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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

SUBCOMMITTEE ON HOPE CREEK GENERATING STATION, UNIT 1

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

SUBCOMMITTEE ON HOPE CREEK GENERATING STATION, UNIT 1

Sheraton University City
36 and Chestnut Streets
Philadelphia, Pennsylvania

Wednesday, November 28, 1984

The subcommittee meeting convened at 2:30 p.m.

PRESENT:

C. FIEFF
J. EBERSOLE
M. CARBON
C. MICHAELSON

Lynette daniels

DR. SIESS: The meeting will now come to order. This is a meeting of the Advisory Committee on Reactor Safeguards Subcommittee on Hope Creek Generating Unit.

I am C. P. Siess, Subcommittee Chairman.

The other ACRS members present today are, starting on my left, Mr. Carbon, Mr. Ebersole, Mr. Michelson; and we also have a consultant, Mr. Pomeroy.

The purpose of the meeting is to review the application filed by Public Service Electric and Gas Company for a license to operate Hope Creek Generating Station Unit 1.

This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act and the Government in the Sunshine Act, and the designated Federal employee for the meeting is Mr. Gary Quittschreiber, at the end of the table; and Mr. Med El-Zeftawy, on my right, of the ACRS staff is helping in that respect.

The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the Federal Register on November 9 and November 21, 1984.

A transcript of the meeting is being kept and will be made available as stated in the Federal Register Notice. It is requested that each speaker first identify himself or herself and speak with sufficient clarity and volume, and I replace that phrase, use the microphone. I don't know if volume is going to help you without a microphone in here, so he or she can be heard, not only by the audience, but by the reporter.

We have received no written statements from members of the public. We have received no requests for time to make statements from members of the public. We have the most recently revised agenda. Do all the members of the subcommittee have the most recent one?

MR. QUITTSCHREIBER: It is in the book.

DR. SIESS: Okay. I haven't looked at the book yet, which calls for the meeting to start at 2:00 o'clock, and to go this afternoon until about 6:00 o'clock. We are starting about a half an hour late, which suggests on the basis of my experience that we will be ending somewhat more than a half hour late today. But we will try to keep within the allotted times. And I use the "we" advisedly because it is usually the subcommittee that is responsible for overruns, rather than the presenters.

Was there something postponed? I&E was scheduled for this afternoon and had to be postponed or are they scheduled for tomorrow?

MR. EL-ZEFTAWY. No, Region I, they will appear tomorrow at 10:25; Item 2-B.

DR. SIESS: Okay. So we gain a short amount on Item 2-B, Construction Experience -- Noncompliance During Construction, the report from Region I. I still call them I&E,

but they are officially a region now. Mr. Starstucky from the region will be in tomorrow to give that report.

We have tried to include on the agenda those matters that it is customary to look at, as well as those matters which are of particular interest to the ACRS at this time. We may not have succeeded. And occasionally we may need to deviate. I believe that there were some questions posed by members of the subcommittee during the site tour this morning that answers will be provided some time today or tomorrow. If those answers should come at appropriate places within the subject matter, fine. If not, if the applicant will let us know whether they are prepared to present those, we will set aside a sufficient amount of time. And, if there are some that still remain unanswered, we can defer answers to the full committee meeting. But I would prefer not to do that because we will obviously have more time today and tomorrow than we will have during the full committee meeting.

Does that take care of your open questions?

Max, do you have anything?

DR. CARBON: No.

DR. SIESS: Are there any comments on the agenda from members of the subcommittee? If you look through it and see items you would like to add, just let me know. Equally important, if there are some items that you would personally prefer to delete, or truncate, and if there is any sort of a consensus on that, we will so inform the people that are planning to present it.

We should not, however, defer portions to the full committee meeting. Rather, we should try to take care of as many things here as we can that we can eliminate from full committee consideration. We have a good representation here.

Did all of you get the staff's SER in time to look at it? One day?

DR. EBERSOLE: That was a special case.

DR. MICHELSON: I had plenty of time.

DR. SIESS: You had plenty of time.

Max, did you have plenty of time? I had a good amount of time.

So I am going to suggest that people that are making presentations can make an assumption that -- and this applies somewhat to the staff more than the licensee -- I will have to keep calling you an applicant. You are a licensee for another plant. And I think it will apply in particular to the staff's presentation, because that is their document. But you can assume we have at least looked at it, and maybe read it. Or those portions of it. Nobody has read it, I am sure.

Have you read it?

MR. WAGNER: I have read it.

DR. SIESS: You have read it all. That is one person in the NRC that has read the whole thing.

MR. WAGNER: But I may not have retained it all.

DR. SIESS: Yes. It is unbelievable, but I will -- we will start off with the staff. Mr. Wagner is Licensing Project Manager, and I will turn it over to you. And I think we can do this in a lot less than an hour.

MR. WAGNER: We will try.

Thank you, Dr. Siess.

Good afternoon, ladies and gentlemen. My name is David Wagner and I am the Licensing Project Manager for the Hope Creek Generating Station for the NRC. Other staff members with me here today include Mr. Albert Schwencer, Chief of Licensing Branch No. 2 sitting at the table. In the audience we have John Chen, Fred Allenspach, and Phyllis Sobel from NRC.

Tomorrow we will be joined by Region 1 personnel. Right now we expect Richard Starstucky and Bill Bateman, the Hope Creek Resident Inspector, to be in attendance.

Many of you may remember the Hope Creek Generating Station as the Newbold Island Nuclear Generating Station. In 1970, Public Service applied for a construction permit for the Newbold Island Nuclear Generating Station. The site for Newbold Island Station was in the top of Bordentown, in Burlington County, New Jersey, which is about six miles south of Trenton on the Delaware River.

Due to population concerns, the physical plant of Newbold Island was relocated to Artificial Island, New Jersey, adjacent to Public Service's Salem Generating Station, which was then under construction.

In December of 1982, Public Service announced the cancellation of Hope Creek Unit 2, which was then about eight percent completed. With the exception of the containment, Hope Creek is very similar to other plants recently reviewed by the NRC, such as Limmerick and Susquehanna.

(Slide.)

MR. WAGNER: By the way, all these slides are in your handout, the NRC presentation.

Major licensing activities, and whether they were or will be completed are shown on this slide. As indicated, the OL application was docketed in March of 1983. In June of 1984, the draft environmental statement was issued. The final environmental statement is scheduled to be issued within the next couple of days. Of course, the staff's safety evaluation report was available earlier this month.

(Slide.)

DR. SIESS: I think you can skip that slide. ASLB and ACRS are separate distinct entities and we don't usually get involved in their business and they don't usually get involved in ours.

(Slide.)

MR. WAGNER: A number of the key design features included the safety auxiliary's cooling system and concrete secondary containment building.

Regarding the safety auxiliary's cooling system, which Public Service calls the Sacks, I think it is important to note that the Sack system forms an intermediate closed cooling loop. On one side, you have the station service water system. On the other side of the loop you have plant systems. So regarding brackish water intake, the safety auxiliary's cooling system essentially is a barrier to other plant systems from this brackish water.

In fact, the only components the brackish water from the Delaware Estuary sees are the four Sacks heat exchangers.

Regarding the concrete secondary containment, some of the other BWR plants are not fully reinforced concrete, as are Hope Creek. On Hope Creek, the lower levels, the upper levels and the roof are reinforced concrete. On some other plants, although the lower levels are reinforced concrete, the upper levels and roof may be comprised of sidings.

The staff's safety review is based on the Hope Creek FSAR through Amendment No. 7 and additional reports submitted in support of the FSAR. Additionally, numerous site visits, audits and meetings were conducted in the course of the review.

The safety review to date, we have approximately 15 open items, 37 confirmatory items, and 7 proposed license conditions.

(Slide.)

MR. WAGNER: Could you go up one more slide, please?

(Slide.)

MR. WAGNER: Projected now is a table of the open items. The staff has classified as open items for which a technical resolution has not been reached at this date.

DR. SIESS: What I would ask Mr. Wagner to do is put this list up and let's see which ones the subcommittee would like to hear more about. He has a slide for each of these with a little more detail, if you don't remember it. But, first, you just defined open items, and I still, except for OI initials, I am slightly confused between outstanding issues and open items.

MR. WAGNER: They are the same, sir.

DR. SIESS: I use all that plus open issues while I am writing it down.

You say there are things for which a resolution has not been --

MR. WAGNER: Reached.

DR. SIESS: -- reached.

But this list really falls into two categories. There are several of these items where the resolution hasn't been reached simply because you haven't finished your review.

MR. WAGNER: That is true.

DR. SIESS: Which could have been said about anything a few months ago, and presumably you will finish your review. When you finish your review, they may still be unresolved issues at that point. You don't know now.

MR. WAGNER: That is right.

DR. SIESS: There are others where there is a difference of opinion or position between the staff and the applicant as to whether they have properly met the NRC licensing criteria.

MR. WAGNER: Well, we really don't see any differing technical positions on any of these open items as yet.

DR. SIESS: Okay.

Now I would like to know what the status of the Riverborne missile is, and how it might be resolved.

MR. WAGNER: First, would you like the status of what the issue is.

DR. SIESS: Well, you can put the next slide up and tell us briefly.

DR. MICHELSON: Are we going to leave this one now?

DR. SIESS: This is number one.

DR. MICHELSON: Just number one, all right

MR. WAGNER: All right. I will leave it to you folks to read the summary that has been provided. Basically, during the probable maximum hurricane, the ten percent excedence high tides, the staff and applicant agree that about 12.3 feet of water will flood the site. That is a depth above site of 12.3 feet of water. The basis of our concern is standard review plan section 3.5.1.4, entitled "Missiles Generated by Natural Phenomena" in which it states the staff reviews possible hazards due to missiles generated by design basis flood.

DR. SIESS: Has that always been in the standard --

MR. WAGNER: It has since the --

DR. SIESS: This is the first time I have seen the issue raised. I am not saying it is not a legitimate issue, but missiles generated by natural phenomena has nearly always been tornadoes.

MR. WAGNER: There is another section about tornadoes. I think this is the first time floating missiles have ever been investigated. I don't know that for a fact.

DR. SIESS: Not the first time they have ever had the potential but the first time anybody ever thought of them under 5.51.

MR. WAGNER: Well, I don't know about that.

DR. SIESS: We just went through the SEP plants most of which get flood levels well above grade, and nobody thought of it there.

MR. WAGNER: Well, location has a lot to do with this. Specifically, the staff is concerned about Riverborne traffic, either breaking loose in Philadelphia or out in the bay.

DR. SIESS: Something that is big enough to damage a plant but small enough to float.

MR. WAGNER: That is right.

DR. SIESS: When you say 12.3 feet above the site grade, how do you define the site grade? Is that ground level outside the building -- service water building, and somebody said the flood level was up to the top of that concrete structure.

MR. WAGNER: I think it is important first to really ize what elevations the plant is at. At the service water intake structure, the plant is elevanted, either surface is at 10.5 mean sea level.

Going up to the plant itself, it is at 12.5 mean sea level. That is the outside.

DR. SIESS: So there is only two feet difference?

MR. WAGNER: That is right. It slopes up.

DR. SIESS: Then whoever told us that was wrong because that building is at least 20 feet high.

MR. WAGNER: Well, flood protection doesn't always -- it doesn't singularly occur. I am talking about the elevation of the soil. Now the service water intake structure is flood protected up to an elevation of 39 feet, which is about 27, 28 feet above the level of the site at that point.

Flood protection means it is protected against the static and dynamic effects.

DR. SIESS: Okay. So your concern here is that something with a draft less than 12.3 feet could float in and hit the building.

MR. WAGNER: Yes.

DR. SIESS: Was it the building or was it the waterproof doors? Which is your principal concern, or both?

MR. WAGNER: Right now the principal concern has to do with the door.

DR. CARBON: The doors of the intake structure.

MR. WAGNER: Floods of the safety-related structure.

DR. SIESS: To protect the plant against floods of this level, they have to be water-tight doors that are normally accessed.

What does it take to resolve this, and what -- I will ask the applicant to tell us what his proposal is. You can just tell me his proposal if you think you are near resolution.

MR. WAGNER: Okay. Right now the applicant has submitted a probability analysis on this event, and the staff is reviewing it. In fact, we have hired a wind engineering consultant from the National Bureau of Standards to look at some of the assumptions Public Service has made. The time line, conclusion of Public Service's report is that the probability of this occurring, a ship or any, really any type debris; a car, some kind of tank floating down the river during PMH and compromising plant safety is of the order of ten to the minus eight.

DR. SIESS: Why was a probabilistic approach taken rather than a deterministic approach of seeing what the doors could resist because nobody could decide what force would be on the doors?

MR. WAGNER: For static flood protection --

DR. SIESS: No, I mean for the barge or something that hits a door.

MR. WAGNER: We really haven't gotten that far into the review.

DR. SIESS: That is not in the review if it is probabalistic. Ten to the minus eight, you forget about it.

MR. SCHWENCER: Al Schwencer from NRC staff.

At the time the question came up, our review plan does permit another applicant to take a probabilistic approach in this area. We did pose that question and they, at that point, may wish to speak with us further today, but at that point, they -- they did not choose to address what it would take to fix the "what if" that you are asking.

DR. SIESS: Yes. Well, it is not a question that needs to be answered. There are two possible approaches and I think I know why they took the probabilistic one, because somebody would have to define what force that door has to resist. I don't know whether that is any easier or more difficult than a signing probabilities.

What is that reason or have you got a better one?

MR. PRESTON: Bruce Preston, Licensing Manager, Public Service. We plan to have a full presentation on this topic tomorrow.

DR. SIESS: We don't really want a real long presentation, if the thing is -- somthing has been proposed.

MR. PRESTON: Okay.

DR. SIESS: And the possibility that the staff accepts it, you see, then why should we listen to the argument?

MR. PRESTON: Yes. We have done some additional analysis that indicates the doors could withstand the forces of a certain spectrum of missiles. It is the large craft that the probability case rests on.

DR. SIESS: Okay. Now you came up with ten to the minus eight. That must be at least in two parts. One is the part the site will be flooded to that depth and the second is the part that there will be a craft that gets loose somewhere. I guess there could be a third part, that it actually hits a particular target.

MR. PRESTON: Yes.

DR. SIESS: What is the probability for it?

MR. PRESTON: I would like to call Bob Douglas up to discuss the numbers.

DR. SIESS: How many of these open issues are you planning to make presentations on because they are open issues?

MR. PRESTON: The most specific one was the flood.

DR. SIESS: That was the only specific one?

MR. PRESTON: We also plan to make a presentation on generic material problems.

DR. SIESS: Yes. Well, that is a generic issue.

MR. PRESTON: In a sense it could relate to the ISI issue. That is an open item.

DR. SIESS: We want to hear that.

DR. DOUGLAS: Bob Douglas, Manager, Licensing Analysis, Public Service. The probability of the flood level of 12 feet existing on site that could cause the floating missiles to impact on safety-related structures is about ten to the minus fifth per year.

DR. SIESS: So you have got theother ten to the minus three on the missile being there and hitting a certain thing, or did you assume if it was there it would hit the door?

DR. DOUGLAS: We looked at the number of potential missiles that would be within a certain radius of the site and the probability of those ships and other missiles, then, getting on to the site. And then hitting an area which defined all the safety-related structures. The combination of those factors times the probability of the MH condition that gave us the overall factor of approximately ten to the minus eight.

DR. SIESS: At what level does the staff say no problem? Is ten to the minus eight your criterion or ten to the minus seven or six?

MR. SCHWENCER: Dave, help me if I don't remember this correctly. But if it is a conservative analysis, we have a threshold of ten to the minus six.

DR. SIESS: Okay.

MR. SCHWENCER: If it is a nonconservative --

DR. SIESS: Let's say realistic.

MR. SCHWENCER: Ten to the minus seven.

DR. SIESS: They have got a factor of ten, depending on the analysis. You have got a consultant looking at this, you said?

MR. WAGNER: Yes.

DR. SIESS: Who?

MR. WAGNER: We have Emil Simiu from the National Bureau of Standards. Dr. Simiu.

DR. SIESS: What is he, a statistician?

MR. WAGNER: His official title is wind engineer.

DR. SIESS: Well, that is pretty good. Anybody else want to explore this issue? Get the list back up for us, please, the previous slide.

(Slide.)

DR. SIESS: No. 3, equipment qualification.

Yes?

DR. MICHELSON: Yes, I have a few questions on it. The difficulty is, as pointed out in the slide to be used, the staff is just getting started, so to speak, looking at the details. I looked at the licensee's presentation, or applicant's presentation, and didn't really find any appropriate category comparable to equipment qualification. Maybe I missed it. Is there going to be no discussion of equipment -- yes, excuse me. 9:15 tomorrow morning, "Environmental Qualification of Equipment". I will hold my questions until then.

DR. EBERSOLE: I have a few questions.

DR. SIESS: You might want to look through the book at that part of it and see if it is covered.

Jesse?

DR. EBERSOLE: I read what I could find in the SER on that topic and found nothing that satisfies this question. I see no explicit language that says we know in fact that the valves in this plant have dynamic competence to intercept faulted flows. It is the old question, you know, which erupted years ago when we found out the containment butterfly valves used for purging were not even specified to close against the dynamic flows which would emerge from a LOCA, thus the containments were nonexistent.

It is part of 3.10 in the SER. As a matter of fact, it is C-E.

DR. SIESS: Yes, but what I was going to say, Jesse, is that is not equipment qualification in the sense that it is used here.

DR. EBERSOLE: I read it, however -- seismic and dynamic qualification is packaged in one topical area.

DR. SIESS: Let me ask the staff. Is that type of qualification included under the equipment qualification review?

MR. WAGNER: Yes, I believe it is.

DR. EBERSOLE: I found again as I usually find, no explicit --

DR. SIESS: They haven't done it yet.

DR. EBERSOLE: They don't say they are going to do it.

MR. WAGNER: We are going to do it.

DR. EBERSOLE: Okay.

DR. MICHELSON: I assume tomorrow morning at 9:15 we will find out what the applicant has done or is doing or intends to do.

DR. SIESS: Is that correct?

MR. PRESTON: That is correct.

DR. SIESS: Fine.

There are other items in the same category. Pre-service inspection program, you are still reviewing, am I correct?

MR. WAGNER: Yes, we are.

DR. SIESS: Or you will review it when you get it.

