, but if you get into a situation where you are going to use an air-cooled condenser, you're going to have to modify the building law. That's just the way it is.

JUDGE TRIKOUROS: But with respect to these 20-foot diameter openings, you didn't use any design information to reach your conclusions regarding the modifications that would have to be made?

MR. POWERS: No, I have not reviewed the building plans. I am not sure that at this level of design a standard design includes structural beam locations and that type of information. Maybe it does.

JUDGE TRIKOUROS: You didn't speak with Westinghouse at all, did you, about any of this?

MR. POWERS: What question would I have asked Westinghouse?

JUDGE TRIKOUROS: What they would think of the extent of structural modifications that would be needed to accommodate a dry cooling system. Had you contacted Westinghouse at all to discuss any of these issues with them?

MR. POWERS: I contacted GE. That predated this particular project. But I do reference that in my report that I did talk to who they considered to be their lead on a particular turbine design they got, the D-11. And I was asking him specifics about the difficulty of modifying a standard backpressure turbine to high pressure operation or high backpressure operation. And the modification is very basic: removal of the last-stage bucket, the last set of blades.

And we were talking about it in the

context of making a modification to turbines that had been purchased as standard design turbines but would need to be modified to accommodate an air-cooled condenser and whether or not that should just be done in the field or the turbine would be better modified in the plant.

JUDGE TRIKOUROS: Okay. In question 23, you make a statement that a standard design serves as a point of departure for customizing the design for a specific site with specific site constraints.

In making that statement, are you saying that the turbine building is a site-specific structure or that it is part of the standard design? Basically that statement doesn't imply that the turbine building is not part of the standard design.

MR. POWERS: The question is, is the turbine building a sufficiently integral part of the design that it would be a major issue to modify it?

JUDGE TRIKOUROS: Yes. Would you consider that the turbine building is, in fact, an integral part of the standard design that is currently identified in the DCD?

MR. POWERS: I would agree you have to have a turbine building. I would not agree that the --

JUDGE TRIKOUROS: When you say it is a departure point, it is the words "departure point" or the words "point of departure" that are really at issue here.

MR. POWERS: My understanding of the standardization, these standardized designs, is that the more you can standardize design, you can lower costs and that to the extent you're at any site that has a different requirement for your application, then you may have to move off the standard design and that might increase the cost.

But I don't see the standard design as an inviolate situation. And I think that I can't imagine that the shell of the turbine building would preclude you from using air cooling if you chose to because that shell was designed before you looked at a particular site where you had to use air cooling. So now you can't punch holes in the shell of a building to let those ducts out. I just can't imagine that being a showstopper.

JUDGE TRIKOUROS: I think what I'll do is just I won't continue with these statements that you have made regarding design issues or modification issues. I think basically you did not do a formal engineering evaluation. You didn't look at engineering drawings. You didn't speak directly to Westinghouse.

So basically when you talk about different things that could or could not be done, you are doing it on the basis of sort of a conceptualization. Is that a correct statement?

Because you make a number of these statements. And I just want to make sure that I understand the extent of detailed design work that went into those statements or if they were, again, conceptual statements.

You did have access to conceptual information, some overview diagrams, those types of things, I'm sure. Is that a correct statement? I don't foresee the need to go through each of these independently.

MR. POWERS: I wouldn't say that's a correct statement. For one, talking to Westinghouse, I realize you asked that question earlier to Mr. Cuchens. And in that case, it was you've made a long series of statements about the lack of viability of being able to modify the design or the turbine, "Did you talk to Westinghouse?"

I thought that was a very appropriate question because it turns out that that is opinion about what Westinghouse might or migth not be able to do.

I would like to differentiate that from removing the last-stage bucket from the standard turbine to use it in an air-cooled condenser design. That is a universally understood modification to a turbine to adapt it to a high backpressure application.

I don't see where I would need to call Westinghouse to confirm that that is what they have done on numerous projects where they use air-cooled condensers with the turbine.