MR. WAGNER: They have submitted a preservice inspection program. One of the next slides might state our concern. That is it. Generally the staff believes the pre-service inspection plan looks pretty good except for one area having to do with some corrosion resistance cladding applied to from recirculating line welds.

DR. SIESS: The concern is about being able to detect flaws through the cladding.

MR. WAGNER: Yes, they have applied inside and outside diameter cladding to the welds.

DR. SIESS: This is unique to Hope Creek.

MR. PRESTON: No, sir. Other utilities are utilizing this particular method to protect themselves against intergranular stress corrosion cracking.

DR. CARBON: I am puzzled. Why is there a question here?

DR. SIESS: I think the question is whether the measure that has been taken to prevent cracking also prevents the ultrasonic testing needed to detect cracking if you didn't take measures to prevent cracking.

DR. CARBON: Estuary either it is being done differently here or --

MR. PRESTON: I can just bring you up to date on this particular issue. We did have a meeting with the staff on Monday of this week, where we made a demonstration to them of our ability to inspect this type of clad pipe. The issue we still have is the staff would like us to demonstrate that we can effectively determine the crack on a piece of pipe that is actually intergranularly stress corrosion cracked. We have been unable to obtain a piece of pipe that has that type of a crack in it, and is also clad the way our pipe is clad. That is basically where we stand at the moment.

DR. SIESS: There have been tests made of UT techniques on actual cracks, haven't they, in the more recent rounds? Some of the earlier tests were made on artificially formed cracks but they have taken out some actual pipe that had intergranular cracks and tested them.

MR. SCHWENCER: But I am not aware of in this configuration.

DR. SIESS: No, but there are none with the clad?

MR. SCHWENCER: None I am aware of, no.

DR. SIESS: Is the issue the clad itself or surface of the clad?

MR. PRESTON: Sir, I believe the issue we have with the staff is the fact that our pipe is both OD and ID clad. The demonstration we did for them on Monday, the only pipe we could get that resembled our pipe was pipe that I believe had what they call a belly band applied to it, or OD. What they would like is a pipe that is OD and ID clad that has cracks in it, and then for us to demonstrate we can adequately see those cracks.

DR. SIESS: What piping is this used on?

MR. PRESTON: It is the recirculation piping.

DR. SIESS: All the recirculation? There is sort of a Catch-22. If the thing really works, you will never find any cracks in a pipe to test it on. So if you have got a really good system to prevent intergranular stress corrosion cracking, you can't use it. The more perfect the system is, the less chance there is of being able to use it because if it is perfect, you are never going to find a pipe that was naturally cracked. So how do we get out of this one?

MR. SCHWENCER: I don't know whether we know today how we are exactly going to get out of it. I can conceive asking for something as a licensing condition that says we might like to take a look at sample or require some demonstration as he has indicated. We had asked to see if we could get a specimen to demonstrate that it can do it. Whether they can develop a laboratory between now and the time we would consider it timely resolved, they can find a test specimen, that may be one way it gets resolved.

DR. SIESS: It would be nice if they could demonstrate it, but I think before I would want to ask them to do it, I would like to be sure it is possible to do it. I hate to ask somebody to do something that is impossible. I wonder if you metallurgists or metallurgical consultants have suggested it is possible to produce an intergranular stress corrosion crack in something like this.

MR. SCHWENCER: I think the safe thing to say is it is under active discussion and they may convince us on argument that they are okay, but at present, we have a concern, but we are not satisfied yet.

DR. SIESS: You have one obvious approach. That is to let it go as it is, and when it cracks, you will find out. We seem to be accepting the leak-before-break concept.

DR. SIESS: Right now I would say there has been enough intergranular stress corrosion cracking in BWR piping system that I don't particularly feel uncomfortable about it being a calamity. It is going to be detected, and it is going to be fixed. A lot of the cracks we found weren't found by UT. A lot were found by water coming out of them. The first we found, if I recall, at Ninė Mile Point was the leak detection system was it dripped on somebody's head.

MR. SCHWENCER: That certainly would be one way if that became the first specimen to test.

DR. SIESS: It would be a nice way because you might never get it.

Yes?

DR. MICHELSON: Clarification.

Is Hope Creek now going to use four injection lines for LPCI, directly into the vessel slide? I read it two different ways in two different parts.

DR. SIESS: The Newbold Island modification, does it stay for Hope Creek?

MR. PRESTON: Yes, sir; that is correct.

DR. SIESS: How did you make the attachments to the vessel and what are the materials for the piping system?

MR. PRESTON: For that question I would like to bring up Mr. Rogozenski to respond to that.

DR. MICHELSON: While he is coming up, you can answer a couple other questions. The HPCI, as I understand it, will inject into the core spray line. Is that still the case?

DR. SIESS: The HPCI goes in through four nozzles.

DR. MICHELSON: No, that is the LPCI. I read one place it sent through core spray and read another place one of the alternate flow paths would be to the feedwater line. So I am not sure which is which. What is the intention?

MR. PRESTON: The HPCI injects into the core spray line.

DR. MICHELSON: Core spray sparger. What material are you building the core spray line out of?

MR. PRESTON: Mr. Rogozenski will address that.

DR. MICHELSON: Another related question, not a materials question, that is, this is a question to the staff: Is there any other plant in operation already that uses HPCI injection into the core spray sparger?

MR. SCHWENCER: I don't know. We will have to check.

DR. MICHELSON: I will be surprised, but perhaps there is one around somewhere. I would like to know what knowledge we have of the hydraulic instabilities that you will get into when you have a depressurizing reactor flashing steam in a core spray sparger and injecting cold water with a HPCI at the same time.

DR. SIESS: I thought high-pressure core sprays were standard now.

DR. MICHELSON: No, but the standard is to inject into the feedwater.

DR. SIESS: No high-pressure core spray.

DR. MICHELSON: Yes, but there are none of those in operation. We don't have the experience yet. We don't get accidents --

DR. SIESS: That particular item is of interest because it was a Newbold item feature intended to make the plant safer.

MR. PRESTON: I would like to clarify a response that I gave you, Mr. Michelson. I think this might clear up some of the discrepancies in the literature. One of the changes we initially made at Newbold Island, Hope Creek, was with the high pressure coolant injection system. It was redesigned to permit injection through the core spray sparger rather than into the down-comer region through the feedwater system. As a result of ATWS considerations, a later change was made such that high pressure injection would be made through both the core spray and feedwater systems.

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DR. MICHELSON: That is the present arrangement.

MR. PRESTON: Yes, sir.

DR. MICHELSON: So part is going into the core spray sparger. So to the extent it goes into the sparger might question pertains. If you don't inject in the sparger the problem goes away. But I would like to see addressed somewhere your understanding and knowledge or test data, whatever, on what happens when you inject cold water into a confined core spray sparger in a reactor which is depressurizing, and therefore the sparger water is also depressurizing, it is partly flashed to steam already, and you are injecting cold water into the system.

MR. PRESTON: Sir, that would be from a material point of view.

DR. MICHELSON: From the -- mostly the hydraulic instability you get into from water hammers, condensing knocks and whatever. That reflects on materials of construction.

DR. SIESS: Let me ask a question. I thought that many of the changes that were made for Newbold Island became standard in subsequent BWR designs. Am I completely wrong on that? I thought the high-pressure core spray was in BWR 5's and 6's.

DR. MICHELSON: Yes, but they are not in operation yet. The ones you could get some experience on. You have got to be in operation a while and get a depressurization and an injection before you will ever see the phenomenon.

DR. SIESS: That was the last of the fours, was it, and Limmerick was done before this, and Susquehanna.

DR. MICHELSON: Limmerick, remember, we asked the same questions.

DR. EBERSOLE: Carl, I would like to get further into that because I think GE experimentation and testing has shown the actual literal spray function is no longer needed with the countercurrent flow phenomenon. So this would tend to imply that who cares if the spray ring falls down as long as the water goes in.

DR. MICHELSON: You do care, of course, if the, if you somehow break the pipe outside the reactor vessel in the process of doing this.

DR. EBERSOLE: Oh, yes, outside, I agree.

DR. MICHELSON: It is a stainless steel pipe and you introduce a water hammer --

DR. EBERSOLE: You are talking about the external portion of the cracking? I see that clarifies it. I thought you were talking about the ring itself.

DR. MICHELSON: No, I am not too concerned about that. The problem originates from the confinement of the ring.

DR. SIESS: You have raised a concern. I am trying to figure how it might be addressed. Obviously Hope Creek does not have any operating experience. I gather from what response we have gotten that this isn't something that has come up before that you have thought about, is it, or GE has thought about?

MR. PRESTON: To my knowledge, no, sir.

DR. SIESS: Is it something you would like to have them try to address at the full committee meeting, consider it a generic matter we should explore --

DR. MICHELSON: We have already explored it a little in discussing this potential with core spray systems in general. I just wondered since this is now a specific example of a plant about to go on line, I wondered if they had any experimental information or otherwise on it?

MR. PRESTON: Sir, we would attempt to provide the additional information before the two days are over in response to Mr. Michelson's questions.

DR. SIESS: Okay. If you can get something at this meeting, if not we will decide whether we want to hear it at the full committee meeting.

DR. MICHELONS: I would like to get the material answers which the gentleman was going to give us.

DR. SIESS: What materials are used in the piping that leads into the vessel?

DR. MICHELSON: Yes, both the LPCI and HPCI.

MR. ECKERT: While he comes up, the other question you asked, if we can't get back to you today or tomorrow, we will certainly try to get to you before the full committee meeting.

DR. MICHELSON: I am not trying to trap you or anything. I just wondered what information you might have or what thoughts you have on the matter, whatever.

MR. ECKERT: We will get it to you.

DR. ROGOZENSKI: Joe Rogozenski, Principal Engineer, Piping and Materials, Public Service.

I would like to address the safe-end connections to the reactor pressure vessel nozzles. There are questions regarding the low-pressure injection. That is carbon steel and for the core spray, 304(1) grade. We would have 304(1) grade for the -- so as far as investigation corrosion cracking, we have applied a remedy through the application of the low carbon grade stainless steel.

DR. MICHELSON: The LPCI injection then will be a stagnant leg in a carbon steel system, then, below the water line? Is that right?

DR. ROGOZENSKI: Non-flowing, right. It would be stagnant.

DR. MICHELSON: Do you have any comments on the water chemistry control for that leg?

DR. ROGOZENSKI: Sir, I would have to defer the water chemistry, quality of the water to the --

DR. MICHELSON: That is all right.

DR. SIESS: They are going to address water chemistry to:·)rrow.

DR. MICHELSON: Thank you.

DR. SIESS: Max.

DR. CARBON: My curiosity is getting the better of me. With regard to item three, why wouldn't it be practical to take a piece of pipe with some stress core errosion cracking in it and then plate it and see if you can detect it ultrasonically?

MR. PRESTON: The pipe that is currently available that has been stress corrosion cracked and cut out of various plants, they have applied the belly band fix as a temporary measure. We can get that particular pipe to sample. The problem is that when they applied the belly band material, or cladding, that the cracks closed up. Therefore, to detect a closed crack kind of defeats the purpose.

DR. CARBON: I guess you are saying there is no way to take it.

MR. PRESTON: We are anxious, of course, to reach resolution on the issue, and we are looking at a way to resolve the staff's concerns with an actual specimen.

DR. SIESS: Did the question come up in your own mind? Did you plan to do UT on this pipe?

MR. PRESTON: Yes, sir.

DR. SIESS: When you plan it, did this issue come up in your own minds, effectiveness of going through the plan?

MR. PRESTON: I would like to defer to Mr. Bob Brandt responsible for our SI programs.

DR. MICHELSON: I have one more question for the staff.

To your knowledge, are there any boiling water reactors now with direct LPCI injection in operation? Is this the first with direct LPCI --

MR. WAGNER: Into the core spray spargers?

DR. MICHELSON: No, low-pressure injection.

MR. WAGNER: I don't know.

DR. SIESS: This was a Newbold Island feature again.

DR. MICHELSON: This is the only plant that that -- with that feature?

DR. PRESTON: We understand Limmeric has direct LPCI injection.

DR. MICHELSON: Gee, I missed it somehow.

DR. BRANDT: I am Bob Brandt, Nuclear Plant Services Engineer.

We have been looking at this problem since 1979 since we first decided to go with the CRC overlay. At that time it was mutually agreed upon between General Electric, Bechtel and Public Service that the overlay could be inspected, rather, that a code inspection could be performed on this type of joint, based on calibration standards, existing standards.

We had the same problem then we have today, in that we couldn't get a clad specimen with a crack in it. We put the cladding on so we don't get cracking.

DR. SIESS: Of course, in 1979 we were a lot more optimistic about detecting cracks in anything.

DR. BRANDT: Absolutely. Since there there have been a couple of changes. We decided ourselves that just the fact we could see a notch, a code notch in the calibration standard wasn't acceptable to us, either. We have been working with Southwest Research, our ISI contractor and EPRI concurrently on the problem.

Until recently we had seriously considered going to field X-ray. The Minac approach since then we have decided against it, because of recent work done on the UT based on Nine Mile Point and Peach Bottom problems, there have been a lot of new developments. And as Mr. Preston pointed out, at our recent demonstration we had Southwest Research demonstrate a technique that will provide considerably improved sensitivity.

We still have the same problem with the crack. Our demonstration was two pieces. One was a clad mock-up with the cladding on both the ID and OD, but no crack. Also on a specimen that had a crack that was developed for one of a series of specimens developed for EPRI by IHI that has a crack in it. These pieces we are working with now. The NRC Materials Engineering Branch is asking us, though, to go further and try to demonstrate on some kind of a crack specimen. That is what we are trying to obtain right now.

DR. SIESS: The one you have from IHI, what was that, a fatique crack.

DR. BRANDT: No, an artificially induced stress corrosion crack but it has no cladding on it.

DR. SIESS: What is the material, 304(L)?

DR. BRANDT: 304(L).

DR. SIESS: Anything else on this item?

DR. BRANDT: Excuse me. I beg your pardon. The recirculation leep is regular grade, solution-treated.

DR. SIESS: Solution-treated?

DR. BRANDT: Right.

DR. SIESS: Okay.

The next item is the GDC-51 compliance, the drawer prevention criteria.

(Slide.)

DR. SIESS: As I recall, the only issue there are some feedwater valves, and the solution would be some ISI.

MR. WAGNER: That is right, augmented ISI.

DR. SIESS: Anybody interested in following that up? I didn't think we would be.

The next item is solid-state logic modules. As I read the staff report, the question really relates to one type of module and demonstrating its reliability. As I recall I didn't really appreciate that 862, but after the visit this morning, I saw Bailey about 500 times. How many of those are there in the plant?

MR. WAGNER: Sir, I don't know.

DR. SIESS: Can applicant tell me how many Bailey 862 solid-state logic modules there are? Are we talking about hundreds?

MR. PRESTON: I would like to call on Mr. Joe Yaworsky up.

MR. YAWORSKY: Joe Yaworsky, Chief Control Center Electrical Engineers.

The approximate count is around 2,000, slightly higher.

DR. SIESS: The issue suddenly got larger, didn't it? Is the concern with the physical reliability or logic? It says common manual and automatic initial capability. Can staff explain that briefly?

Go ahead.

MR. YAWORSKY: The concern is that manual and automatic calls for the same module. Now according to -- 1979 and according to regular guide 1.62, one should keep the commonality of such manual and automatic initiation to a minimal. Our position is that we do have redundant circuits which, in case of failure of their module, would still provide a safe operation or shutdown, as the case may be.

DR. SIESS: In other words, if one of those several thousand modules failed, it would disable both manual and automatic initiation through that module?

MR. YAWORSKY: Through that module.

DR. SIESS: What is the staff's position with regard to resolution to this? What are the possible resolutions and where do you stand?

MR. WAGNER: I hate to use a cliche, but the Instrumentation and Control Systems branch is reviewing this item.

DR. SIESS: That is not a cliche, that is a redundancy.

MR. WAGNER: Well, that is the status of it right now.

DR. SIESS: What are they reviewing, the whole logic to see if they agree with the level of redundancy?

MR. WAGNER: Yes.

DR. SIESS: I would have thought that would have been the question they raised in the first place. I mean I would have thought this became an issue because the staff looked at it and said, "Gee, that is not redundant."

MR. WAGNER: I believe the staff's concern was more of a separation concern.

DR. SIESS: Is anybody interested enough in following this up that we should try to get somebody from the staff in or should we just leave it to them?

DR. MICHELSON: I have one question but not related to the particular concern.

DR. SIESS: Can you find another place to ask it?

MR. MICHELSON: No, this is the place to ask it.

DR. SIESS: Then ask it.

DR. MICHELSON: The question is, of the applicant, in the environmental qualification of these modules, what temperature are you qualifying them to?

MR. YAWORSKY: These modules meet the environmental qualifications in the mild environment that they are.

DR. MICHELSON: Does that mean none of them are located in areas that become -- well, what is your definition of mild environment, temperature-wise?

MR. YAWORSKY: Mr. McGuire will answer this question.

DR. McGUIRE: Tim McGuire, Controls Engineer.

The equipment of concern here has been qualified to 104 degrees.

DR. MICHELSON: One hundred four?

DR. McGUIRE: Correct.

DR. MICHELSON: Am I to assume in no location do you exceed 104 degrees on these modules?

DR. McGUIRE: That is correct.

DR. MICHELSON: Does that mean all the modules are in the control room or switch gear room.

DR. McGUIRE: They are all located in the control equipment, elevation 102.

DR. SIESS: That is the one two stories below the control room?

MR. WAGNER: That is correct.

DR. EBERSOLE: Is this equipment in cabinets of some sort?

DR. McGUIRE: Yes.

DR. EBERSOLE: Do the cabinets, in order to maintain the local temperature low enough, do they have their own little fan systems?

DR. McGUIRE: Yes.

DR. EBERSOLE: What happens if I let a painter in some day, and he decides to put drop cloths over everything, including the side-by-side redundant modules, and this equipment is not intelligent enough to know it has got a fever and may do things disruptive to the safety logic.

DR. McGUIRE: First of all, the fan systems provided do have alarms on them and there is a temperature monitor in the cabin. So if the temperature does rise, the operator in the control room is made aware of it.

DR. EBERSOLE: I see. So you have, what is it, audible alarm and a drop?

DR. McGUIRE: Yes, an ennunciator window, digital logic trunk.

DR. MICHELSON: Perhaps I misunderstood your mild environment of 104. Is that actual temperature to which the module was exposed during its test? And then if it is, how does this relate to an all-cabinet situation where the module may be high in the cabinet and must still stay below 104 degrees and what room temperatures are we dealing with?

DR. McGUIRE: The cabinet itself would be in a room at a temperature of 104 degrees.

DR. MICHELSON: The cabinet is in a room at 104. So you qualified the modules at somewhat higher temperature then?

DR. McGUIRE: Bailey has assured us in their design rates testing of the modules that they will operate to 104 degrees. Above 104 degrees they will experience some drift.

DR. MICHELSON: Wait a minute. Now, 104 room temperatures or actual module temperature.

DR. McGUIRE: I will have to check that.

DR. MICHELSON: Because there is quite a difference. The modules may be in cabinets that have heavy heat loads. Is 104 the maximum temperature your control room and auxiliary instrument room will ever reach?

DR. McGUIRE: I believe the 104 figure was arrived at by assuming that the redundant HVAC systems were lost for a period of 24 hours.

DR. MICHELSON: I can't lay my finger on it for a moment because I read so much but I thought somewhere I read under certain loss of power and other circumstances that some of these rooms reached 120 degrees. Maybe I misread. You are saying none ever reach over 104?

DR. McGUIRE: Not the control room or control equipment.

DR. MICHELSON: All right.

DR. EBERSOLE: It is fair to say then that the operation of the plant is in fact dependent on the air conditioning system?

DR. McGUIRE: Yes.

DR. EBERSOLE: Because what is the safety? I have an observation, not necessarily. Is that correct?

DR. McGUIRE: Operation of the circuits is somewhat questionable above 104 degrees.

DR. SIESS: Are these circuits control circuits or protection circuits, or both?

DR. McGUIRE: Control circuits basically. Protection circuits are within the GE cabinets.

DR. EBERSOLE: If I go to the control center, do they depend upon the circuits to do what they have to do?

DR. McGUIRE: Referring to the shutdown valves? No, not at that point.

DR. EBERSOLE: So you can achieve safe shutdown without the modules?

DR. McGUIRE: That is correct.

DR. EBERSOLE: So you can argue then that the safety is not dependent on them.

DR. MICHELSON: One more clarification. Are your GE modules rated for higher temperatures than Bailey?

DR. McGUIRE: I believe GE was given the same temperature.

DR. MICHELSON: Generally it is 104. I don't disagree. I just want clarification. So you are talking about both protection system and control systems.

DR. McGUIRE: Certainly they are in the same environment.

DR. MICHELSON: I think their ratings are probably the same although you have to tell me that.

DR. McGUIRE: We will doublecheck.

DR. SIESS: Anything else?

The next item is Possible Accident Monitoring Instrumentation. Reg. Guide 197, which I have a notice under review.

MR. WAGNER: I can elaborate on that, Dr. Siess. The applicant has responded to Reg. Guide 197.2. Just recently the results of the review came back in. Generally, Hope Creek looks okay except for four specific instruments. In fact, I don't even think the applicant knows this.

DR. SIESS: That is four out of the entire list?

MR. WAGNER: That is right.

DR. SIESS: What is a passing grade?

MR. WAGNER: Well, I think we will have a meeting to discuss these even further.

DR. SIESS: I think we can leave that. I didn't think anybody could get all of them. You don't know what the issues are?

MR. WAGNER: The instruments?

DR. SIESS: No, the issue. Is it the classification of the instrument, or whether it is there, or range?

MR. WAGNER: A little of all issues.

DR. SIESS: Okay.

The next item, I guess, is the question of minimum separation between non-class 1-E conduits and class 1-E cable trace. I understand there were tests made. Staff wasn't satisfied. I think I heard this morning more tests were being submitted. Is that correct?

MR. WAGNER: I don't know if more are being submitted.

DR. SIESS: Can you bring us up to date?

MR. PRESTON: Yes, that is correct. We do plan to make another submission on that particular open item.

DR. SIESS: The test will simulate the situation you have.

MR. PRESTON: Yes.

DR. SIESS: Of a conduit in a -- cable in a conduit and another cable not in a conduit, is that the issue?

MR. PRESTON: That is correct.

DR. SIESS: Control of heavy loads.

DR. WAGNER: Yes. Regarding control of heavy loads, we have issued our status on phase one and phase two of the control of heavy loads at Hope Creek. We did that in the draft SER. Not SER regarding phase one the applicant recently provided information with which the staff feels we can close out phase one.

Now, regarding phase two, I have a report from the Auxiliary Systems Branch who does review this area that there are no problems regarding phase two. We don't anticipate any problems.

DR. SIESS: You know, I found the staff's review of that rather interesting. I don't know how many of you read it in detail, but there are conclusions in it, like, these are the legalistic-type things. Design is in compliance with general design criteria, X, Y, Z, but it is not in compliance with the guidelines in regulatory guide, or guideline in a branch technical position.

Now, if it is a guideline that it is not in compliance with, they are free to argue an alternate way of accomplishing it, right?

MR. WAGNER: As long as the alternate method is acceptable.

DR. SIESS: Has the staff ever accepted an alternate method to their own guidelines? I sort of get the impression that the staff reviewers say, "This is what the SRP says. These are our guidelines. This is what we will accept." And if somebody comes in with something different and staff finally accepts it, do they put that in the SRP as being an acceptable way or do they still make the next guy argue the same thing through?

MR. SCHWENCER: I think practically speaking the standard review plan is like changing the constitution. It is very difficult and time consuming to do that. Chances are the review plan will stay consistent. But what I can say is that when the staff has found an approach acceptable generally industry by their NOPAD method or whatever very quickly learns of this new way of getting something done. Once we have done it, a particular way and it is generic in nature, we do pursue that on the next case.

DR. SIESS: Is it harder to change the standard review plan than it is a rule I presume about the same?

MR. SCHWENCER: No, rules are harder.

DR. MICHELSON: On the control of heavy loads, can you tell me what is the current situation relative to the cask drop, potential cask drop accident?

DR. SIESS: Which end are you concerned about, the craft or what it drops on?

DR. MICHELSON: I am concerned about the floor it drops on. To help you along, I thought I read "applicant found that it could not tolerate the cask drop. There weren't details as to why. As a consequence, you are focusing on the unlikely nature of the incident instead of on the consequence.

MR. SCHWENCER: I think that is essentially correct. I think we have considered the crane is essentially very high reliability, but I am not sure. Have we completed our review of the area, Dave?

MR. WAGNER: No, we haven't.

DR. MICHELSON: Will there be better information at the time of the full committee meeting on this issue?

MR. WAGNER: We can certainly try, Doctor.

DR. MICHELSON: Yes, I would like to hear why. Also at that time would you tell me what other plants can't tolerate cask drops and, you know, kind of in general why that is okay now?

DR. SIESS: What part of the floor can't tolerate a cask drop? Which area? I thought the cask drop into the spent fuel pool was settled ten years ago.

DR. MICHELSON: No. This is the cask drop into the truck loading area. The torus is directly below the floor and you wouldn't want it to go through the floor.

DR. SIESS: What is below it?

DR. MICHELSON: The torus. If you rupture the torus, then you lose the torus water and you are in potential difficulty if this all causes an isolation as well.

DR. EBERSOLE: I would like to comment on that.

DR. SIESS: That is an old problem.

DR. MICHELSON: Yes. I thought it had gone away long ago.

DR. SIESS: It went away with the Mark 29.

DR. MICHELSON: That would also help, yes.

DR. EBERSOLE: Let me comment. This plant is, I don't know whether it is unique, but certainly it is not designed to tolerate a loss of water in the donut. If it is true, a cask drop would penetrate the concrete above the torus and knock a hole in the torus. I think the consequences get extremely conplex after that and possibly lead to the loss of the station. I don't know.

It seems that is a place where you could easily package up a small PRA, but it should involve taking the can off the crane, gear boxes and so forth and examining very carefully what failure modes are within the crane, and coming to a conclusion about a real best estimate of the probability of that accident happening, along with an analysis of what would result from loss of the water in the torus. It is just another, I think, PRA exercise which is well worth your while.

MR. PRESTON: Since this particular question did come up on the tour. we do plan to respond in more detail. In a deterministic fashion, I would like to point out we have a failure-proof crane-lifting device to preclude losing the cask on to the floor. But we do plan to look at the consequences and to have some further discussion on this over the next two days, or tomorrow.

DR. EBERSOLE: It just proves you will come up with low numbers.

DR. SIESS: No. It is single failure-proof. Not quite the same as failure-proof when you start looking at low probabilities.

DR. MICHELSON: That is entirely different. You end up with failures that are much higher than you can tolerate.

DR. SIESS: You said something about the cask going over certain areas. Cask has to go over the truck area, doesn't it?

MR. PRESTON: Yes. What we hope to do is take a look at exactly where on the floor that cask could possibly hit. How much energy it would have coming through the floor area, et cetera. And what proximity that is in relation to the torus, which is really the key point.

DR. SIESS: You might consider having the truck always parked under there when the cask -- I think it would absorb a certain amount of energy and spread some load. Well, it would spread some load. How thick is that slab, if a concrete man can ask a question?

MR. PRESTON: Chuck Churchman, could you respond to that?

DR. MICHELSON: The same kind of a question is asked which the applicant said he would get information on on the dropping of the drier separator into its pool to make sure the concrete floor is adequate. I assume those areas have been long looked at.

DR. SIESS: We looked at the present fuel pool way back but the other I remember being looked at but I don't remember what the answer was. If he is in the back of the room, forget about it.

DR. CHURCHMAN: Reinforced concrete slab is at a minimum one foot thick.

DR. SIESS: That is not very thick for a cask dropping a hundred feet, is it? Let's go on.

The next item is alternate and safe shutdown. What is the issue there?

MR. WAGNER: The issue here is that the staff has not completed its review yet.

DR. SIESS: You haven't found anything wrong, you just haven't finished?

MR. WAGNER: That is correct.

DR. MICHELSON: One small question. Which environmental control system maintains the environment in that area?

MR. WAGNER: The safe shutdown panel?

DR. MICHELSON: Yes. Applicant would probably have to answer.

DR. SIESS: Did you hear the question?

DR. MICHELSON: Which environmental control system maintains the environment in the shutdown body area?

MR. PRESTON: You mean what heating and ventilation system?

DR. MICHELSON: Yes. How do you keep it cool enough?

MR. PRESTON: Mr. Pavincich will address this.

DR. PAVINCICH: There are a number of areas associated with alternate shutdown requirements. The two most significant ones are mode shutdown panel and the second is diesel generator control area. Each of these units is fed by two completely different HVAC units, one is a safety-related unit. The other is a nonsafety-related unit which has power droll that can be hooked up to safety-related systems.

It would be possibly triple failure consideration to consider the loss of the areas necessary for us to man the alternate shutdown stations.

I think we mentioned earlier those areas would be the cable-spreading room and control equipment room. Fire in this area would not necessarily impinge upon either the two necessary alternate shutdown areas, HVAC systems. We did, however, go to do a further study and ascertain that temperatures within the remote shutdown panel area would not exceed a hundred degrees Fahrenheit for well over 21 hours if it were to lose all its HVAC system. So we have even under a double contingincy failure, 21 hours to reconnect that power system.

DR. SIESS: Is that with the door to the hallway open?

DR. SIESS: What is behind the panel in the room?

DR. PAVINCICH: There is about two, three more feet of space, sir, and then there is a wall that joins the reactor building wall.

DR. MICHELSON: In the diesel generator area, what do you think the temperatures are going to be?

DR. PAVINCICH: In the diesel generator control area?

DR. MICHELSON: Yes.

DR. PAVINCICH: For what conditions, sir?

DR. MICHELSON: For the condition wherein you have had to evacuate the control room and go to the shutdown --

DR. PAVINCICH: They should remain at design considerations.

DR. MICHELSON: What do you think that is?

DR. PAVINCICH: That is about --

DR. MICHELSON: This is with engines running and so forth.

DR. PAVINCICH: Yes, sir. In that area it is designed about 77 degrees Fahrenheit.

DR. MICHELSON: That is the normal temperature.

DR. PAVINCICH: Normal, 72 to 77.

DR. MICHELSON: With the engines running?

DR. PAVINCICH: Yes, sir. They are in a different room.

DR. MICHELSON: Then maybe I saw the wrong room.

DR. PAVINCICH: Nos, sir. You are looking at, sir, the panels at the end of the diesel --

DR. MICHELSON: That is right. I was told those had to be manned during this time in order to get to safe shut-down.

DR. PAVINCICH: No. Pointed out to you on elevation 137 the switch gear area, that panels --

DR. MICHELSON: This is the panel directly in front of the diesel engines. We were told each of those, there is a man down there that could man those. He had a three-way telephone --

DR. MICHELSON: Maybe I misunderstood.

DR. PAVINCICH: You did, sir.

MR. SCHWENCER: I overheard that conversation also and that is what you were told, that there were two people that went different directions. One went directly to start a diesel and the other went to the shutdown --

DR. MICHELSON: I understood --

DR. PAVINCICH: That is correct, but none of that, sir -- I was the gentleman who told you. I am not likely to change my mind. It was up at the diesel --

DR. MICHELSON: I didn't hear well.

DR. PAVINCICH: It was diesel generator area where the switch gear was. I showed you the sequence to one side, diesel generator control panels on the other side and I showed you the key and lock switch that would be necessary from the control room. No one has to be in the diesel generator room proper at all.

DR. MICHELSON: I thought he did. That was why he had three ways --

DR. PAVINCICH: No, sir. The man communicates with the diesel panel. Immediately joining --

DR. MICHELSON: Immediately adjoining the diesel generator.

DR. PAVINCICH: No, sir.

DR. MICHELSON: Right in front of it. Kind of the next compartment over.

DR. PAVINCICH: It was a very robust tour, sir. You were no doubt confused.

DR. SIESS: That was not in the diesel generator room. We wentup on a little platform.

DR. PAVINCICH: Yes.

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DR. SIESS: No, it was in the room next to it.

DR. PAVINCICH: The upshort of your question is it would take a triple contingency failure to jeopardize the FVAC system --

DR. SIESS: The local --

DR. MICHELSON: In the room right in front of the engine. I am looking right at it.

DR. SIESS: Let's get one thing straight. Local control for the diesel generator is not required to run the alternate shutdown --

DR. PAVINCICH: Oh, yes, it is part of our plan. An operator may be required; may.

DR. SIESS: May have to go there?

DR. PAVINCICH: May have to go to the diesel generator control panel which is not the panel that Mr. Michelson thinks is in front of the machine.

DR. MICHELSON: Okay. Next floor up?

DR. PAVINCICH: It is the next floor up.

DR. SIESS: Okay.

DR. EBERSOLE: Then the alternate shutdown process involves working the alternate --

DR. PAVINCICH: It is where the switch gear was.

DR. EBERSOLE: Involves working this panel in conjunction with working this other center we were talking about.

DR. PAVINCICH: That is correct.

DR. EBERSOLE: Using voice transmission in some fashion.

DR. PAVINCICH: They have sound-powered phones, a PA system and two-way radios.

DR. EBERSOLE: Does this mean the man at the alternate shutdown panel is really sort of a dispatcher, function dispatcher by voice control?

DR. PAVINCICH: Senior reactor operator would be the --

DR. EBERSOLE: Can functions eliminate from the alternate shutdown panel by hard wire?

DR. PAVINCICH: Yes, sir.

DR. EBERSOLE: It is capable if something malfunctions within it.

DR. PAVINCICH: When the shutdown panel is manned and transfer switches are thrown, he is connected hard wire.

DR. EBERSOLE: It can also send control signals out by hard wire.

DR. PAVINCICH: Yes, sir.

DR. EBERSOLE: As well as voice control.

DR. PAVINCICH: Oh, yes, sir. He is controlling. The man dispatched to diesel generator is only under hypothetical condition got a fire-induced standing trip, could be on the diesel generator control circuitry. When the gentleman goes to the area, by throwing the area he removes that interface with the main control room. He then starts the diesel, and everything takes off on its own. He doesn't do anything else essentially unless additional problems may come up.

DR. EBERSOLE: If I were to hypothetically go blow up the alternate shutdown panel, what would happen?

DR. PAVINCICH: Nothing. You would have interfered with the control on one mechanical division. This would have caused the operator in the main control room to bring the unit down.

DR. EBERSOLE: On another channel.

DR. PAVINCICH: Yes, sir.

DR. EBERSOLE: Thank you.

DR. MICHELSON: Now that I have got straightened out as to where the diesel control area is, let me ask the question. You say it is about 77 degrees there. Is this with or without normal ventilation, keeping in mind normal ventilation may or may not be available during a fire?

DR. PAVINCICH: That would be with normal ventilation that would normally feed that would be available immediately, assuming even loss of off-site power, the ventilation would be immediately available upon starting of that diesel generator unit.

DR. MICHELSON: Okay.

DR. PAVINCICH: It would load up automatically and load up its one ventilating system that was supporting --

DR. MICHELSON: There is no reason to believe the fire and smoke would in any way interfre with that particular ventilation?

DR. PAVINCICH: No, sir, not in its origin place.

DR. SIESS: Thank you.

The next item has to do with the diesel. Staff tells me this has been resolved because applicant has described how he will deliver fuel oil.

MR. WAGNER: Yes, sir.

DR. SIESS: And it is acceptable to the staff.

DR. EBERSOLE: I see no other place to open this topic so I have to do it here.

DR. SIESS: Well, no, you don't. Do it at the end of this if it is not on this list.

DR. EBERSOLE: You want to relate it to the diesel generator at this time?

DR. SIESS: No. This is a particular open item. We will take them up one by one. Then we will go back to general things.

DR. MICHELSON: Does this open item include the problem of the diesel storage tanks in the basement of the diesel area?

DR. SIESS: This open item dealt only with how fuel oil would be delivered to the site from the flood waters 12 feet overgrade.

DR. MICHELSON: Some other time we will discuss the fire protection problem. Okay.

DR. SIESS: What subject, fire?

DR. MICHELSON: Fire protection.

DR. SIESS: 3.6 is the next item, "Filling of Key Management Positions". Staff couldn't sign off because all the positions haven't been filled. They have a description but they don't have the names of the people going into them. Is that a fair statement?

MR. WAGNER: Yes. I think I should set the scene here first. Public Service underwent a rather large corporate reorganization right as --

DR. SIESS: We are familiar with that. Let's just stick to what the issue is. Assume we know the background.

MR. WAGNER: Okay.

DR. SIESS: Any questions on this?

Next is a series of items all relating to the training program. You might just summarize the status on that.