The issue about my opinion about whether the design control document, for example, in the standard design is something that is fixed and set and it can't be modified, I would just refer back to the design control document that is at JTI000051, the statement that GE makes on the ESBWR, where they say, "In the design control document, other turbine configurations may be selected for plant-specific applications in order to obtain optimal thermal performance of the turbine plant at the site-specific conditions."

And this statement says to me that they see us in play modifying the turbine design to fit the turbine condition that it is not an extraordinary step to consider this, even though there is a basic standard design.

JUDGE TRIKOUROS: You heard the testimony --

CHAIRMAN BOLLWERK: What page are you reading from? I'm sorry. What page?

MR. POWERS: Page 1.2-50.

CHAIRMAN BOLLWERK: Thank you.

JUDGE TRIKOUROS: You heard the testimony of Mr. Cuchens earlier regarding what standard design means in terms of interconnections of things so that there are analyses that are done in other parts of the DCD in the plant design that all would have to be reevaluated in light of any changes that are made pretty much anywhere because the standard design is sort of an integrated system. Do you agree with that?

For example, the turbine missile analysis that's done in the DCD, the issue regarding 100 percent load rejection, was discussed, potential to have to re-look at the primary to secondary leakage calculations. There's a bunch of radiological analyses that are done for steam generator tube rupture, for example, and a number of others as well.

All of these things would have to be at

least re-looked at, not necessarily reanalyzed but re-looked at. And then somebody would have to write a dissertation on why they wouldn't have to be reanalyzed.

Do you agree with all of that, that you can't just touch that plant and ignore the rest of it?

MR. POWERS: I would agree with that. I think using the number that I put out earlier, which I think is reasonably accurate, about $8,000 of kW, this Vogtle 3 is a $10 billion project.

And so to have my engineering team spend some number of millions to go through every line and verse of AP1000 standard design and make the appropriate modifications, I don't see that as a -- that may be an appropriate step.

JUDGE JACKSON: Judge Trikouros?

JUDGE TRIKOUROS: I'm sorry. Yes. Go ahead.

JUDGE JACKSON: Before we leave this area, I wanted to ask you a question about -- this is not a bright line. In your experience, you found that you can scale up large heat exchangers in these kinds of applications by, say, a factor of two and not have growing pains and difficulties?

MR. POWERS: In this case I think it is

somewhat of a moot point because the first design that was proposed or analyzed by Southern Nuclear was a 324-cell air-cooled condenser, which, as I pointed out in my testimony, you would not approach a design in that way. No one would build a unit of that type for this application.

The second iteration was what we both agreed is state-of-the-art, which is approximately 200 cells for the ACC. And one of the examples of mine from my initial declaration is the Midlothian plant in Texas. And, in fact, there are two pictures in that. There is the Midlothian plant in Texas, and there is the Matimba plant in South Africa.

The Midlothian plant -- it may be an exhibit. It must be an exhibit. I just don't have the complete exhibit list here. That would be worth taking a look at, the pictures of Midlothian and Matimba because Midlothian, it is true that the air-cooled condensers of Midlothian are coming off six different units.

CHAIRMAN BOLLWERK: There's a photograph. Is that what you're --

MR. POWERS: Yes.

CHAIRMAN BOLLWERK: That would be JTI000037.

MR. POWERS: If we look at the top photograph, we can see on the right-hand side there are six large gray shoe boxes, basically, with pipes on the top. Those are the air-cooled condensers.

And in -- let's see. Here we have got, in this case, we have got 90 cells total. If we go down in Matimba, which is below, we have a few hundred cells at Matimba. This is a 4,000-megawatt plant near cool condensers.

Everything in the foreground and the issue of putting a very large number of air-cooled condenser cells together has been done at a scale quite a bit larger than it would be used in the AP1000. The issue then is plumbing.

Okay. We put several hundred of these together, Matimba. And now we want to put 200 together for Vogtle 3. The plumbing would be different, but operating hundreds of air-cooled condenser cells together is not a novelty.

It has been done. This plant has been operating for 15 years. This is not a new installation. So I don't see any scale-up issues when it comes to putting a large number of condensers together.

JUDGE JACKSON: Basically you're saying

your experience shows that you don't tend to have growing pains when you go into new applications that haven't been done before?