MR. WAGNER: Yes. Let me elaborate on some of these. Since the SER was issued, we have had a meeting with the applicant. And generally, the applicant has satisfied us on most of these concerns. We do have one outstanding concern. That has to do with a response to generic letter 84-10.

To be more specific, Public Service was planning, is calling RO experience at Salem as comparable experience to be used on Hope Creek.

In accordance with, I believe 5525(b) of the Commission's regulations.

DR. SIESS: Where does that come in on this? That would seem to be operator qualification?

MR. WAGNER: I don't know. I would have to look at it. That is essentially the only thing we consider outstanding.

DR. SIESS: You are talking about what?

MR. WAGNER: Generic letter 84-10.

DR. SIESS: Interesting. That related to training?

MR. SCHWENCER: Generic letter 84-10 related primarily to the experience that the operating license --

DR. SIESS: That is what I thought.

MR. SCHWENCER: -- would have in initially --

DR. SIESS: That is my problem.

MR. SCHWENCER: I think what Dave was saying, if I understood correctly is, in the process of going through these items with the applicant we learned --

DR. SIESS: Okay.

MR. SCHWENCER: The plans to use experience at Salem as qualified filing, meaning this industry guidelines would be acceptable. The concern the staff has, of course, is that Salem is a PWR.

DR. SIESS: We have another item on the agenda for staffing somewhere. Current status of staff is on the agenda under nuclear-related operating experience of key personnel. We will hear about that whenever that comes up. We will want to hear a lot about that. So we will get back to that item and you can explain the situation.

Item 13 is a computer model. You must provide a description and you haven't gotten it yet. Is that the situation?

MR. WAGNER: Yes, sir.

DR. SIESS: I know of other plants that have developed this sort of thing. Is the staff reviewing the whole computer model or has industry sort of gotten together on the models and it is just a question of site-specific characteristics?

MR. WAGNER: Dr. Siess, I don't know the details of the model.

DR. SIESS: Let me ask applicant. Have you developed your own computer model for this dose assessment thing or is that say one previous people are using?

MR. PRESTON: I would like to have Mr. Yewdall come up and respond to this.

DR. SIESS: I don't want details of the model. Are you doing your own?

DR. YEWDALL: Bob Yewdall, Public Service.

We are currently planning to use Pickard, Lowe and Garrick's model. That is I think a well known model and will be put on Public Service hardware. Thank you very much.

Procedures generation package has not been submitted.

MR. WAGNER: That is right. The submission date is January 1985.

DR. SIESS: This is all procedures, not just emergency procedures or is it emergency procedures?

MR. PRESTON: Dr. Siess, that is emergency procedures.

DR. SIESS: Any questions?

The last item on my list and your list is human factors engineering, an area in which we are all expert.

MR. WAGNER: Maybe a brief summary would help.

Chapter 18 of the SER. It is noted the staff does an audit, in this case of Hope Creek, of the control room design, does an audit of the control room design review. We also review the SBDS. Recently the control room design review was performed. And the staff results from that indicate Hope Creek is doing well. They have done a good job of identifying the human engineering discrepancies, and they are on a good course towards resolving these discrepancies. As far as SPDS goes, we are expecting a report on the -- expecting the safety analysis in December.

DR. SIESS: What did the review team think of the extensive use of the CRT? Was that good or bad, or did they ignore it because it is not hard-wired?

MR. WAGNER: I don't know what their purposes were on the CRT. I will try to find out.

DR. SIESS: Is that review done by staff or staff consultants?

MR. WAGNER: It is done by the staff.

DR. SIESS: Any questions?

Staff has a long list of --

DR. MICHELSON: Before we leave outstanding items, I do have a question but I thought you meant on the first fifteen items.

DR. SIESS: That is exactly what I meant.

DR. MICHELSON: I think I would like a clarification on whether or not there are two additional items, or what status is. One is fire protection. By the absence of fire protection as an outstanding item, how do I interpret it?

MR. WAGNER: We have addressed it in section nine point five.

DR. MICHELSON: No. I mean in the list. I gather there are no more outstanding issues on fire protection; correct?

MR. WAGNER: That is right, except for --

DR. MICHELSON: The next one is, I know applicant used fibrous insulation throughout inside of containment.

MR. WAGNER: Yes, they do.

DR. MICHELSON: You address this in the SER by saying it doesn't plug the sump, therefore it is a nonproblem. I think there is more to it than that. So when will be the appropriate time to pursue the applicant's view on the presence of fibrous insulation on the use of cyclone separators to clean the water for their RHR and core spray pumps?

DR. SIESS: Well, there is a place on the agenda we will find and if there is not we will put one there.

DR. MICHELSON: Okay.

DR. SIESS: We should give the applicants some warning though as to what the subject is. They need to get people in if they haven't already. Did you hear the question?

MR. PRESTON: Yes, sir. This morning that was brought to our attention on the tour. We are currently researching the fiber glass and possible impact on the bearings, et . cetera. We are looking at that. We hope to have some further discussion on it tomorrow.

DR. SIESS: If you have something, let us know.

DR. MICHELSON: Yes, I think if they are not prepared, it would be better just to let it be a five-minute presentation at the full committee or something.

DR. EBERSOLE: May I ask a little refinement? These seperators must certainly in the engineering design of a source term for the contaminants which they are suppos to remove. I would like to know what that material is, the context of what it is and what its concentration is. It is density relative to earth.

MR. PRESTON: The fiber glass material?

DR. EBERSOLE: Not merely that. Dirt. Whatever else you may regard as the integrated contaminant mixed with that little machine must clean up.

MR. PRESTON: Yes, we will attempt to provide that also.

DR. MICHELSON: That takes care of it.

DR. SIESS: Okay. I would suggest that confirmatory items, in most cases they are just that. If there might be some of those somebody would like to know a little more aobut the status of, did any of those come up in anybody's mind? SER did a pretty good job of explaining the status. I looked at the list of license conditions. That is where we find the cask drop accident. But that didn't relate to our question. That simply related to how they kept it from going over certain areas, I believe.

Are there any of those anybody would like to hear more about? It seemed to be an unusually short list.

MR. WAGNER: Dr. Siess, I would like to add that there are no differing professional opinions.

DR. SIESS: All right. Thank you. Okay. If I find my agenda. It seems that covers staff items A and C.

MR. WAGNER: That is right.

DR. SIESS: We will have something from I&E tomorrow. From here on out we will be basically hearing presentations initiated by the applicant, but with the staff on a stand-by basis as needed.

I think without further ado, I am going to go as long as I can stand it without a break. We got started about 2:30 and I am aiming for no later than about 6:30 tonight, I think, though if we are in the middle of something I might stretch it. If anybody has a dinner engagement, that doesn't apply to the committee. They are used to working late.

DR. EBERSOLE: Chet, I have been looking around. Even in the topical, in the index, I didn't find anything much in the matter of the mainfeed water analysis. It is not even listed as a topic. Yet I see in one of these listed there is an interim, what is it, short-term feedwater analysis said to be on 6.2.3.

DR. SIESS: These are confirmatory items, Jess?

DR. EBERSOLE: Yes, yet I don't find anything, as a matter of fact, 6.2.3 is secondary containment. So there is some kind of misprint or foulup.

MR. WAGNER: I will claim responsibility for that.

DR. EBERSOLE: Mainly I open the topic because I think we all know the main feedwater system is the most frequent culprit in excessive shutdown frequency. I think we would like to hear why we can't begin to approach the Japanese frequency of trips which is one every three years, especially in the feedwater control area, not invoking SCIC or other main feedwater sources after you get a trip or certainly not inducing trips. In short, I found nothing on what I think is the most critical system in respect to causing spurious shutdowns, at a million dollar a crack and challenge to the safety system.

DR. SIESS: You said you saw nothing?

DR. EBERSOLE: Nothing in the index, nothing in the text.

DR. SIESS: Index of what?

DR. EBERSOLE: SER.

DR. SIESS: Is there a standard review on trips caused by main feedwater?

MR. WAGNER: Just a moment, please.

DR. SIESS: I think maybe it is not a safety issue.

DR. EBERSOLE: Typically the minimal challenges a year has not impressed the staff. That is a linear effect on safety.

DR. SIESS: Applicant might be thinking about this.

DR. EBERSOLE: It has a linear relationship on safety. Frequently you have to ask it to do what it is to do.

DR. SIESS: I think the staff's only concern is that it trip.

DR. EBERSOLE: Tripping is the first stage of getting into trouble.

DR. SIESS: I tell you what, let's go on and let the staff be thinking about this and see -- you understand my question, don't you? I am not sure the staff considers feed-water mismatched trips to be a safety issue.

MR. WAGNER: I will check on that, Dr. Siess.

DR. SIESS: Mr. Ebersole thinks any challenge to the trip function is something to be avoided, but I don't think that is in your standard review plan or in the regulations anywhere.

DR. EBERSOLE: We are finding that a little more especially if it involves invoking new emergency equipment response.

DR. SIESS: Yes. The applicant, I am sure, has a concern about this because it affects his availability and reliability. He may want to think about it in the meantime, too, but I believe the general design criteria simply say the plant shall trip when you want it to trip and doesn't care how many times it trips.

DR. EBERSOLE: That is right. I might observe my feelings are reinforced by recent findings, of course.

DR. SIESS: No statements, just questions. Remember the rules.

DR. EBERSOLE: Right.

DR. SIESS: New rules, but I am going to enforce them as much as I can.

We will turn this over to Mr. Eckert.

MR. ECKERT: Thank you, Mr. Chairman.

Good afternoon, gentlemen.

DR. SIESS: I needn't remind you, try not to repeat what we heard this morning.

MR. ECKERT: Yes. I do have a couple comments I thought I might make before we started here.

DR. SIESS: I know there are some items here on status, plant start schedule. I thought we got that at the training center this morning.

MR. ECKERT: You may notice on the agenda that item 3.3, "Seismic Design of Plant and Equipment" is scheduled for later on today. We are running late. Our concern is that our consultant who is going to have part of this story can only be here today. So we can't let that carry over until tomorrow.

DR. SIESS: Right. We know that.

MR. ECKERT: We may try to push things around a little in order to accommodate that situation.

DR. SIESS: You can put it on right now if you want.

MR. ECKERT: I would propose to go through the first introduction which is pretty short. Then rather than going into organization and management section, we will put him on next and come back later with the organization --

DR. SIESS: Fine.

MR. ECKERT: We will start our presentation with a brief overview of the Hope Creek Plant and its features.

Following that, we will move into organizational technical discussion in accordance with the agenda. Much of what I will say here you have picked up through the course of the tour. We thought it would be appropriate to put it on the record at this time.

To start, let me talk briefly about Hope Creek Generating Station. It is a single unit BWR, net electrical output of 1,067 megawatts. Public Serivce owns 95 percent of the plant and Atlantic Electric owns the other five percent. It will be operated by Public Service Electric and Gas Company. Bechtel was the architect engineer constructor with a major assist by Public Service people.

The nuclear steam supply and turbine generator manufacturers was General Electric. The plant will be operated by Public Service Electric and Gas Company. The site, as you know, is on the Delaware River immediately adjacent to our generating station and it is a -- Salem Generating Station and it is a cooling turbine installation. Preconstruction ACRS review resulted in a favorable letter in 1974. The construction permit was issued in 1974 but construction did not start until 1976, following protracted state environmental reviews.

Hope Creek was originally a two-unit plant. The second unit was cancelled in 1981 when our load projections could no longer support the need for the unit. We are scheduled to load fuel on Hope Creek on January of 1986. We are working for a target date, instead of January, December 1st of

1985. We hope to be on the December 1984 ACRS full committee agenda.

Very briefly that is my introduction. I would like to now turn the discussion over to Bill Gailey who will give you an overview of the Hope Creek plant.

Bill?

MR. GAILEY: Thank you, Dick.

(Slide.)

MR. GAILEY: Good afternoon. My name is Bill Gailey, Chief Project Engineer of Hope Creek for Public Service. I am going to give you a summary of certain Hope Creek design features which are either unique or will enhance the safe operation of the plant. This overview is intended as an introduction to our technical presentations which will follow this afternoon and tomorrow.

Many of the things I intended to give an overview on were touched on either during the tour this morning or in the discussion this afternoon. So I will try to pass over there in the interest of time.

Hope Creek is a BWR 4-5 NSSS system. It has a Mark 1 containment which is the inverted light bulb and suppression chamber. Ultimate heat sink for the plant is the Delaware River which feeds the service water system. Waste heat from the condenser is dissipated by the circulating water system through the cooling tour.

(Slide.)

MR. GAILEY: Next I will discuss certain aides which enhance engineering of the plant over the years. First, scaled model of the plant was developed. I believe you saw the drywall model of unit 2 in the training center this morning.

PSE&G personnel spent more than 20,000 manhours conducting design reviews which utilized the model. Major concerns such as ALARA, studies on maintainability and accessibility, as well as equipment and constructionability were addressed addressed.

There is a picture of the model.

(Slide.)

MR. GAILEY: You can see the blue tag in the front right under, about in the center of the slide. That was put on by our operations people to reserve space for accessibility for the equipment removal.

(Slide.)

MR. GAILEY: In 1977, we conducted a control room operability review using a full scale control room mock-up. The review team was made up of Public Service Engineering and Operation personnel, General Electric, Bechtel, Bailey Meter Company, and significantly, Peach Bottom Operations personnel.

The purpose was to make sure from a human engineering standpoint that the latest industry experience including actual plant operations, were being factored into the Hope

Creek Control Room design.

(Slide.)

MR. GAILEY: Third is the simulator which you saw this morning which is identical to the control room. I won't dwell anymore on that.

I owuld now like to cover certain features of Hope Creek which are unique. First is the reactor building; secondary containment, a cylindrical reinforced concrete structure with a reinforced steel-lined dome. The purpose of this particular design is to provide as low a leakage structure as possible.

FRVS, filtration, recirculation and ventilation system has been included to recirculate and filter the atmosphere in the reactor building. This system has six-25 percent capacity recirculation units which include charcoal filters and provide cooling and filtration to the entire reactor building.

FRVS is designed to collect air-borne contamination released to the reactor building and by mixing, filtering and maintaining negative pressure minimized radio active releases.

DR. MICHELSON: I have a question for clarification. The reactor building appeared originally to kind of be just the cylindrical portion. Later you expanded into the corner rooms to incorporate them as part of the reactor building. Are the corner rooms included as a part of the FRVS system? Its fans are in the cylindrical portion but does the ventilation, ducting and everything come from the corner room areas?

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MR. GAILEY: It primarily handles the cylindrical portion, certain -- in the square area of blowout panels.

DR. MICHELSON: I am thinking of normal ventilation which I thought --

MR. GAILEY: Normal-y FRVS would handle everything within the cylindrical part.

MR. PRESTON: Roger will provide additional information.

DR. MICHELSON: This is where you get confusion between what you call the reactor building and what used to be the reactor building. What you now --

DR. DREWNOWSKI: Ron Drewnowski, supervising site engineer. You are correct. We are using the square section also as the reactor building. That area is serviced by the FRVS system.

DR. MICHELSON: Does its duct work come through into the cylindrical portion up to the fans, which I think those fans are in the top portion of the cylindrical part of the reactor building?

MR. DREWNOWSKI: They are in the same --

DR. MICHELSON: So the duct work comes back and forth through the concrete wall.

MR. DREWNOWSKI: That is correct.

MR. GAILEY: In addition to the two main normal isolation stop valves, a third valve has been added to each main steam line. This was added because of its low leakage characteristics to minimize leakage during shutdown.

(Slide.)

MR. GAILEY: In addition, a seal air system was added to further reduce leakage during main steam isolation.

(Slide.)

MR. GAILEY: Another unique feature is the main control room. Although not unique to public service, which has implemented its concepts for the last 20 years, it does differ from the standard BWR plant. Our control room utilizes low voltage, compact layouts, panel arrangements you saw this morning, and computerized display system.

The control room provides operators with an effective and reliable means for the safe operation of the plant.

DR. EBERSOLE: May I ask about the third stop valve and all the investment in it? Is that put in on the thesis that you are trying to stop the flow of contaminated steam from a damaged core?

MR. GAILEY: Not necessarily from a damaged core. It was put in, it is a slow acting valve. It was put in to prevent leakage through the normal two fast-acting main steam isolation valves into the turbine area during shutdown.

DR. EBERSOLE: For an undamaged core?

MR. GAILEY: It would apply to both.

DR. EBERSOLE: Say again?

MR. GAILEY: Pardon me?

DR. EBERSOLE: What do you say?

MR. GAILEY: It was for an undamaged core, but would apply to both.

DR. EBERSOLE: Right. What was the explicit dose problem resulting from a minor leakage in the turbine hull?

DR. SIESS: At Newbold Island, it was considerable. These were all Newbold Island features, close in population. The changes made for Newbold Island, most of which has just been mentioned, were to reduce the calculated design basis accident doses.

DR. EBERSOLE: That is why, for damaged core.

DR. SIESS: No, no damage core. We didn't think of damaged cores ten years ago. It was design basis accidents. LOCA..

DR. EBERSOLE: When the reactor is depressurized?

DR. SIESS: Yes.

DR. EBERSOLE: And these valves aren't pressure-paths from a depressurized vessel to atmosphere?

DR. SIESS: Now, the other changes, containment building, it was the same thing. It was designed to release the off-site, reduce off-site releases following a design basis accident. Changes to the high-pressure core spray and

LPCI were in response to ACRS concerns of the period which were improved ECCS. That was one of our major issues at that time. Those were changes made to meet our demands for improved ECCS.

DR. EBERSOLE: So, Chet, this third valve is a piece of history from the days when the large LOCA predominated, and one was looking at large LOCA core damage in the context of having leakage through the main steam lines?

DR. SIESS: That is correct. It was simply a result of calculating Chapter 15 accident doses.

DR. EBERSOLE: Would it be put in today, do you think?

DR. SIESS: No, of course not. It wasn't put in any plants then except at Newbold. Newbold Island site was comparable to Indian Point. It was comparable to Indian Point, actually, a little worse than Zion. These were all features put in during extensive review of a large reactor at a very highly populated site.

DR. EBERSOLE: Yes.

DR. SIESS: Then they were maintained after the plant was moved to the other side to expedite licensing. The staff said if you move it and don't change anything, don't change too much, we will get you a new SER out in six months. I think they did.

DR. EBERSOLE: I can think of better places to put that big valve.

DR. SIESS: That is the trouble with ACRS designing reactors. ACRS changes by the time they get it built.

MR. GAILEY: Next, certain design features later incorporated into other BWR plants. High pressure coolant in vehicles via cool spray sparger, and later through both core spray and feed water systems was discussed earlier.

In addition, the turbine-driven HPCI pump was redesigned, provides about an additional 12 percent of flow of water to the core. Direct low-pressure cooling system injection was redesigned so that it was direct to the core, four separate penetrations through the core flowed rather than recirc lines.

MR. GAILEY: As briefly mentioned earlier, another feature we consider significant is the safety auxiliary cooling system, that it is closed loop and only its heat exchangers are exposed to the brackish Delaware River water.

(Slide.)

MR. GAILY: In addressing the subject of ATWS, we have incorporated what is known as the ATWS-3A modifications. This provides for automatic initiation of standby control system, tripping recirc pumps, alternate rod insertion and feed water runback.

Recently there was an industry concern about blocked walls in nonseismic Class I -- in seismic Class I equipment areas. I would like to point out Hope Creek has no block walls or nonseismically qualified walls in its seismic class I equipment areas.

(Slide.)

MR. GAILEY: This concludes my presentation. I would like to introduce Pete Landrieu, construction manager, who will present a statement on construction status and start-up.

DR. SIESS: Any questions?

MR. LANDRIEU: Good afternoon. Since we did go through a lot of similar material this morning, I am going to move rather rapidly unless you want me to change this. So far, as the Hope Creek engineering and construction PSE&G is to interface with Bechtel and GE on the project, we have had a project team which is designed somewhat in the mirror image of the Bechtel typical matrix organization. I would like to simply say that on that team, we have a majority of people with previous Salem experience and the majority have been with the Hope Creek Project since prior to first concrete. So we do have continuity of management in that team and our interface relationships with Bechtel and General Electric.

Our fall load data is January 15, 1986.

(Slide.)

MR. LANDRIEU: Our current schedule analysis, jsl

critical path analysis, we have been positive to that date for some time.

(Slide.)

MR. LANDRIEU: For that reason we have been working for the past several months to a target fuel load schedule of December 1, 1985. We are working toward that schedule.

In order to build assurance that when things can and do go wrong, as they sometimes do during startup of a plant like this, that we will still be able to accommodate that kind of happenstance.

Construction status is approximately 93 percent complete.

(Slide.)

MR. LANDRIEU: Bulk commodity installations, as you can see, are just about complete. Wire and cable terminations being the ones with the majority to go.

(Slide.)

MR. LANDRIEU: This busy graph simply compares Hope Creek percent complete versus months to fuel load with a number of other similarly sized plants. I simply show this to indicate that we are not out in the woods on the right or left of other people's experience.

What we have ahead of us, we feel it is aggressive but attainable. Our startup status is 34 percent complete at this time.

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As you can see, we are slightly ahead on our startup program; the blue line being the January 15 schedule, red line being the schedule that would support the December 1st date.

As you can see, we are behind December 1st but ahead of January.

(Slide.)

MR. LANDRIEU: As Roger mentioned, approximately a third of the systems have been turned over to Public Service for operation, maintenance and testing.

(Slide.)

MR. LANDRIEU: One thing I would like to mention which will allow us to achieve some of the things we have out ahead of us is the control room you did see, which was completed and turned over to Public Service for testing in December a year ago.

(Slide.)

MR. LANDRIEU: At that time, we began a six-month integrated checkout of the different circuitries in that control complex and completed that integrated checkout one month early, in May of this year.

We feel that having that circuitry checked out and behind us as we go into the heavy system turnovers is going to serve us very well in getting through an ambitious program.

I would now like to introduce Stan LaBruna, who

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will speak to maintenance.

MR. LA BRUNA: Good afternoon.

(Slide.)

MR. LA BRUNA: Stan La Bruna, Assistant General Manager of Hope Creek Operations.

Several topics, Planning for Maintenance, In-Service Inspection, and Preoperational Test. I am basically going to be reflecting on these from an operational readiness for the Hope Creek operations team as we are participating in these activities.

(Slide.)

MR. LA BRUNA: The first is Planning for Maintenance. The maintenance program established for Hope Creek is based upon our past experience and maintenance enhancement resulting from our nuclear department improvement programs.

A fundamental aspect of maintenance at all PSE&G facilities during the past decade has been our repair and maintenance procedures systems, better known as RAMPS. This defines requirements for a planned approach to maintenance activities using detailed procedures and all phases of plant maintenance to assure a structured approach to maintainance that results in quality and efficient use of personnel.

(Slide.)

MR. LA BRUNA: The managed maintenance program reflected by this busy display indicates an expanded program

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and concept to complete an integrated approach to maintenance planning, monitoring and control.

This automated data base approach to maintenance assures the effective control of our corrective, preventive and predictive maintenance activities.

As you can see in this slide, and from the discussions at our planning office this morning, I realize some of these gentlemen didn't have the opportunity to share with our maintenance manager the programs we do presently have in place to take care of our present PM activities and corrective maintenance activities, but this approach provides our personnel with the adequate tools to plan, schedule and control these maintenance activities.

(Slide.)

MR. LA BRUNA: Obviously the cornerstones of the managed maintenance program are the preventive-predictive-corrective maintenance and integrated spare parts and component data file that we use.

Preventive maintenance program, schedule of surveillances and planned inspections and calibrations is based on vendor recommendations in addition to our own experience at other facilities and knowledge of anticipated environment and equipment qualifications.

Predictive maintenance program is based on trend analysis of in-service pump and valve performance, including

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valve signature analysis, to which we are gaining that baseline through our preservice inspection program.

DR. MICHELSON: What type of valve signature analysis are you doing?

MR. LA BRUNA: We are going to be using a motor operator technique, testing rig, which is in calibration right now. We expect to be using that for our operators to provide us with a baseline of current versus actual force.

DR. MICHELSON: Who is the supplier of that piece of equipment?

MR. LA BRUNA: Offhand I don't have that information. Perhaps our startup manager, Mr. Suconi --

DR. MICHELSON: Maybe you could tell me in the morning.

MR. LA BRUNA: Sure.

DR. MICHELSON: I'm curious because we are very much interested in signature analysis.

DR. CARBON: In terms of your preventive maintenance, do you get input from EPRI and other BWR operators, and is it of any help to you?

MR. LA BRUNA: We --

DR. CARBON: I mean do you expect it will be? Of course, you're not doing it now.

MR. LA BRUNA: Certainly from an NPRDS standpoint, that some of the concerns have been already in the industry,

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certainly through our programs. I will speak a little about that later on.

From our operating experience standpoint, generally that is a reflection of some of the concerns already identified in the industry that we are including in our procedures, whether it be a concern or improved maintenance practice or precaution in performing these activities.

So in that respect we are participating and reflecting activities of the industry in our programs.

DR. CARBON: I'm still not clear. If there is some type of valve or pump or something on BWRs that is continually giving problems, you will learn that from someone else, or only from your own experience?

MR. LA BRUNA: That is my point. Through the program of SERs, SOERs, operation and maintenance reminders and through the general SILS and TILS program, we feel we have a very firm grasp on things that can protect us.

The corrective maintenance program is a prioritized approach to preplanned activities for a responsible manager to assure plant equipment availability.

Essentially we are talking about classifying work orders as they come in. Those that have to be worked immediately and those that can be deferred and planned logically in the best interest of use of personnel.

Spare parts inventory coordination is an important

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part of our managed maintenance program, assuring adequate inventory levels and shelf-life controls.

Accurate technical and quality classification information. At Hope Creek the component data file, master equipment lists and spare parts data base are integrated to provide a wealth of technical, manufacturer, vendor, documentation and quality classification information for a consistent and reliable source for our maintenance and engineering personnel.

All of these programs are supported by computerized inspection order and work order initiation program, as you saw this morning.

This also provides the ability for closing management review and program activities which aid and are historical tracking of work completed on components and systems, as well as complementing our records for preservation and retrieval for future audit or recall for follow-up on review of past work.

(Slide.)

MR. LA BRUNA: Our managed maintenance program. Effective procedures. Trained maintenance personnel in the support of our on-site engineering staff of cognizant engineers, all of which are in place functionally during the preoperational test program, provide resources for an effective approach at Hope Creek.

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(Slide.)

MR. LA BRUNA: I would like to take a few minutes to talk about our planning for in-service inspection.

Planning for the Hope Creek in-service inspection program started during design phase of the plant.

(Slide.)

MR. LA BRUNA: PSE&G, Bechtel Engineering and Southwest Research Institute analyzed ASME code, section 11 and 10, CFR 50, Appendix J, to assure that the plant design supported access and instrumentation required for inspection and test.

We see that paying off particularly from the standpoint of accessibility.

(Slide.)

MR. LA BRUNA: Within the nuclear department our nuclear site maintenance group is responsible for the identification action, direction and conduct of preservice inspection activities as personnel are temporarily assigned to the preoperational program startup manager.

It is the same group of nuclear department personnel who will implement the in-service inspection plan for the operating facility. This participation provides the following benefits:

Develops personal experience to support operating inspections.

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It optimizes the procedures for future testing and assures the test implementation is suitable for both preservice a d future in-service inspections.

And in-service inspection problems will be recognized and corrected to support future needs.

At present our preservice inspection program is in progress and will attain the key baseline ta for volumetric and surface examination of piping system welds, some of which we have already talked about and some of the problems we have currently.

Examination of related hangers and supports, valve and penetration leak rate testing, pump and valve testing in accordance with ASME 11.

(Slide.)

MR. LA BRUNA: During plant operation the nuclear service department will coordinate in-service inspection and surveillance activities, analyze test results with our performance and reliability group of Hope Creek operations technical department.

The test data trending and assessment of the results for adherence to section 11 and requirements will also support the predictive maintenance program requirements to assure component reliability.

The personnel and procedures supporting these activities for preservice inspection program will assure

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successful transition to the testing programs for the operating plant.

(Slide.)

MR. LA BRUNA: Planning for preoperational test.

(Slide.)

MR. LA BRUNA: Preoperational test program is the integrated effort between engineering construction and nuclear department personnel under the direction of the startup manager. The testing program commences with the jurisdictional system and equipment turnover to PSE&G and ends with initial fuel loading.

First stage of the preoperational test program includes instrument calibration, energized checkout of the electrical power and control systems, piping flushes and isolated equipment operation.

The second stage of the program demonstrates the capability of systems to satisfy design intent.

All records generated during the testing program will, in accordance with the Reg Guide 168, be retained for the full life of the plant. This includes the preservation of records, microfilming and indexing, using our document retrieval programs.

This will support the retrieval for future review and audit or reference for maintenance and modification retest requirements.

jsll

To help accomplish these testing activities, the Hope Creek operations staff supports the testing implementation with a permament staff of supervisors and craft personnel trained to perform equipment operation, calibration and test of maintenance and components, some of which you saw this morning in our INC shop.

Certainly, I think you saw the capability at our training center to train the appropriate crafts whether it be INC, mechanical or electrical maintenance. We are certainly very proud of the staff we have in place today.

By doing this work ourselves and minimizing use of contractors, the operations staff has the clear advantage of retaining the experience gained during the preoperational testing program.

This integrated support and involvement of the operations personnel and these activities provides the opportunity to develop, exercise and optimize our plant administration, equipment operation and repair and maintenance procedures prior to plant operation.

It also complements the classroom training of personnel to enhance their qualifications.

(Slide.)

MR. LA BRUNA: Our Hope Creek operations planning plan is nearing completion. This program of early management has assured availability of highly trained and experienced

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staff who will continue to develop in the unique aspects of Hope Creek during the next year of preoperational testing.

Thank you very much.

I would like to introduce our next speaker, Bill Gailey, our chief project engineer.

DR. SIESS: Mr. Gailey, this item that relates to previous ACRS letters, I would suggest that you need not address anything in a letter that clearly was related to the Newbold Island site, since we are no longer at the Newbold Island site. I am not sure how much that leaves you.

MR. GAILEY: Let me explain. There are two letters I was going to discuss. The first was the Hope Creek letter in 1974. And I was going to discuss the three items that were identified as requiring further attention.

DR. SIESS: Okay.

MR. GAILEY: The second letter was specifically the Newbold Island letter. So I will just not discuss that, if that is what you are saying.

DR. SIESS: I don't believe there was anything in the Newbold Island letter as an ACRS concern that in the current context carries over to Hope Creek. If I can find my copy of the letter, I will check that.

Why don't you start, at least, with the Hope Creek letter?

MR. GAILEY: The purpose is to discuss the two jsl3

previous ACRS letters which identify three items in each requiring attention.

In the '74 Hope Creek letter, the first item identified was a request to reevaluate core operating limits as a result of what was then recently promulgated acceptance criteria for emergency core cooling.

(Slide.)

MR. GAILEY: 10 CFR 5046. This is commonly known as the -- case study. This reevaluation was done back in the 1974 time frame. Of course, as is consistent with current staff practice and requirements, we are currently redoing that analysis which is normally done about a year prior to fuel load.

(Slide.)

MR. GAILEY: The second item addressed was although Hope Creek was very close to Salem and was expected to have essentially the same seismological, geological and foundation conditions as Salem, Hope Creek had committed to undertake an extensive soil boring and testing program, and a specific Hope Creek design would be reviewed with the regulatory staff.

The programs were undertaken and completed. They have been satisfactorily reviewed with the staff. And they have resulted in no open items in the SER.

(Slide.)

MR. GAILEY: The third concern identified in the jsl4

letter was a commitment on our part to conduct an analysis, probability analysis, of waterborne accidents that could affect plant safety. These are accidents on the Delaware River.

That analysis was completed, and indicated a very low probability of an accident occurring. It was reviewed with the NRC staff, and the conclusion was that because of the low probability waterborne accidents need not be considered as a design basis for Hope Creek.

Those were the three items in the Hope Creek letter that required further attention.

DR. SIESS: Okay. Thank you.

In the Newbold Island letter there was one paragraph in that which has been addressed.

MR. GAILEY: That is correct.

DR. SIESS: Thirteen years ago. There was a paragraph on hydrogen control, and recommendation that the containment should be inerted, which has been followed. In addition to which you have the recombiners.

MR. GAILEY: That is correct.

DR. SIESS: Then there was an item -- that is, a paragraph, that ends up, that the applicant should make design provisions to reduce the quantity of reactor coolant discharged to the reactor building in the event of a process line break.

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This has to do with instrument lines, which, as I recall, were a particular concern of ours in those days. Something like 150 instrument lines that went through the dry well, and they had flow restricting orifices.

Do you remember in particular whether anybody has done anything about that? I think it was fairly standard comment for BWRs, and I don't remember the resolution. It was not a Newbold Island item.

It was also mentioned in the Hope Creek Subcommittee minutes. I checked that.

MR. GAILEY: As far as instrument lines are concerned, the orifices were retained, in addition to excess flow check valves. I believe it has been concluded the instrument lines were not a further concern.

As far as process line breaks are concerned, the intent was to provide some features to keep the off-site releases well within the 10 CFR 100 guidelines.

DR. SIESS: You are right. It was the process lines. That was the concern.

And it said previous to that although the off-site doses from such an accident would be well within the part 100 guidelines, it would be comparable to greater than doses calculated for other less probable accidents.

DR. EBERSOLE: May I comment?

DR. SIESS: Let's see if we have got response to

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this.

MR. GAILEY: Yes, that has been addressed in our design. We feel with the combination of the isolation features in the process lines and pipe whip restraints, which have been extensively addressed in Hope Creek, we have seen that the off-site releases are well within 10 CFR 100 guidelines at the Hope Creek site.

DR. SIESS: Jesse?

DR. EBERSOLE: Yes. That was a period, I guess I will call it an era of darkness, a little bit, because I noticed in particular that one focused on was release of radioactive nuclides in the stream of water which came out.

Yet, the implications of anything beyond just a modest dose was not even looked at at all. Those implications are that you are going to pollute the environments of critical electrical equipment and places where people have to live, and that in the context of direct radiation release is really of no particular consequence.

What is of consequence is you are going to disable potentially large amounts of apparatus which continue to cool the core after it is tripped. So there is sort of a distortion in the rationale in looking just at the dose consequences and not looking at the enviornmental impact on critical equipment and people.

I certainly thing you better look at it in this

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new context. It is part of the environmental qualification process.

DR. SIESS: You are speaking of environmental qualification?

DR. EBERSOLE: Yes.

MR. GAILEY: Our qualification for harsh environments takes into consideration these --

DR. EEERSOLE: These emissions?

MR. GAILEY: Radioactive releases.

DR. EBERSOLE: I have no interest in the radioactive component.

DR. SIESS: Temperature and moisture.

MR. GAILEY: That is correct, they are considered. Yes.

DR. EBERSOLE: Condensation on surfaces which lead to short circuits, etc.?

MR. GAILEY: If condensation is a problem, yes.

DR. EBERSOLE: The equipment is normally at ambient temperatures. So you wet down many terminal boards, many stud connectors.

DR. SIESS: We have an item tomorrow on environmental qualification.

DR. EBERSOLE: Right, but it directly related to the emission problem.

DR. SIESS: Among others. That wasn't what we had in mind in the letter.

MR. GAILEY: Yes.

DR. SIESS: That was strictly doses.

Thank you, Mr. Gailey.

MR. GAILEY: You're welcome.

DR. EBERSOLE: We would like to move to Mr. Churchman.

DR. SIESS: Yes. Before he starts, I looked through section 12. I think I need to clarify the concern of the ACRS in the seismic area and to define it somewhat more narrowly, maybe, than it was interpreted to be.

I don't think at this point in time and at this point and at this plant we are particularly concerned about the seismic design basis as it was done at the CP.

We have only a minor interest in comparison with the uniform hazards' curve. I am perfectly happy to accept a statement by the staff that it was done and it compared well with your design spectrum.

In terms of margins, this is a generic issue that we are pursuing with the staff and research and following the industry work. I was in attendance at the EPRI workshop. Right now we don't have any immediate major concerns we could look at at Hope Creek in terms of seismic margins for structures, components and piping.

Not that we are not concerned, but those issues

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are not the uppermost in our minds.

Margins, of course, many margins for earthquakes larger than the design basis, larger than the SSE, outside of the licensing criteria. Although on the East Coast, once the position of the Geological Survey on Charleston was clarified, is that the word, if there was ever misused, that will go down in history.