MR. POWERS: I would like to make a distinction here. The common element through all of these plants is the steam turbine. And the function of a nuclear plant, coal plant, gas plant is to make steam. And that steam goes through a steam turbine. And this is the condenser system for the steam turbine.

And so the issue of it being a nuclear plant for the sake of talking about the cooling system to me are two separate issues. There's no -- other than the cooling system, it happens to be adjacent to a nuclear plant. What matters is the steam turbine.

JUDGE JACKSON: Would you agree there can also be coupling perhaps in a nuclear plant in the safety analysis and potential accidents and so on that might feed back differently than, say, a fossil plant of some kind?

MR. POWERS: Only in the sense of an ancillary system's reliability because all of this would be external to what I understand in the nuclear core component of the plant.

And my presumption would be that what the plant would require from the cooling system is high reliability. And it would get that with the air-cooled condenser.

JUDGE JACKSON: Okay. Thank you.

JUDGE TRIKOUROS: Yes. Just to clear the record, there are links. We talked about the 100 percent load rejection requirement. There are others as well. There are design requirements on the primary side that are impacted by the performance of the secondary side.

And, in fact, the TMI-2 accident was started on the secondary side, for example.

MR. POWERS: What accident was that?

JUDGE TRIKOUROS: What's that?

MR. POWERS: What accident was that?

JUDGE TRIKOUROS: I couldn't --

MR. POWERS: I thought you said that an accident had started on the second --

JUDGE TRIKOUROS: TMI-2 accident. It started on the secondary side, not the primary side.

Okay. In your opinion, would you say that the AP1000 with a high backpressure turbine would operate as reliably and efficiently as it would with the standard turbine?

MR. POWERS: Yes.

JUDGE TRIKOUROS: Yes? Is there any experience with that, with those turbines that you could point to to substantiate that?

MR. POWERS: With the AP1000 turbine?

JUDGE TRIKOUROS: No. With high backpressure turbines in a plant like the AP1000.

MR. POWERS: There are no large nuclear plants that are equipped with air-cooled condensers. And so there is no field experience with an air-cooled condenser in a large nuclear plant. We're looking at the Matimba plant, which is nearly 700 megawatts in a unit. And there's --

JUDGE TRIKOUROS: Is that a high backpressure turbine?

MR. POWERS: Matimba is, yes.

JUDGE TRIKOUROS: So there is experience out there with high backpressure turbines, but they are not nuclear?

MR. POWERS: That is correct.

JUDGE TRIKOUROS: As far as cost differential goes, the high backpressure turbine is a comparable cost to a standard turbine?

MR. POWERS: Slightly less.

JUDGE TRIKOUROS: Why don't we go on to Dr. Young?

JUDGE JACKSON: Can I just ask one question before we --

CHAIRMAN BOLLWERK: Yes, absolutely.

JUDGE JACKSON: In your testimony you talked about an ACC design system and that it would be simpler. We discussed that earlier and the issue of the complexity of having a large number of fans and dry motors and so on that would require more maintenance than the wet cooling tower.

Do you dispute that the complexity of the dry system would cause potential maintenance issues and reliability issues versus a wet cooling system?

MR. POWERS: I do. The fact that you have got 200 fans, 200 low-speed fans, does not imply higher maintenance because there are 48 fans in the wet cooling tower and 200 in the dry tower for the air-cooled condenser.

And I don't have a paper at my fingertips on this, but the principal vendors at air-cooled condensers are the principal vendors of wet cooling towers with the same company. They make the same. It's part of their product line.

I've worked with them off and on for many years. And the air-cooled condensers consistently have less maintenance than the cooling tower. And it's not surprising. Cooling tower is moving a lot of water. There are corrosion issues, cleaning issues. And, again, it's anecdotal. I can't provide a paper today.

JUDGE JACKSON: I want to ask you if there's any evidence or anything in any of your exhibits that we could look at to check this.

MR. POWERS: I do not think I have included an exhibit that compares the projected maintenance for an air-cooled condenser versus a cooling tower. The only testimony I can provide here is based on my conversations with the manufacturers of that equipment. But I would not assume that because there are more fans on an air-cooled condenser, that the -- I mean, the fans on a wet cooling tower, for example, are exposed to all of the moisture and difficult operating conditions of that system; whereas, fans on an air-cooled condenser are looking at ambient air.

My understanding is that they are consistently lower maintenance than cooling tower.

JUDGE JACKSON: Thank you.

CHAIRMAN BOLLWERK: Do we want to take a break? Mr. Trikouros, do you have any objection if we take a couple of minutes here?

JUDGE TRIKOUROS: No.

CHAIRMAN BOLLWERK: All right. It's just a little before 5:00 o'clock. Why don't we take a break until 5:15. Thank you.

(Whereupon, the foregoing matter went off the record at 4:56 p.m. and went back on the record at 5:14 p.m.)

CHAIRMAN BOLLWERK: We're back after our break. Judge Trikouros I think has some additional questions or some questions for Dr. Young, I think.

JUDGE TRIKOUROS: Right. Dr. Young, in your rebuttal testimony, question 1, is it your assertion based on that testimony that any impact, even if it's small as per the FEIS, requires a detailed evaluation of alternative cooling systems? And if so, what is the basis for that?

DR. YOUNG: For question 1, my rebuttal was just to point out the contradictory statements by Mr. Vail. In the FEIS, the conclusion that the impacts would be small based on a criteria from one portion or one document basically meant that there would be no adverse impacts.

But in another area, the conclusions where they used the term "small" was used in conjunction with the assessment that there would be some adverse impacts associated with the dry cooling alternative when the original use of small in terms of the wet cooling in that context, I believe, meant no adverse impacts.

So if there were really no adverse impacts using wet cooling implied by the term "small," then why would there be adverse impacts using the term "small" in terms of dry cooling? There just seemed to be a contradiction there. And I was just pointing that out.

JUDGE TRIKOUROS: Further, with respect to the need to evaluate dry cooling in more detail, do you agree that if the impact is small, that the FEIS level of evaluation was appropriate or would you think it was inappropriate?

DR. YOUNG: In?

JUDGE TRIKOUROS: In the staff's evaluation of the FEIS.

DR. YOUNG: Whether their conclusion is appropriate?

JUDGE TRIKOUROS: Well, the way I read it, you were saying that, regardless of whether or not an impact is small or not, a detailed evaluation of alternatives should have been done with respect to cooling systems. That's how I --

DR. YOUNG: Okay. So referring more to the last two sentences, where I stated, "Accordingly, it is possible that under a small impact situation, adverse impacts on aquatic species may still exist"?

JUDGE TRIKOUROS: Right.

DR. YOUNG: Yes, I agree with that that some of these small impacts could be on threatened and endangered species or species of concern. So overall you may have small impacts in terms of entrainment or what on species that is abundant, but even some impact on a threatened and endangered species should be evaluated. That's what I was referring to.

In terms of whether or not you select a particular technology, is that the second part of your question?

JUDGE TRIKOUROS: Right.

DR. YOUNG: Well, yes. I think that if it turns out that you are impacting threatened, endangered, or species of concern, that you should probably try to exercise some caution and evaluate another technology that might eliminate those impacts on your threatened and endangered species.

JUDGE TRIKOUROS: Okay. So that is what you meant by that testimony?

DR. YOUNG: So yes.

JUDGE TRIKOUROS: Okay. The question that we have been asking everybody. We are going to ask you as well. Let's go to question 2 of your testimony. Could you explain the distinction between the existence of endangered species and the existence of extremely sensitive biological resources? And I guess I would wonder if the significant risk is sort of the attending term for you in terms of that standard.

DR. YOUNG: Okay. Is this also like in conjunction with potentially like my question 6, sort of addressing that same issue?

JUDGE TRIKOUROS: Yes, right. It was, right, exactly.

DR. YOUNG: Okay.

JUDGE TRIKOUROS: Well, I'm sorry. It's in answer 6 of the prefiled direct testimony of Dr. Coutant.

DR. YOUNG: Okay. For the most part, this extremely sensitive resources issue to some extent, it's really a non-issue in terms of my testimony, that I agreed with both the staff and the applicant that the EPA did not intend to establish a category called "extremely sensitive resources."