I will put it my way. Once they unloosed Charleston on us up and down the Atlantic Seaboard, the licensing-regulatory implications of an earthquake larger than the SEE that had been previously accepted may loom somewhere in the future.

There are two things we would like to address here. You may have to repeat this for the full committee. One is we are interested in the way the staff has treated more recent information regarding SSE, which in this case I think is the New Brunswick earthquake, which was real, and the unleashing of Charleston, which may or may not be real.

Both of these are addressed in the SER, and we probably ought to hear briefly from staff on that.

But in terms of the seismic margins, the one concern we're looking at, would like to discuss briefly, would be the soil conditions and liquefaction.

Again, what we're concerned about with respect to margins is whether there is a cliff out there, and how close

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to the edge of it we might be. If the cliff is three times the SSE out there, we feel one way. If there is a cliff out there and it is 1.2 times the SSE, we are obviously going to feel very differently.

And there is some concern that liquefaction might be the cliff that is most likely for some sites, because we know from history that some of the sites we reviewed met the SSE for liquefaction, but nobody really looked at them for anything higher.

So I guess to this plant we would like to know if you have some information from your consultants about the liquefaction possibility at earthquakes greater than the SSE; and if you have not, tell us what you do know about it.

And I think I would like to start off by hearing from staff on their treatment of contemporary knowledge regarding earthquakes on the Eastern Seaboard.

DR. MICHELSON: Wouldn't this be a good time for a break, before we go into this subject?

DR. SIESS: It all depends on whether your consultant has a plane.

MR. ECKERT: How are we doing? We could break first.

DR. SIESS: We will take 10 minutes.

(Recess.)

DR. SIESS: We are on the seismic issue, and the

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first speaker will be Phyllis Sobel.

Are you a geologist, or seismologist?

MS. SOBEL: Seismologist.

DR. SEISS: That's the best kind.

MS. SOBEL: I'm Phyllis Sobel, and I would like to give a brief description of two issues which were treated in the staff's SER: the 1886 Charleston earthquake and 1982 New Brunswick earthquake.

(Slide.)

MS. SOBEL: To set the stage for the New Brunswick earthquake issue, I will use a seismicity figure of the Eastern United States. This is a recent instrumental seismicity, and this figure is from a recent bulletin of the Northeast U.S. Seismic Network.

The asterisk in the southwest part of New Jersey is the Hope Creek site.

The maximum historic events within about 200 miles of the Hope Creek site were of about epicentral intensity 7, and about maximum estimated magnitude 5. These events occurred in Asbury Park, New Jersey, which is on the northern coast of New Jersey, near New York City, Wilmington, Delaware, and Richmond, Virginia.

The January 1982 New Brunswick earthquake, of magnitude 5-3/4, occurred in a cluster of seismicity at about latitude 47 degrees.

Although about 700 miles from the Hope Creek site, this New Brunswick event is significant because it occurs in the New England-Piedmont tectonic province. The closest approach to the province is about 18 miles northwest of the site.

Now, as I said, the maximum events within about 200 miles of the site were about estimated magnitude 5. The maximum events within about 50 miles of the site were about magnitude 4. This is discussed in the SER, so the staff did not see, did not believe it was possible for a magnitude 5-3/4 event to occur within about 200 miles of the Hope Creek site.

However, by examining the seismicity, we found that the largest event would probably occur near the fault zone which is about 18 miles from the site. So to be conservative, we looked at the possibility of a magnitude 5-3/4 event occurring about 18 miles from the site.

(Slide.)

MS. SOBEL: As an appendix to the SER, there is a study by Lawrence Livermore of site-specific response spectra for the Hope Creek site. One of the cases they looked at was magnitude 5-3/4 event at about a distance of 18 miles from the site.

They looked at strong ocean recordings on sites that were deep soil sites.

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On this figure you see the Hope Creek SSE, which is .2 G, Reg Guide .06 spectra, and you also see the 50 and 84 percentile site-specific spectra for the magnitude 5-3/4 event at 18 miles.

You can see the SEE envelopes the 84 percentile. So staff found that the site SSE was adequate for describing the ground motion effects of the New Brunswick earthquake at 18 miles from the site.

(Slide.)

MS. SOBEL: This figure shows seismicity recorded by the Southeastern U.S. Seismic Network. This may be the first time you've seen this particular figure. It is from the latest bulletin of the Southeastern U.S. Seismic Network.

The events that were believed to be reservoir-induced or quarry blasts have been eliminated from the figure. As you can see, I have sketched in the fall zone as a dashed line. It is a boundary between the Piedmont province to the northwest and Coastal Plain to the southeast.

Hope Creek site again is the asterisk. The Coastal Plain is virtually aseismic except for the area around Charleston, South Carolina.

As you know, during past licensing decisions the NRC has held to the position that the relatively high seismic activity within the Coastal Plain province in the vicinity of Charleston, including the 1886 intensity 10 earthquake, was for licensing decisions related to a unique tectonic structure there.

However, because of the variety of possible source mechanisms that have developed for the Charleston seismicity, the USGS, as Dr. Siess says, clarified their position in a letter to the NRC, dated November, 1982.

The staff's position with respect to that letter is in the SER. The staff's position was presented also to the ACRS in April of 1983. I will be giving you a short update now.

If you remember, the position includes both the deterministic and probabilistic studies. The deterministic study should reduce the uncertainty by better defining the causal mechanism of the Charleston earthquake.

One significant deterministic study has been trenching of liquefaction features in the South Carolina Coastal Plain. Researchers at the University of South Carolina have been trenching a sampler, which is recorded as being due to the 1886 earthquake.

In addition, both the USGS and University of South Carolina have discovered liquefaction features due to pre-1886 events.

As an aside, during the excavation for Hope Creek, the applicant and the staff geologist examined the foundation for evidence of earthquake-induced structures, and they found no liquefaction features in the faces of the excavation. The foundation strata belonged to the Vincentown Formation, which is at least 53 million years old.

The second part of the staff's Charleston program is a probabilistic program. This is being done by Lawrence Livermore National Laboratories. It includes the use of expert panels for seismicity and ground motion inputs and sensitivity studies. The basic objective is to identify those sites which have a high hazard with respect to their design.

The Hope Creek site is not one of the first 10 test sites. In fact, the staff does not know of any uniform hazard response spectra for the Hope Creek site.

Progress to date, the final calculations for the first 10 test sites are in program. There is a NUREG on the interim results for these 10 sites. But the final calculations are in progress now, and a report on them is expected in winter of 1985.

EPRI is running a similar parallel hazard study, and those results should be available in April or May of 1985. Then there will be a comparison period, comparing the two programs, and finally, Livermore will extend their runs to include all of the remainder of the nuclear powerplant sites in the Eastern United Sites.

So to conclude that topic, given the speculative nature of the hypothesis with respect to the recurrence of a large Charleston-size earthquake and the low probability associated with such events, the staff does not see a need for any action for specific sites at this time.

We have evaluated the possibility of the recurrence of an event the size of the 1886 earthquake occurring in the vicinity of Charleston and found the effects of the state are less than the SSE.

That concludes my presentation. Dr. John Chen, who is the staff geotechnical engineer, is available for any questions on liquefaction.

DR. SIESS: Thank you, Phyllis.

I think we will hear from the applicant, first, on liquefaction. Then if necessary, we will call on John.

MR. POMEROY: Phyllis, I wanted to explore, first, the logic between, if you will, your using the New Brunswick earthquake, which I understand your position to be that it is not associated with a specific tectonic feature, and therefore should be moved to the nearest point of approach to the plant site of the tectonic province it occurred in.

With your treatment of the Charleston earthquake, which you also have no evidence in my belief, that would associate it with a particular tectonic feature and yet, the staff is choosing to leave it at Charleston. There is an inconsistency in that logic.

MS. SOBEL: First, with respect to the Charleston earthquake, our position has been based on larrgely statements made by the USGS in the past, which have relied heavily on the fact that seismicity since 1886 has been concentrated in the Coastal Plain in the vicinity of Charleston.

And granted, that is not -- there is no known, definite known source mechanism. But studies are underway. We are optimistic.

In terms of the New Brunswick earthquake, it is still an open issue. Not in terms of this site, but in terms of our generic studies, whether or not New Brunswick is associated with structure.

There are after-shocks associated with conjugate fault plains in the area. It seems as if the seismicity is being localized to a structure. It is just a question of whether or not similar structures could exist throughout the Piedmont Province.

MR. POMEROY: I have another question with regard to your seismicity, instrumental seismicity maps.

DR. SIESS: I didn't get the answer there. You referred back to the previous USGS position on Charleston.

MS. SOBEL: Yes.

DR. SIESS: But you sort of ignored the clarification.

MS. SOBEL: The clarification is that we are allowing the possibility of the event occurring in other parts

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of the Eastern Seaboard by following through with probability studies.

DR. SIESS: On a probabilistic basis?

MS. SOBEL: Right.

DR. SIESS: I see.

Go ahead.

MR. POMEROY: Then did I understand you to say the staff has no best estimate of the seismic hazard at this site?

MS. SOBEL: There is no uniform hazard response spectrum.

MR. POMEROY: I guess I'm asking for site-specific seismic hazard curves other than those being, that may be generated in the future by Lawrence Livermore.

MS. SOBEL: You're talking about response spectra, probabilistic response spectra?

MR. POMEROY: I'm talking about a seismic hazard.

DR. SIESS: Seismic hazard. I don't think the staff has done a seismic hazard except Livermore, have they?

MS. SOBEL: That's correct.

DR. SIESS: Applicants have done them, right?

MR. POMEROY: Could I pose the question to the applicant at this time?

DR. SIESS: Yes, I think so.

MR. POMEROY: Does the applicant have any best

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estimate or any seismic hazard curve for the Hope Creek site?

MR. PRESTON: I would like to introduce Chuck Churman, who will address your question.

MR. CHURCHMAN: Good afternoon. I'm Chuck Churchman, Southern Engineering Manager for Public Service.

We did do a site-specific hazard spectrum analysis for Hope Creek for comparison purposes. Essentially what we have done is following the methodology used by Lawrence Livermore for those 10 other sites. We have engaged Dr. Robin McGuire. I would like Dr. McGuire to further address your question.

MR. POMEROY: Thank you.

DR. MC GUIRE: My name is Robin McGuire. In order to give the applicant some perspective on seismic hazards associated with Hope Creek, we undertook a study which involved replication of the assumptions used in the Lawrence Livermore study for the Hope Creek side.

(Slide.)

DR. MC GUIRE: We have elected to consider a subset of all the many options produced by Lawrence Livermore which we feel gives an accurate, reasonable representation of what the Lawrence Livermore study would have produced at Hope Creek had it been run at that site.

That subset consisted of using the source zones specified by 11 seismicity experts. The best estimate source

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zones and best estimate seismistic parameters for the source zones. Also, using the best estimate attenuation function specified by each of the four attenuation experts. So in all there were 11 seismicity experts times four attenuation functions, or 44 sets of curves.

The parameters we looked at were peak acceleration and spectra velocity at 9 Hz and at 1 Hz. This represents a summary of those 44 assumptions on seismic sources and attenuation functions, showing the 16th, 50th and 84th percentile, which give a reasonable representation of the hazard which would have been produced under the assumptions of a Lawrence Livermore study.

(Slide.)

DR. SIESS: Robin, where did -- I'm trying to recall from the Lawrence Livermore study where the experts put Charleston.

DR. MC GUIRE: That varied among the experts. Some of them had relatively small zones in the Southeast. Some of them allowed it to migrate up and down the East Coast.

DR. SIESS: They did. And that was sort of factored in on the expert basis.

DR. MC GUIRE: Yes, sir.

DR. SIESS: Were those opinions before or after USGS? And if so, do you think they were influenced by it?

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DR. MC GUIRE: I'm sure they were influenced by it.

(Slide.)

DR. MC GUIRE: The next slide shows similar results, being annual probability of accedance versus spectral velocity for the 9 Hz and 1 Hz spectral velocities. Again, this is a summary for each frequency of the 44 hazard runs.

DR. SIESS: Would you put the previous slide back on for a minute?

(Slide.)

DR. SIESS: What do we get at the 50th percentile, 2/10 G, about 7 or 8 times 10 to the -4?

DR. MC GUIRE: I believe it is about 2 to 3 times 10 to the -4.

DR. SIESS: That is in the range we've been talking about, isn't it? 1,000 to 10,000 years.

(Slide.)

DR. MC GUIRE: Using that set of results we constructed an approximate uniform hazard spectrum by adopting the 1,000-year peak acceleration as the high frequency asymptote, amplifying -- using the 9 Hz and 1 Hz 1,000-year spectral velocities to draw quasi-uniform hazard curves. That was done for a 1,000-year return period and for the 10,000-year return period.

Those are shown here on the third slide. Compared

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to those spectra on this slide are the Hope Creek Reg Guide 160 spectrum spectrum, .2 g, and also the Lawrence Livermore site-specific spectrum, which is for 5¼ magnitudes at near field distances and small buildings.

In this case, the later spectrum at high frequencies is very close to the Lawrence Livermore, what we estimate to be the Lawrence Livermore median 1,000 spectrum. The Reg Guide falls slightly below that, but still in the range between the 1,000 and 10,000-year spectrum.

DR. SIESS: I would like to ask a question. I'm not sure you are the one to answer it, but I wanted to ask while this is still on the screen.

What frequencies are of particular concern in relation to soil liquefaction?

High or low will be a satisfactory answer.

DR. MC GUIRE: I'll defer that question to another consultant.

DR. SIESS: We can defer the question, but save the slide.

DR. DREWNOWSKI: The frequencies that are of interest are in the low frequency range, generally less than 1 Hz.

DR. SIESS: Thank you.

DR. DREWNOWSKI: If you look at the curve, it is a very good question, because it indicates the --

DR. SIESS: Identify yourself.

DR. HARSKIL: I'm Harskil, with Dames and Moore.

The frequencies of interest are generally less than 1 Hz. As you can see from this particular curve, there is an ample safety margin with the use of the Hope Creek response spectra, which corresponds to Reg Guide 160.

DR. SIESS: Thank you.

DR. MC GUIRE: That concludes my presentation.

DR. SIESS: Thank you very much.

MR. POMEROY: Is it possible for us to get a copy of those slides, Robin?

DR. MC GUIRE: Of course.

MR. ECKERT: Now Mr. Churchman will make his presentation on the rest of it.

DR. CHURCHMAN: Good afternoon. I'm Chuck Churchman, site engineering manager. This subject of seismic design encompasses an area of many sub-subjects, such as geology, seismology, soil structure interaction, soil sensitivity studies and structural seismic analysis.

We realize that the ACRS current review emphasis has been centered on the adequacy of design input notion, seismic design margins and recent seismic developments. Within the limitation of time and your speciric request, we will tailor our overview to that interest.

We have engaged Dr. Allin Cornell of Stanford

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University, Jim McWhorter of Dames & Moore, Richard Holt of Weston Geophysical and Dr. Robin McGuire. They are available for further discussion regarding seismology and seismicity.

Professor Harry Bolton Seed and John Lysmer of the University of California at Berkeley are also present to discuss seismic analysis, particularly in the area of soil structure interaction and soil liquefaction.

Our next slide shows the topics to be presented during the overview. We are going to look at earthquake ground motion, seismic design major conservations, New Brunswick sequence, soil liquefaction, site-specific response spectra and seismic margins.

Dr. Siess, we now understand, would like to streamline this more directly to the soil liquefaction area. To do this, I would like a minute concerning the conservatisms inherent in our design SSE.

For the earthquake ground motion and location of epicenters, we go to the next two slides.

(Slide.)

DR. CHURCHMAN: Looking at the next slide, location of the epicenters, we show a 50-mile radius from the site. At the center you see a green-colored circle, which is the site. Elsewhere, you see squares which represent earthquakes.

All known earthquakes within a 50-mile radius

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have magnitudes of 4.0 or less. Approximately 15 miles to the north of the site is a square in the Wilmington, Delaware area.

(Slide.)

DR. CHURCHMAN: We have searched the historic record, which is more than 200 years, and have found within the site vicinity the 1871 Wilmington, Delaware earthquate to be the largest event with a modified Mercali intensity of 7.

Based on rather moderate fault area and limited damage, the 1871 Wilmington earthquake was probably no greater magnitude than 4.0. Based on 10 CFR 100, Appendix A, we have arrived at an SSE of intensity 7, which the NRC staff has correlated to a magnitude of 5.3.

This is very conservative, compared to the Wilmington event, with a magnitude of 4.0. We have used the Trifunac and Brady correlation, a more conservative correlation than the other popularly accepted correlation by Murphy and O'Brien.

Using the Trifunac and Brady correlation we came up with .13 G. If we had used Murphy and O'Briends, the result would have been approximately 10 G. Hence, we are more conservative.

While the standard industry practice is to use this mean value, .13 G in our case, we made it more

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conservative by going more than 1 standard deviation from the mean value, and used .20 G for our SSE input.

For the OBE we were following the Code of Federal Regulation, which required us to specify the OBE as one-half the SSE. So the OBE is 1. G.

I will move quickly through some of the other areas you have asked me to skip.

MR. POMEROY: Before you skip ahead, I really do want to ask you a couple of questions.

In the FSAR, in Table 2.5. or -1 -- I forget which it is -- you have a list that purports to be all of the earthquakes within a 50-mile radius of the site, I believe. And the last entry on that list is in 1980, I believe.

My first question is is that list, in your estimation, a complete list?

DR. CHURCHMAN: Yes, it is.

MR. POMEROY: There are two events that I am aware of that are February 10th, 1977 and April 28, 1974, with magnitudes w.6 and 2.2, respectively, that occurred in the Wilmington area, according to the Delaware Geological Survey.

If you put those points on your seismicity plot, or indeed, if you put them on the seismicity plots shown by the staff, that would begin to change the perception in that Wilmington area to some extent.

My other question has to do with, are you aware

37 of any significant activity in the Wilmington area more recently than 1977 or so?

DR. CHURCHMAN: We have researched the record over the past 200 years and made a recent recheck. What we tried to highlight today was the greatest magnitude in the 50-mile radius, particularly the Wilmington event, 15 miles to the north.

MR. POMEROY: That's correct. You did that properly. I'm not objecting to that.

DR. CHURCHMAN: Okay.

MR. POMEROY: I'm just concerned that there are events in the Wilmington area that are missing from the tabulation and from your maps that I think might change the perceptions somewhat of people looking at the seismicity map.