It's just that, however, in my rebuttal

testimony, I am simply disagreeing with Dr. Coutant's statement that the EPA requires some significant impacts on these species or threatened and endangered species before any dry cooling should be considered.

From what I understand, the EPA does say that dry cooling may be an appropriate technology when there are some extremely sensitive biological resources, which I imagine the threatened and endangered species are inherently an extremely sensitive resource in any water body that in that case you should proceed with caution or exercise, take care and exercise, that caution when evaluating impacts.

And it was just in rebuttal to this new term that showed up in Dr. Coutant's testimony that it appeared that he had created some new criteria that I was not aware of. And so I addressed that.

JUDGE TRIKOUROS: Okay. I think for me the issue is if there is such a thing as an extremely sensitive biological resource, that its mere existence would initiate a detailed evaluation of alternative cooling systems, possibly the installation of a dry cooling system in the end, as opposed to the need to show that an endangered species and an extremely sensitive biological resource is at risk. And only if it's at risk do I then consider a detailed evaluation of alternative cooling systems and possibly the installation of dry cooling. I think that is a big difference, really.

The staff position and SNC position is if the existing technology is not going to put that resource at risk, then I really don't need to go any further. But the other definition would say untrue. You still have to go further.

DR. YOUNG: Could I answer that in two parts?

JUDGE TRIKOUROS: Sure.

DR. YOUNG: First part, I would like to reiterate that I am only responding to something, this criteria that is stated by Dr. Coutant. I didn't create this new extremely sensitive resource having to be at significant risk. I just responded to what appeared to be a new level of significance created to determine impacts or to evaluate alternative technologies. That was the intent for the most part of the rebuttal.

In the second part, discussing that if you show there are only small impacts, you know, from this proposed wet cooling, then why even move on? I would say in my estimation, there are a number of pieces of testimony and information sort of discussing these threatened and endangered species or species of concern that may qualify for this extremely sensitive resource that need to be evaluated to determine whether you should move on to that evaluation of dry cooling or alternative technologies.

For instance, Dr. Coutant discussed the migratory pattern of robust redhorse or even shortnose sturgeon, saying that, well, the facility appears to pose no obstacle to migration for the adult stages, which is likely true.

However, he stopped short there. And what he doesn't discuss with you is that it likely does pose an obstacle to the larval stages of those species when they're in a drift community.

And so there are a number of omissions to evaluate whether these extremely sensitive species or threatened and endangered species of concern, however you would like to classify them, are indeed impacted by the current facility or the cumulative impact of expanding to four units. And so that is what I am trying to address in this rebuttal testimony.

JUDGE TRIKOUROS: All right. Thank you.

With respect to your rebuttal question 9, -- and I'm hesitant to get into more and more a mental discussion because we have done so much of it, but I will ask you this one question -- given your testimony that Vogtle 3 and 4 will adversely impact the larval fish of the robust redhorse, what can you say about the impact of Vogtle 1 and 2 on this drift community? Shouldn't there have been measurable impacts over the many years of this operation?

DR. YOUNG: Could you repeat which question and answer?

JUDGE TRIKOUROS: It's question 9. It's referring to answer 7 of Dr. Coutant's prefiled direct testimony, your question 9 in your rebuttal.

DR. YOUNG: Could you please repeat your question?

JUDGE TRIKOUROS: Yes. I'll read it again.

DR. YOUNG: Thank you.

JUDGE TRIKOUROS: Given your testimony that Vogtle 3 and 4 will adversely impact the larval fish of the robust redhorse, what can you say about the impact of Vogtle 1 and 2 on this drift community? Shouldn't there have been measurable impacts over the many years of plant operations?

DR. YOUNG: That there should have been some measurable effect?

JUDGE TRIKOUROS: Shouldn't there have

been measurable impacts over the many years of Vogtle 1 and 2 operation on the robust redhorse?

DR. YOUNG: Well, there isn't really any way to quantify the impact on the robust redhorse because there were no studies conducted between construction and operation in the '70s until recently.