But I don't want to pursue that especially because I'm more interested in the second question, which has to do with the more recent activity in the Wilmington area.

DR. CHURCHMAN: Regarding more recent activity I would like to ask Jim McWhorter to answer that question.

MR. MC WHORTER: My name is Jim McWhorter, with Dames & Moore.

Regarding your first question, Paul, I think many of the events reported in the Wilmington area, especially those noted by the Delaware Geologic Survey, are so small

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in magnitude that they are very, very poor epicentral locations.

We did not include those very small magnitude events for that reason. There are several events that have been noted in the Table 2.51 that you referred to that have, you know, essentially fault events, but not located very well.

The most recent events I'm aware of which occurred after the most recent staff review were I guess December of last year, November-December last year. I don't think that would change dramatically our perception of the seismicity within 50 miles of the site.

MR. POMEROY: I have a November 17, 1983, 2.9 event. December 12, 1983, 2.4 event. February 15, 1984, 1.5 event. And January 19, 1984, 2.5 event. All of those, with the exception of the 1.5 magnitude, probably would certainly fall on your map if it included that more recent activity. Again, that would change your perception.

I guess the question I would pose to you, Jim, although I realize there may not be an answer, is would you attach any significance to the occurrence of a number of earthquakes in the Wilmington area, and at least to the extent possible from intensity surveys, all of those events are occurring in the same general area, which is an area on the Brandywine River.

MR. MC WHORTER: Yes. We are well aware the

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Wilmington area has been the scene of recurrent activity.

One thing I would like to add is that during the PSAR level at Hope Creek we did extensive mapping in the region -- excuse me -- I mean to say the Delmarva Summit site PSAR, we did extensive geologic mapping in the area of the Summit site. Before that, the Red Lion site.

There are many exposures afforded to us -- Route 295, Route 95 exposures -- that cut through the Coastal Plains. We are looking at some linears that -- from the Delaware Geologic Survey had pointed out in one of his studies, Spolarik's studies, that he felt perhaps could be related to seismicity in that region.

We also did several deep borings to try to track some of the mid-tertiary geologic structures in the area. We did not see any geologic phenomena at the surface that would be indicative of liquefaction phenomena we see in other areas in the Coastal Plain.

So we do attach some significance to the fact that Wilmington is the seat of recurring seismicity, but it has been of a low magnitude, as you know.

MR. POMEROY: Thank you. I would like to pose the same question to the staff, if I could. Do you attach any significance to this kind of activity in the Wilmington area?

MS. SOBEL: We have been in touch with the people at the Delaware Geological Survey. It seems to be their impression, and ours, that this is an area of some recurring minor seismicity. There was an event in 1871; we're not too sure about seismicity surrounding that event.

Then it seems as if there was no record of seismicity until just before the 1973 magnitude 3.8 event at Wilmington, which has been the largest event in the last 14 years or so.

They are not required to report events below magnitude 3, but they discussed the events near Wilmington, and staff has been looking at it.

DR. CHURCHMAN: Proceeding with soil liquefaction.

(Slide.)

DR. CHURCHMAN: Liquefaction potential for Category 1 structures was determined by comparing the shear stresses induced in the soil by the SSE with the cyclic shear strength of the soil in the field condition.

The maximum shear stresses at various points in the foundation were obtained from dynamic analysis. The dynamic strengths of the foundation soils were determined primarily by laboratory test data, correlated with field data.

The Hope Creek Project has three major Category 1 foundation systems: power block, service water intake, and the service water pipeline.

Due to unique schemes and construction methods I will address each separately. The power block extends

41 approximately 62 feet below grade, and is supported rather directly on -- which extends from Vincentown to the bottom of the concrete foundation.

The results of our analysis show that the foundation media of the power block, consisting of engineer backfill and Vincentown formation, have factors of safety against liquefaction in excess of 2 under the postulated condition.

. Material sloping from the Vincentown elevation up to approximately 150 feet horizontally from the power block have been excavated and replaced with engineered backfill. This further enhanced the stability of the power block against sliding.

MR. POMEROY: Excuse me, Mr. Churchman. Can I just ask a question for clarification there?

When you say you have a factor of 2, does that imply to me, compared to SSE conditions, does that imply to me that if at something like .4 G that liquefaction might occur?

DR. CHURCHMAN: I'll get to that in a minute.

In our elevation of the factor of safety against sliding of the power block structures, we were requested by the NRC staff to conservatively assume the upper 30 feet of soil liquefies under the SSE condition.

Even under these extreme loading conditions, the

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analysis proved acceptable, factor of safety, against sliding.

We would like to address the intake structure next. It extends approximately 75 feet below grade and is supported on competent Vincentown Formation. The results show the foundation has a factor of safety against liquefaction in excess of 2 under a postulated SSE condition.

DR. MIESS: What does a factor of safety mean in this case? Ratio of what to what?

DR. CHURCHMAN: Factor of safety is a ratio comparing the shear stresses induced in the soil by the SSE with the cyclic shear strength of the soil in the field condition.

DR. SIESS: Can you translate that into a seismic margin and tell me at what SSE level, assuming the same spectrum --

DR. CHURCHMAN: I'm preparing to get to that in a minute for all three structures.

DR. SIESS: Okay.

DR. CHURCHMAN: The service water pipelines are located in a trench approximately 95 feet wide. The in situ material was excavated down to Kirkwood Clay Formation and replaced with engineered backfill. The peiplines which are located at approximately 15 feet below grade use only a 15-foot wide space near the center of the trench.

The foundation of the pipeline consists of

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engineered backfill, Kirkwood clay, Basil sand and Vincentown sand.

DR. EBERSOLE: Apart from seismic liquefaction, if you were to experience a failure in one of the service water lines, would it scour the region in the vicinity of the failure and simultaneously cause collapse of both pipes?

DR. CHURCHMAN: Loss of one of the pipes has been evaluated, and the plant, it would have an acceptable effect upon the others in the vicinity.

DR. EBERSOLE: How far apart are the pipes?

DR. CHURCHMAN: Approximately 15 feet.

MR. POMEROY: I'm a little confused. That is the second time you have used the word "acceptable." Could you quantify that for me just a little bit?

DR. CHURCHMAN: For instance, with the factors of safety I've been talking about for the SSE event, I've been pointting to, for instance, for sliding conditions, a 1.1 factor of safety as required by the Standard Review Plan, 3.8.5.

DR. EBERSOLE: I guess I didn't get an answer. Did you say you have examined this problem and you don't find any problem?

DR. CHURCHMAN: That's correct. The factors of safety against liquefaction we have discussed are in general based primarily upon laboratory test data which tend to

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underestimate these values due mainly to sample disturbance.

The in situ factors of safety are very likely to be considerably higher. To assess this, we have retained Professor Seed from the University of California at Berkeley for his evaluation of seismic margin against liquefaction.

Based on Professor Seed's evaluation using field performance data, it is judged that the foundation of the power block, intake structure and pipelines have ample margins of safety against design acceleration level of .2 G, and also against significantly increased SSE acceleration levels.

DR. SIESS: That is all very interesting, but it hasn't addressed the issue I raised, the one we were interested in.

DR. CHURCHMAN: All right, Dr. Ebersole --

DR. SIESS: I would appreciate it if you would get on with it because you're telling us a lot of stuff we're not particularly interested in at this time.

DR. CHURCHMAN: I would like to introduce Professor Seed to provide a brief summary review concerning the basis for these judgments.

MR. SEED: My name is Harry Seed. And I am professor at the University of California-Berkeley, consultant to Geotechnical Engineering and Earthquake Engineering.

I have been retained by the applicant to evaluate the safety margins against liquefaction for the soils at the Hope Creek site. As Mr. Churchman just told you, when the liquefaction factors of safety were evaluated at the time the plant was designed, it was done by comparing the cyclic loading resistance of the soils as measured by laboratory tests with the estimated stresses to be induced in the ground, postulated SSE.

That comparison led to a factor of safety of 2. That was done about eight years ago, I think. At the time that was the recognized and accepted method of evaluating liquefiability of sandy deposits.

Since that time a number of changes have taken place. One of the major changes has been the recognition by the geotechnical engineering world that when we take samples of relatively dense sands that they were inevitably disturbed in the sampling process. And that disturbance leads to a reduction in the cyclic loading resistance of the sands.

I would like to show you a Vugraph to show you a typical example of that reduction in cyclic loading resistance.

(Slide.)

MR. SEED: The upper line in the plot shows the cyclic loading resistance. That is, the cyclic stress ratio plotted on the vertical action is against a number of cycles required to cause a core pressure ratio of 100 percent, which

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is interpreted by some people as being indicative of liquefaction, for a deposited dense sand.

That deposit was large enough to be tested in a large, very large-scale cyclic load test. So that is the property of a large block of sand.

An identical block of sand was made and samples were extracted from the large block of sand using conventional undisturbed sampling procedures and handled as samples of the parent block. The samples were extruded from the sampling tubes and tested as samples, 2.8-inch diameter samples in conventional cyclic loading tests in the laboratory.

The results of that set of tests are shown by the lower curve on the plot. And the comparison between the properties of the soil after sampling and the properties of the soil as compacted, indicates that the measured cyclic loading resistance of these samples of dense sands were reduced from their actual values by a factor of about 4 in the sampling process.

This kind of result has been determined in the United States and also in Japan, and is characteristic of the kind of behavior that occurs in relatively dense sands during the sampling process.

At the Hope Creek site we find ourselves dealing with a lot of relatively dense sands. The properties of these sands in the initial studies were measured by laboratory

47 loading tests. As such, the results of those tests are likely to provide a very, very considerative estimate of the true liquefaction resistance of the deposits at the site. This problem has been recognized by the geotechnical engineering profession.

And to circumvent the problem, new procedures have been developed which evaluate liquefaction resistance without resorting to the problems of sampling.

As a matter of fact, it is recognized now, I believe, that the only way that a truly undisturbed sample of sand could be obtained for testing in the laboratory would be to freeze the and in situ, and then extract the frozen soil from the ground, bring it to the laboratory and thaw it. That is extremely expensive, but it is being done in some parts of the world.

An alternative to that is to do an in situ test on the sand. In situ test is usually a penetration test, and usually, the standard penetration test. And by going throughout the world, deserving sites which liquefy during earthquakes and sites which do not liquefy during earthquakes, using actual field behavior and standard products to penetrate the resistance of sands to the liquefaction resistance of sands.

A plot showing the present correlation for that purpose which has been developed over a period of about

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15 years is shown on the next Vugraph.

(Slide.)

MR. SEED: This plot shows maybe 150 sites that have been investigated. Sites which have liquefied during earthquakes.

Open circles show sites which have not liquefied during earthquakes. Cyclic stress ratio developed during the earthquakes is plotted on the vertical axis and the penetaation resistance of the sands at the sites is plotted on the horizontal axis.

A line is drawn separating liquefiable sites from nonliquefiable sites. The line is drawn quite conservatively so that almost -- very few of the solid black points fall below that line, whereas a lot of the open circles, which are known liquefiable sites, fall above it.

It is a near lower bound line. And that, plots of that type are being used widely nowaways to evaluate the liquefiability of sand products and the factors of safety for those sandy products against earthquake-induced liquefaction.

The particular plot you see is a plot developed from magnitude 7½ earthquakes. It is possible to extend plots like that to other magnitude earthquakes. Such a plot is shown on the next Vugraph.

(Slide.)

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MR. SEED: If the magnitude goes down, then the boundary line separating liquefiable sites from nonliquefiable sites moves upwards.

Turn it that way.

The plot labeled N = 7½ on this plot is exactly the same as the line I showed you on the preceding plots. The other lines on the plot have been developed on the basis of that line, extrapolating to smaller magnitude and slightly larger manitude earthquakes on the basis of the fact that the lower magnitude earthquakes produce smaller numbers of stress cycles due to the shorter duration of shaking.

On that basis, the results of the 7½ magnitude earthquakes can be extrapolated to smaller magnitude earthquakes. This kind of approach is considered by most people in geotechnical engineering to be the most reliable way of evaluating liquefaction resistance of sand deposits at the present time.

Therefore, that is the approach I have chosen to use to evaluate the liquefaction resistance and factor of safety against liquefaction for the soil deposits at the Hope Creek site.

Now, if we could go back to the cross-section we showed you earlier, I will discuss with you the factors of safety found for the various soil deposits using that approach.

(Slide.)

MR. SEED: And possibly what they mean with regard to safety margins. The main power block structure, as you see in this slide, is supported directly on compacted backfill, shown by the cross-hatched line, and the backfill sits on top of Vincentown sand.

The compact backfill has been densified to a degree of compaction of 98 percent based on the modified compaction test. That is an extremely dense condition. There are very few sands in any projects anywhere that have been placed so densely.

Because of its dense condition it has a very high liquefaction resistance. My evaluation of the factor of safety of that deposit, backfill against liquefaction, for the postulated SSE for the Hope Creek Project, is that the factor of safety is at least 4, and probably larger.

The compacted backfill in turn rests on Vincentown Formation. We know the penetration resistance of the Vincentown Formation. Using the penetration resistance approach, the in situ testing approach, combined with field performance data for previous earthquakes, reached the conclusion that the factor of safety against factor of safety is at least 4, and probably larger.

Thus, the power block sits on two soils, both of which have a factor of safety against liquefaction of the order of 4 or more.

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DR. SIESS: Does factor of safety, can I translate factor of safety as a ratio of the G value that would cause liquefaction to the design G value?

MR. SEED: That's right. What that means, in fact, is acceleration could be 4 times higher than the postulated SSE value, and that would not bring those soils to a condition of failure.

DR. SIESS: Assuming the spectrum was the same.

MR. SEED: Right.

DR. SIESS: Now, on the Vincentown, as I recall, and somewhat confirmed by the staff SER, there was quite a range of density. It says here from 16 blows per foot up to refusal.

MR. SEED: That's right.

DR. SIESS: Was your evaluation based on --

MR. SEED: It was based on what I would call the 30 percentile value of the penetration resistance values?

DR. SIESS: How many blows, do you remember?

MR. SEED: Twenty-five, 26, thereabouts.

DR. SIESS: Twenty-five, 26?

MR. SEED: I could look it up.

DR. SIESS: That's all right.

MR. SEED: I would rather tell you. Twenty-five.

DR. SIESS: Twenty-five.

MR. SEED: That brings us to the intake structure

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which, as you see, sits on concrete which, in turn, sits on Vincentown Formation, which we have already discussed. Its factor of safety is 4 or more.

That presents no problem and provides a large margin of safety against liquefaction. The service water pipeline actually is surrounded by compacted sand because the hydraulic fill surrounding the service water pipeline has been removed as also has the river bottom sand which you see in this profile.

Those two materials are replaced by compacted sand, the same compacted sand we have under the main structure. That is extremely dense, has a factor of safety of 4 or better. That is underlain by the Kirkwood Formation, which is clay and is simply nonliquefiable, so the issue doesn't arise.

Kirkwood Formation is underlain by a very thin layer of Basil sand. We don't have an awful lot of data with that Basil sand because it is hard to get penetration resistances in the Basil sand because of its very small thickness.

Based on laboratory tests the factor for the Basil sand is 2. It's relatively dense material. We would expect that to be a lower bound value for the same reasons I have discussed with the other sands in the project.

We have -- do have some limited penetration test data for the Basil sand, and that limited data indicates the factor of safety with that layer also is of the order of 3 or 4.

Thus, all the structures of this project are supported on soils which have a high margin of safety against liquefaction. And I don't think -- and I consider personally that that margin of safety is ample for any earthquake that we might want to consider for this particular site.

DR. SIESS: What about the hydraulic fill in the upper part, there? Nothing is on it. But it can represent a lateral load on the intake structure.

MR. SEED: That's right.

DR. SIESS: Has that been looked at.

MR. SEED: Yes. In analyzing the intake structure the hydraulic fill has been considered to have liquefied during the earthquake and the pressures on the structure are representative of the pressures of liquefied hydraulic fill acting on the structure. That still provides an adequate factor of safety against sliding of the structure due to those pressures.

The interesting thing about that is that while the factor of safety comes out to be a number like 1.25 or thereabouts, since higher accelerations can't do more than cause it to liquefy; doubling acceleration does not reduce that factor of safety hardly at all.

The hydraulic fill only liquefies just the same.

DR. SIESS: Yes.

Questions?

MR. POMEROY: Did you say that the river bottom sand had about the same factor of safety as the engineering backfill?

MR. SEED: No, I didn't say that. I said the bottom sands under the surface water pipeline had been removed and therefore didn't have relevance to the issue.

MR. POMEROY: Yes. Could you comment briefly on possible differences in frequency content between intraplate earthquakes and interplate earthquakes that might give rise -- does the difference in frequency content and perhaps duration of the signal have any effect on the liquefaction?

MR. SEED: Yes. Frequency content has an influence on liquefaction. High frequency content. High frequencies of motion. What really counts in liquefaction is the number of stress cycles induced by the earthquakes regardless of their frequency.

To explore that we have over a long period of time examined the number of stress cycles induced by a lot of the accelograms representative of earthquakes of magnitude 5, 5½, 6, 6½, 7, and so on and so forth, and considered that in the whole analysis procedure.

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MR. POMEROY: If you had a large number of cycles of, say, 30 or 40 Hz, that would --

MR. SEED: That would make a large difference. If you get 30 or 40 cycles, you would be talking about a magnitude 8½, 8½ earthquake, actually.

MR. POMEROY: We have seen them in the Eastern United States at smaller magnitudes than that. But thank you very much.

DR. SIESS: Thank you, Harry.

MR. SEED: Thank you.

DR. CHURCHMAN: Thank you, Dr. Seed.

Based upon Dr. Seed's discussion we have judged that the Category 1 foundations for the Hope Creek Project are not only adequate for the design SSE of .2 G, but also has sufficient seismic margin.

(Slide.)

DR. CHURCHMAN: Streamlining the remainder of the talk, according to Dr. Siess' request, in conclusion, we have high confidence in our seismic design because we have incorporated many conservative factors.

We judge that the final product is truly conservative.

I would now like to introduce Joe Yaworksy, Chief Controls and Electrical Engineer --

MR. ECKERT: We readjusted the schedule, Chuck,

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to put you on this afternoon.

DR. SIESS: We are still readjusting schedules. But before we leave the seismic issue I have a question. It is a secondhand question. I won't identify the author. Take it from me, if you want. But I don't expect the staff to be able to answer today. Maybe not ever.