So there was no monitoring directly looking for the robust redhorse to monitor it. And it was actually lost for many years. It was thought to be extinct.

So apparently if people did pick up specimens of that species, they likely misclassified them.

JUDGE TRIKOUROS: Okay. I think that answer will apply to my next question as well. All right. I think that's it.

I guess this question of the impact of units 1 and 2, if I were to generalize the question and say, would you say that Vogtle 1 and 2 operation has had an impact, a measurable impact on any fish species in the Savannah River?

DR. YOUNG: I would say yes.

JUDGE TRIKOUROS: Would you elaborate on that?

DR. YOUNG: Yes. Just looking at the

trends in the more important species that have constituted the fisheries historically and now looking at robust redhorse, is that the general trend since major development for different energy sources on the Savannah River?

Striped bass were in decline, partially because of these developments up river and down the estuary. But also American shad had declined. Two species of sturgeon have been placed on -- well, one is known as a threatened and endangered, the second one, the Atlantic sturgeon, is in very low numbers and was petitioned.

On top of that, there are several catostomids, including the brassy jumprock, that, as far as I know, is rare, at best. It actually hasn't even been scientifically classified, the species, as far as I know. But we don't see it, hardly at all.

Highfin carpsucker, another sucker; the quillback carpsucker over the years appear to be in decline. Of course, these are species that aren't studied or they don't get funded for study.

But from my experience in talking with other scientists and biologists from different agencies, there is a noticeable trend that a lot of these species are in decline. And that's in addition to the robust redhorse, which was presumed extinct with very few specimens captured until recently, when we finally understood a little bit more about their life history.

But still the population of robust redhorse is still only predicted to be potentially in the hundreds of adults, which is not very much to sustain a fish population.

And that is occurring during the time, of course, in conjunction with SRS, other development, but it does correspond to the period with the operation of Vogtle plant units 1 and 2.

Just to elaborate, in addition to that, I discussed yesterday that if you look at the Go Fish Georgia and that fishing prospectus is improving or is now good, like I said yesterday or maybe this morning, I don't think it's just coincidence that the prospectus is improving at the same time that we have started to properly manage the flows from Thurmond Dam to lessen the variation.

SRS has been decommissioned. We have reduced fishing pressure, a number of human activities. We have lowered our impact. And it appears to be I believe it's a correlation that the fish are rebounding when we lessen our impact.

JUDGE TRIKOUROS: These declines that you have been discussing, are they unique to the Savannah River?

DR. YOUNG: No, sir. They're unique to most rivers in the eastern United States, which most of them have major energy production facilities, including nuclear power, other types of energy production, dams, the whole gamut.

JUDGE TRIKOUROS: All right. Thank you very much.

JUDGE JACKSON: Do you have any evidence that these declines are in any way connected with the operation of Vogtle 1 and 2?

DR. YOUNG: No, sir. But, as we discussed before or in my previous testimony on contention 1.2, it is very difficult to tease out which facility causes which direct impact because you have these system-wide fluctuations or declines in fish populations when you have all of these different activities going on at the same time.

It is known that our impact cumulatively from all these different facilities causing the impacts are the reason. It's just very difficult to tease out exactly which one causes which.

We know that there is some entrainment

going on at that facility. Whatever level it is, any entrainment still is a negative effect on a fish population or a fish community.

JUDGE JACKSON: Is there any clear evidence that it is any activity related to power plants that cause it or could it be climate change, something to do with the amount of food available, something to do with other conditions? Could it be any of those as well?

DR. YOUNG: Well, it could be some of those as the direct impact, but the operation of Vogtle units 1 and 2 causing variation to Savannah River could cause a food shortage or a disruption ecosystem, especially in conjunction when you are operating Vogtle, you are operating -- not "you" but the operation of SRS, other energy production facilities, dam operations upstream.

Again, I'll refer back to Marcey, et al. They write a section as the authority on this particular ecosystem. And they have a section on the human influences of the fish in the middle Savannah River basin. And in that discussion, as we discussed previously, they list the entrainment at SRS in Plant Vogtle within that discussion.