But the question has to do with the NRC taking a look at this plant to get some idea of the seismic risk of the plant as a whole. You know, seismic PRA-type approach. Limerick had a seismic PRA. It has some features similar to this plant.

I think Livermore, in connection with the SSP, was going to look at a BWR. I think the one they are looking at is Lasalle, which isn't this plant, but would give some idea whether BWRs are a little different than PWRs.

The author of the question also mentioned a Brookhaven report on seismic risk. I don't know where in the staff that question goes, but I would appreciate if you could answer any of that. Fine.

MR. CHEN: Maybe I will want to say something.

DR. SIESS: This is risk, now.

MR. CHEN: My name is John Chen, engineer with the NRC.

First I want to make a few comments with regard to the factor of safety so far in the presentation. We have

57 this understanding, apparently from the applicant. It seems to indicate the factor is real high values. But from our staff point of view, when that level increase your time duration associated with high escalation earthquakes will be different. The factor on the side will be substantially different.

Our evaluation so far, we examined the site. All the safety class structures -- containment building, power blocks -- there is no problems. The factor of safety probably in the range of, from our estimate, maybe somewhere about 3.

DR. SIESS: You're talking about liquefaction?

MR. CHAN: Liquefaction.

DR. SIESS: Okay.

MR. CHAN: Now, for the pipeline itself, because we have this river bottom stand, at higher levels pour pressure would build up. The pour pressure has been evaluated but only for .2 G.

If it goes higher, you would have certain amount of soil sand become liquefied. That effect would affect the pipelines.

For the intake structure, we have evaluated certain amount of these sliding stabilities and also the overturning mode for the intake structures.

If at the higher levels the sliding of this

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structure could be affected, because there is a lot of sand on the south side of the intake structures, we are not able, not capable to provide residence, moving into the Delaware River.

There is nother thing. On the side of the intake structures there is a crane with a coffer that was not considered as safety class structures. That has a marginal stability in the current conditions. Means under current SSE conditions it is above unity, or acceptable to us right now.

DR. SIESS: This is a crane, you said?

MR. CHEN: A coffer that encloses the crane next to the intake structure.

DR. SIESS: How is that safety-related?

MR. CHEN: If that failed under the seismic condition, especially if that one, liquefaction of the hydraulic fill taking place and river bottom sand taking place, the materials could be washed into the area close to the intake structure. Block the function of the intake structure itself.

DR. SIESS: You're going to have river sands flowing into the intake structure or stuff behind it flowing around?

MR. CHEN: Right.

DR. SIESS: Which? Or both?

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MR. CHEN: The river bottom sand hydraulic fill all being retained by the coffer.

DR. SIESS: That is the sheet pile --

MR. CHEN: Sheet pile coffer --

DR. SIESS: At the far end.

MR. CHEN: Either end of the intake structures.

DR. EBERSOLE: Do I understand you're telling me the suction, uptakes of the service water pumps would be jeopardized by incoming sand?

MR. CHEN: I am saying that is a possibility. That means the margin of safety for that cofferdam is 1.1 for sliding.

DR. EBERSOLE: What is it?

MR. CHEN: Steel pile driven down on top of the Vincentown.

DR. EBERSOLE: Does it have any --

MR. CHEN: Very minimal.

DR. SIESS: So if the cofferdam slides out into the river because the sand behind it liquefies, your concern is that the sand would go out behind it, fill around and block the intakes?

MR. CHEN: Yes.

MR. CHURCHMAN: If I could interject --

MR. CHEN: What we are thinking about is, we envision for this above SSE concern. It should be a

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progressive-type of event occurring whenever you have SSE above what the current design for. This is essentially the PRA-type of study.

DR. SIESS: Do you have something?

DR. CHURCHMAN: Yes. Chuck Churchman.

I would like to add that we have looked at the cofferdam, sheet pile cofferdam, and looked at the aggregate, 3/4-inch and ½-inch aggregate. It is fully grouted. We have made an analysis to indicate that pseudo-static analysis that indicated it would be standing with a factor of safety of greater than 1.1 under .2 SSE.

DR. SIESS: If you assume it liquefies at 1.1 times 2 SSE, it doesn't make any difference whether it is 4/10 or 6/10, it's liquefied, period. So that is not linear. Right?

But your point is that that factor, 1.1, means it would liquefy at something not too much above the SSE?

MR. CHEN: Right.

DR. SIESS: If that cofferdam failed, we would then have a problem.

MR. CHEN: Yes.

DR. SIESS: So to avoid the situation, you would say the probability was high that that cofferdam would fail if it was 2 SSE?

MR. CHEN: Yes.

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DR. SIESS: Why? The pressure on it isn't going to be any greater than it was at 1.1 SSE, is it?

MR. CHEN: It is not -- the force acting on the cofferdam will be different when you have a higher --

DR. SIESS: How can it be higher than liquefied lateral -- I mean somebody correct me if I'm wrong, because I haven't been in soil mechanics in 30 years. But I thought once I got something liquefied, it was liquid, I treated it as a heavy liquid. Get the lateral load as a density times the height and now how do I get it any higher than that, than liquid lateral load?

MR. CHEN: Let me just remind Dr. Siess, on the dam, when you have a dam retaining a body of water --

DR. SIESS: You're talking about dynamic effects, then. Dynamic loads transmitted through the soil.

MR. CHEN: Yes. This is essentially the same phenomena as retaining water behind a dam.

DR. SIESS: You have done some analyses of those, or you just think they are higher than static?

MR. CHEN: I think there is a lot of article talk about that, higher than the static, on the dam. There are also some measurements indicate that.

DR. EBERSOLE: Did the applicant have any shutdown mode which is effective without the presence of service water?

MR. PRESTON: No, sir, that is our ultimate heat sink.

dhl

DR. SIESS: Has this study you have mentioned appeared in any of the documentation?

MR. CHEN: Talk of hydro-dynamic effect on the dam?

DR. SIESS: Well, the thing you are talking about here. You see, normally in the SER we don't see anything beyond the SSE.

MR. CHEN: Right.

DR. SIESS: And the study you are talking about, looking at beyond the SSE, has that been reported in something?

MR. CHEN: No. I think that is based on the judgement factor, based on the design margins at this point we have.

DR. SIESS: So in your view of Hope Creek, you are satisfied it is okay at two tenths SSE?

MR. CHEN: Right.

DR. SIESS: But if you were pressed for a margin, if somebody came along and said Yes, we have got to really move Charleston up there, somewhere in the neighborhood, and it goes up to .25, you would have to start over.

MR. CHEN: We have to carry on some additional studies, yes.

DR. SIESS: I see.

You think of a seismic PRA was done, this would be a major thing to be addressed?

MR. CHEN: Yes, I think PRA would show the ranking, the overall ranking of these effects.

dh2

DR. SIESS: It can happen. Of course, it is quite serious; this is the ultimate heat sink.

MR. PRESTON: We would like to provide additional comment on the NRC's statements if we may.

DR. SIESS: Fine.

DR. CHURCHMAN: Dames & Moore, Dr. Harskil.

DR. HARSKIL: My name is Harskil, with Dames & Moore.

Dr. Siess, I think the two things that ought to be borne in mind with respect to the numbers that have been bandied about in the discussions that have ensued, factor of safety of 1.1, assumes extreme loading conditions. It assumes that the hydraulic fill globally liquifies. The hydraulic fill is composed of irregular and somewhat discontinuous layers of silty clays. Clay silts and silty sands with organics in most parts of the layer.

These materials are not liquifiable. Between certain gaps, especially around 10 to 15 feet, there are sporadic thin layers of sand, of fine to medium consistency. These sands are loose to medium consistency with N-values between 2 to 10 blows per foot.

We are of the opinion that the hydraulic fill will not globally liquify. If we make the assumption the hydraulic fill does globally liquify, then the factor of safety against sliding for the intake structure is 1.1. So, factor of safety for sliding of the intake structure is considerably higher than

dh3

1.1.

The second comment was with respect to the buildup of pressure in the Basil sands. It has been said that if a higher seismic design, higher G value for the site was imposed, that there would be higher forward pressure built up in the Basil sands. Right now, using laboratory tests and conservatively associated with sampling, transportation and testing of samples, we have determined a factor of safety in the Basil sands of 2.

The pressure built up using thiss very conservative measure of analysis is relatively low. It is my perception, and prior presentation has verified that, using field performance data, factor of safety in the basil sands are higher, which leads me to conclude that the poor water pressure buildup in the Basil sands will be even less than that predicted from laboratory testing.

I think these two very important considerations ought to be taken into account when we consider the potential for liquifaction and consequences of the potential for liquefaction at the site.

DR. SIESS: Thank you. Regarding the hydraulic fill, I am reading the SER. It says, it is composed of irregular, sometimes miscellaneous layers of clays, clay silts and silty sands with organics in some places. There are -- 2 to 10 is really loose. That refers to non-granular materials.

DR. HARSKIL: That's correct.

dh4

DR. SIESS: I think this has been interesting. It is another issue peculiarly related to licensing because it is beyond the design basis issue. I do believe, though, that the discussion has brought out the fact that there might be some things out there if we have to go to higher earthquakes or if we really ought to start thinking about seismic margins.

What has been postulated by the staff is a very serious thing. If we block another intake structure, that is the surest way to get this plant in really serious trouble. To prove you can't block it involves something I think just [illegible] the start of the art almost. It is trying to predict liquefaction in a very mixed soil, then worrying about dynamic effects of a heavy liquid.

And a factor of 2 is pretty big in some things. But if what happens out at the end of that factor of 2 is total disaster, it is not very big. I am not sure if even a coffer dam fails it is total disaster. It may not block everything. I would have to think about it. I don't think we will reach a conclusion on this and I am not sure what the full committee will want to do.

They might end up with a paragraph in the letter suggesting you continue to look at this. And if somebody ever gets Charleston up there we will all be looking at it.

Any other comments?

MR. CHEN: I have one more comment, with regard to the

dh5

coffer dam stability analysis. For that particular analysis, the staff did not require applicant to assume the hydraulic fill and the river bottom sands liquified for that analysis.

The safety factor for that, based upon applicant's analysis for the sliding failure mode is 1.3, but for the overturning mode, it is 1.14.

DR. SIESS: Overturning in this case means overturning about that concrete or overturning above that? I mean, there is a column there, a structure. Then there is another equal amount of concrete down below it. Are they tied together so that the whole thing has to overturn or can you just tip over the service water --

MR. CHEN: Just turning toward the river --

MR. SCHWENCER: No.

DR. SIESS: I am trying to find out what overturns. Have I got something 50 feet high or 100 feet?

MR. CHEN: The entire coffer dam is 60 feet.

DR. SIESS: Can somebody give us that slide, please?

MR. CHEN: I have a slide.

DR. SIESS: Do you know what I mean by treatment concrete?

MR. CHEN: Yes, but I am not sure there is treatment concrete in that, in the coffer dam.

DR. SIESS: Oh, in the coffer dam area.

MR. CHEN: Just to set the record straight --

dh6

DR. SIESS: I think we have gone far enough on it. We understand the concern and the possibilities. I understand 1.1s and 1.3s, which don't help me very much at this stage. They help me for licensing the plant, but not for determining seismic margin.

Yes, do you have something you want to add?

DR. MC GUIRE: Let me make a parenthetical comment which I should have made during my presentation, which perhaps bears on the committee's consideration of accelerations above the SSE. That is the results I showed which are derived from the Lawrence Livermore study should be considered as conservative in terms of the absolute numbers of probability.

That is based on several conservative assumptions used in the preliminary round by Lawrence Livermore, and I believe is also the stated position of members of the NRC staff; that those results are probably conservative by at least a factor of 3. That may bear on the subcommittee's consideration of the potential effects of accelerations above the SSE level.

DR. SIESS: I don't remember -- see, I don't know how to read your curves on that because you had different curves for different Ms. If I put 7 and a half there, that was Charleston I guess, right? Magnitude 7 and a half?

DR. MC GUIRE: Charleston earthquake is estimated to have body weight magnitude around 6 and a half.

DR. SIESS: Okay.

dh7

DR. MC GUIRE: Six and three-quarters.

DR. SIESS: You see, I don't know at what probability I am comfortable about shutting off the service water. 10 to minus 4, you know --

DR. MC GUIRE: I am not sure what probability you should be comfortable with, either.

DR. SIESS: This is our problem, you know. We are talking about probabilities, nobody knows what they are worried about.

DR. MC GUIRE: My only point was the curves which I showed which you will get a copy of should be considered as conservative estimates of those probabilities.

DR. SIESS: Conservative estimate of the probability, I think means a factor of 10.

DR. MC GUIRE: I think I said about a factor of at least 3.

DR. SIESS: Oh. That's nothing on probabilities. You know. We are dealing with just exponents.

DR. SEED: Mr. Chairman, since I started this, could I say a word or two?

DR. SIESS: Sure.

DR. SEED: I think one of the things that has to be borne in mind, we have to look at the coffer dam problem. But we will do that tonight. The issue about the intake structure, it has to be borne in mind whether we analyze structures like

dh8

this that liquefaction doesn't happen the instant the earthquake begins. On a magnitude 5 and three-quarter earthquake, the total length of shaking is not more than a few seconds. It is going to take all of those seconds for the soil to liquify.

By the time the soil realizes it's liquified, the earthquake is probably going to be over. So it is not always necessary to combine dynamic forces with the pressures on liquified soil at the same time. Soil is likely to liquify at the time the peak acceleration develops during the earthquake if it is going to do it at all.

And by that time the inertia forces produced by the combination of liquified soil and subsequent motions is not going to be the combination of the maximum dynamic effect together with the pressures of liquified soil. These are important considerations and I feel they are being overlooked in the way the staff is examining this problem.

And I think the sequence of the evengs going on needs consideration in evaluating the factors of safety.

DR. SIESS: You are simply saying it is more complicated than we think it is.

DR. SEED: I am suggesting it is not more complicated than I thought it was.

(Laughter.)

DR. SIESS: I didn't say that. But when we are what-if'ing, we like to simplify things. It helps.

lh9

MR. ECKERT: Can we move to another subject?

DR. SIESS: I am going to poll the committee. We have finished the seismic issue for the moment. It is now 6:30. We can go back and talk about corporate organization, which would put us back in order. It seems to me we could do some trimming in there, if you wanted to.

I don't know how much of this the committee is interested in at this time. I would think that, would you like to work until 7 o'clock on whatever we have got?

DR. MICHELSON: I would like to suggest that in the case of Section 3.2 of the agenda that we simply look over the material tonight and ask any questions we have in the morning. Most of the other handouts seem to be reasonably comprehensive. I assume these are, too. One could simply read through it and ask questions in the morning where it isn't there.

DR. SIESS: How would that do with you?

MR. ECKERT: The only problem with that is, all you have there are the slides.

DR. MICHELSON: Yes.

MR. ECKERT: There isn't any text at all.

DR. MICHELSON: That's right.

DR. SIESS: Slides give some idea of the score.

MR. MARTIN: There is some text.

MR. ECKERT: Is there text in the book, too?

DR. MICHELSON: We have text in the SER that will also h10

guide us.

MR. ECKERT: I can make two minutes' worth of comments on it and let it go to that.

DR. MICHELSON: I would like to reserve the right to ask questions after I look at it.

MR. ECKERT: Of course.

DR. SIESS: I think we are about at a point of quitting.

DR. MICHELSON: Why don't we suggest they make a five minute summary statement in the morning, followed by questions on that section?

DR. SIESS: Well, those issues, I believe the committee is clearly interested, I think Items A, B and C are for information. They can get a lot of that off the slides. And ask questions. But D and E, I don't see how they can be separated. This is the operating experience of the people in the plant. We want to know what you are doing about qualified operators, the question the staff raised earlier about the six months' experience on Salem. And how many people you expect to have and so forth.

This has been another issue with the committee over plant. As near as I can tell, that is what D and E addresses; right?

MR. MARTIN: That's correct.

MR. PRESTON: That's correct, yes.

DR. SIESS: It's not so much current status, because hll

you are a year from full load, as where you expect to be then.

MR. ECKERT: You will see those statistics in the book.

DR. SIESS: Okay. What is your target on that?

Item F, we will see how much interest there is on that. I will propose people take the notebook with them tonight. We will start off tomorrow morning with a brief presentation on that and then questions and answers.

MR. ECKERT: Okay, we will give you --

DR. SIESS: D and E, I think, after I look at what is in the book, I will tell you how much of that we want. It won't be all of it. Okay.

MR. ECKERT: We will pick up A, B and C in about two or three minutes in the morning, I think is what you are saying.

DR. SIESS: It might end up a lot longer than if people ask questions.

MR. ECKERT: Fine.

DR. SIESS: Then on the other items, there are a few near the end that we can safe some time on if we have to. I have already looked ahead at some of the content. And things we are interested in, we could easily just skip. In fact, most of it, a lot of the stuff --

MR. ECKERT: If you see some you would rather see a condensed version, if you could identify those, it would certainly help the people tonight.

DR. SIESS: Most of these are pretty condensed

dh12

already. Something we have down for 15 minutes means somebody planned to present it in about 7.

MR. ECKERT: Exactly.

DR. SIESS: Emergency planning, which is strictly the same as Salem, I am not sure there is any point in listening to it. Fitness for duty and personnel selection; people can look through that and decide whether they want to ask questions about it. I have looked at that. I think we might want to hear something on it.

Training, as I look through that, a lot of it is organization charts which I think we can skip and get into criteria, selection and things of that sort. 3.16(b) is emergency operating procedures development, and I think there is some interest in that. Communications. I am not sure we can't drop that. And the radiation protection program, the orginal part of it, that is the first part, I think we could skip. And then the second party, absent Dr. Molar, I am not sure. We might want to save something for him to bring up at the full committee meeting

But I can see some saving in the late afternoon tomorrow. We will have a chance tomorrow to go over that with you so it won't be just cold.

MR. ECKERT: All right.

DR. SIESS: So we are going to recess the meeting until 8:30 tomorrow morning in this room.

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I assume you can leave things here. Don't leave too much. Thank you very much.

MR. ECKERT: I think you can leave anything here you want to.

DR. SIESS: Okay.

(Whereupon, at 6:40 p.m., the meeting was adjourned.)

CERTIFICATE OF OFFICIAL REPORTER

This is to certify that the attached proceedings before the UNITED STATES NUCLEAR REGULATORY COMMISSION in the matter of:

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were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission.

(sigt) CRAIG L. KNOWLES
(TYPED)

Craig L. Knowles

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