I interpret that as entrainment is

negative. So it has had a negative impact on those fish. I am aware that you didn't concur in that, but they are the authority, including Mike Paller, who is one of the biologists at SRS.

And he must have concurred that that could be included in that document. And it states, "Entrainment at those nuclear facilities as part of the human-induced effect on the fishes of the middle Savannah River basin."

JUDGE JACKSON: Is it possible to separate variables in a complex system like this that might have many causes involved?

DR. YOUNG: Yes. You could tease these out. Like, for instance, from the entrainment study that was conducted, this ichthyoplankton sampling, the spatial distribution over the last year whenever the study was conducted is known.

You could extrapolate that to see where those organisms would have drifted in terms of that thermal plume to determine if the thermal plume was negatively affecting any of those species.

Yet, if you review all of the documents, that analysis was never conducted, even though the data needed is there. So nobody ever conducted the analysis of the drift community coming through the thermal plume.

So that is still up in the air. But that would be one instance that you could determine if that thermal plume is affecting the drift community and which species it is affecting.

JUDGE JACKSON: Okay. So your testimony is that you can separate variables in a very complex system like this and determine which are really causing the impacts?

DR. YOUNG: Yes.

JUDGE JACKSON: That's your bottom line?

DR. YOUNG: It is difficult, but it is possible. Another example is that we were talking, other folks have talked about the spawning of the robust redhorse on the gravel bars near Savannah Bluff Lock and Dam in between the lock and dam and Vogtle plant.

My colleagues at Clemson performed numerous studies there. And it became obvious to us and then it was published in a paper by Dr. Tim Grabowski and Dr. Isely that flow fluctuation from the dam appeared to be limiting recruitment or spawning on those gravel bars.

It was just fairly obvious that when you raise the water and all the fish move up and spawn and then you drop the water and your eggs are left on dry land, they are going to die. And they did die. And so that was a fairly obvious cause that could be teased out.

A lot of other things are more complicated than that, but it is possible.

JUDGE JACKSON: Thank you.

CHAIRMAN BOLLWERK: Just for record purposes, the Marcey, et al., that you talked about, that's NRC exhibit 000006. Is that --

DR. YOUNG: I believe so. I can check here.

CHAIRMAN BOLLWERK: Do you have anything further?

JUDGE TRIKOUROS: No.

CHAIRMAN BOLLWERK: Judge Jackson? While he is looking for that reference, maybe you all -- I don't know if you have any questions or do you need a couple of minutes to generate some or you have some? I don't know here your --

MR. BLANTON: I think we had a few, and we may add some more order, Judge.

CHAIRMAN BOLLWERK: All right. What do you need, about ten minutes, then?

MR. BLANTON: Yes.

CHAIRMAN BOLLWERK: All right. Do the minutes work for everybody?

(No response.)

DR. YOUNG: Yes, sir. That is 6, NRC 6.

CHAIRMAN BOLLWERK: All right. Thank you. We will take a ten-minute recess, then. Thank you.

(Whereupon, the foregoing matter went off the record at 5:39 p.m. and went back on the record at 5:52 p.m.)

CHAIRMAN BOLLWERK: We are going to go back into session. We have some questions. And I take it I didn't perceive any from the other two parties. All right.

This is a question for Dr. Young. In looking at SNC000097, you indicated that it demonstrates that the fish populations are improving in the Savannah River. I guess the question is, in light of that and the fact that Vogtle 1 and 2 have been operating during the period of time once these species have recovered, isn't there some sort of tension in your statement at least?

DR. YOUNG: Well, I would like to clarify. I didn't state that they recovered. I stated they were rebounding.

CHAIRMAN BOLLWERK: Improving. Right.

DR. YOUNG: Improving. Yes.

CHAIRMAN BOLLWERK: But, nonetheless, Vogtle 1 and 2 have been operating during the period they have been improving. So there seems to be at least some tension in between the two?

DR. YOUNG: Well, I could understand that. Well, it appears that the Vogtle units 1 and 2 are not the sole cause of those declining fish populations. If it's just a contributor, when you eliminate the other contributions, there will be some rebounding.

Because those fish are rebounding now with the decommissioning of other facilities doesn't mean that there wasn't an effect and there still isn't an effect. I mean, there is some level of entrainment going on there.

So, thus, again, they're rebounding, but they have not recovered. So I don't see how you can insinuate from going to rebounding to that they're fully recovered and because they're rebounding now, that it's obvious there was no impact from the facility.

CHAIRMAN BOLLWERK: Okay. Anything the other judges want to add with respect to that?

(No response.)

CHAIRMAN BOLLWERK: All right. With respect to the other question, they actually have a question for Mr. Powers. You are available tomorrow, I take it? Is that true, sir?

MR. POWERS: Yes, sir. I currently have a flight leaving Atlanta about 4:30 P.M.

CHAIRMAN BOLLWERK: Thank you.

In looking at the questions we have on what the Board has been thinking about, we would like to do something tomorrow morning with Mr. Powers as well as any witnesses from the panel that the applicant provided that they think would be appropriate.

And what we would like to do is have Mr. Powers and whatever witnesses from that panel you want to have on for a series of questions. And we will basically direct questions to one of the witnesses and allow, then, a witness from the other party to respond after they have heard the answer.

We think that would get a better dialogue because there seemed to be a number of things in dispute here, as your questions seemed to indicate. So we thought that would be a good way, rather than asking a series of questions, bringing people back on and off to expedite that.

The staff, I don't think for purposes of this we are talking about what we have been talking with Mr. Powers about for the last several hours.

I am not trying to be pejorative in any way, but your testimony just doesn't go that direction. So I don't see any reason to have the staff witnesses as part of that panel unless you disagree or you want someone to be sitting there.

MR. MOULDING: No, Your Honor. I think we agree with what you have suggested.

CHAIRMAN BOLLWERK: All right. And, again, I think our feeling is that certainly having Mr. Cuchens there would be useful, but we will allow you to put only Mr. Cuchens or two members of that panel or all four of them up there if you think that is appropriate. We will leave that up to you all and then Mr. Powers for the intervenors.

And, again, I would also mention that we have a series of questions from the applicant in light of what I just said. If either of the other parties have additional questions they would want us to be posing given we are going to have both as witnesses for both parties up there, we are certainly willing to accept those in the morning.

It would be helpful to us -- and I should mention since it's Saint Patrick's Day that we have been going late, everybody needs to go out and celebrate a little bit tonight -- we will start at 9:00 o'clock tomorrow morning. It's a little bit of a break here.

If you could get any questions to us by about 8:45, we would appreciate that. That way we can look at them beforehand, and we won't have to spend time, a delay in starting the proceeding. So we will all come in bright-eyed and bushy-tailed at 9:00 o'clock, right, having not had too much green beer, green whatever else tonight.

Any questions about what I have just proposed from anyone?

(No response.)

CHAIRMAN BOLLWERK: And, again, the basic process will be we will direct a question to a particular witness, ask for that witness' response, and then the witnesses for the other party will be allowed to give any response they might have based on that answer.

We may let it go on for a while depending on what the answers are and the dialogue that is ongoing. We think it's a more efficient way to sort of get to the bottom of some of these things.

And we will be here to play sort of referee to some degree. I am a soccer referee. I didn't bring my red and yellow cards with me, but hopefully I won't need them. So everybody will be on their best behavior in terms of the opportunity.

This is really an opportunity for you all to have a dialogue and try to help us get some information. And we do appreciate it.

Any questions about that?

(No response.)

CHAIRMAN BOLLWERK: All right. And then once we are done with that, obviously we will move on to the next contention.

I don't think there is anything for Dr. Young or on the environmental side at this point that we have any further questions about. All right. Any questions?

If not, we stand, then, adjourned until 9:00 a.m. tomorrow subject to whatever questions you might want to bring us at 8:45. Thank you very much.

(Whereupon, the foregoing matter was recessed at 5:58 p.m., to be reconvened on Wednesday, March 18, 2009, at 9:00 a.m.)

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: Early Site Permit

Docket Number: 52-011-ESP;

ASLB No. 07-850-01-ESP-01

Location: Augusta, 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

Tobias Walter
Official Reporter
Neal R. Gross & Co., Inc.