CHAIRMAN FARRAR: Once the actual licensing proceeding is over, that's not a matter for the Board; that's not a matter for the Intervenor. That's just the staff and the Applicant.

MR. TURK: The test results would involve judgment.

CHAIRMAN FARRAR: Right.

MR. TURK: Whatever the test results are, they are.

CHAIRMAN FARRAR: The test says 240, but the Applicant's people got together and said, "Aw, we're going to go ahead anyhow." You all come on the scene three months later and review that, and you find the 240 and now you all caucus and say, "It seems okay to us." or "It doesn't seem okay to us." That's anything but ministerial.

JUDGE LAM: For that matter, if Dr. Khan is here, if he imposed the automatic to estimate the interpretation of 250, then 125 psi would be adequate.

MR. TURK: I don't understand the comment. Judge Lam, Dr. Kim?

JUDGE LAM: Dr. Khan. Remember when we asked for guidance on the interpretation of 10 to the minus 6?

CHAIRMAN FARRAR: I don't know if you were

there, Mr. Turk, but Dr. Lam's referring to the order of magnitude suggestion the staff made on the aircraft accident issue.

MR. TURK: I probably was there, and I think I know what you're referring to. That's an interpretation that would be subject to your ruling here in this proceeding and subject to Commission review.

CHAIRMAN FARRAR: Right. That's because it is in front of us now, but suppose, what Judge Lam is suggesting is that, if after the fact, on the soil somebody says, "Well, it was supposed to be 250; 240 is okay. It's within 5 percent. That's good enough."?

MR. TRAVIESO-DIAZ: Mr. Chairman, if I could comment on that?

CHAIRMAN FARRAR: Yes.

MR. TRAVIESO-DIAZ: I will respectfully argue with your hypothetical. The Applicant is committed to proving to 50. If the results show less and they want to have the results stand, they need to get approval. They can't just go ahead and say, "240 is close enough. We're going to go blithely do it."

It is a commitment in the SAR that they are going to meet. I would be very surprised if the

Applicant prefers to find out with a particular lift the soil cement was 245 and they're going to try to get an exemption as opposed to, as Dr. Wissa said, pull or rip it out. Just as a matter of practicality, it is much easier to fix something that is not combined than to try to prove by calculation otherwise that you are still okay.

CHAIRMAN FARRAR: How big an area would be poured at a single time? In other words, is this the underneath the whole 500?

DR. WISSA: Oh, no, this would depend on the plant capability, but I would think that it is difficult to tell, but maybe a few slabs a day would be probably what I envision. That probably would be a maximum. I don't seem them working -- you don't want to expose the whole site and try to do it en masse. So it is going to be a long process of construction.

CHAIRMAN FARRAR: But the flip side of that is it is in individual sections that would be tested as you go along.

DR. WISSA: That is correct. You would be --

CHAIRMAN FARRAR: So the cost and/or hassle of ripping it out is not enormous?

DR. WISSA: No. I think you would know very quickly if you have a problem. I mean, there's been situations on highways where you have had to rip out pieces of highways, and highways go much faster than this type of construction because highways are a continuous strip. Here it is one little block and the next and the third. So it is going to be much slower, and the opportunity to correct defects is much easier and financially not out of control. So you would know fairly quickly if you have a problem.

MR. TURK: May I add to my answer? I think what we have to look at are two things that the State is ignoring. No. 1, the Applicant has a duty to inform the NRC of facts directly. They cannot make material false statements to us. They cannot alter documents. They cannot provide false test results without running afoul with criminal penalties. So you have that as a first measure, assurance of the integrity of the results reported by the Applicant.

Second, you have staff inspection, which provides us independent means of auditing and verifying that test results have shown the conditions have been achieved that the Applicant committed to achieve.

Third, in the regulations there's an

entire section on quality assurance/quality control. This is Subpart (g) of NCFR Part 72, which includes provisions for things like control of the test program. That is 10 CFR 72.162.

The licensee, if it obtains a license, must conduct its tests in an appropriate manner.

CHAIRMAN FARRAR: Right now we're not questioning the test. We're questioning --

MR. TURK: Yes, I'm going to come to judgment.

CHAIRMAN FARRAR: Right.

MR. TURK: Then, finally, you asked the question, well, what happens if they miss and then there's some attempt to justify? Is it good enough? Under 72.48, there is a provision that states that anytime any Applicant has a result of a test that constitutes an unreviewed safety question, they must evaluate what steps to take next. This is similar to 50.59 in the Nuclear Power Reactor regulation scheme.

If the result of the test is not what they had committed to in their SAR, they must determine whether an unreviewed safety question is presented by that result, and then there must be some corrective action. Either they conduct an analysis to determine that the result is acceptable or it's found not to be

acceptable. Then there's a required series of steps that must be taken. But there's no attempt to brush under the carpet or hide things from the public or from the State of Utah.

MS. CHANCELLOR: Your Honor, I would just like to comment on Mr. Turk's reference to 72.48, whether there's an unreviewed safety question. We have heard Holtec say, and other people say, in this proceeding that sliding is a good thing; sliding is beneficial. Staff and the SER say sliding is beneficial.

The State takes the opposite position. So the fact that there is a regulation that addresses unanswered safety questions, if the staff and PFS don't think this rises to a safety question, then the ability of the State to present its argument in this forum is diminished because the State feels that, if there is sliding, then that does relate to safety.

CHAIRMAN FARRAR: Mr. Turk, Mr. Travieso-Diaz, suppose you all went through the procedure that Mr. Turk just described, and it was an unreviewed safety question, and it was brought to the staff's attention. And the staff said, "Okay, we've checked it out. You missed your mark, but it's okay." What provisions, if any, do the rules provide for the State

to challenge that? Is that one of those petitions they would have to file?

MR. TRAVIESO-DIAZ: 2.206. 2.206 Petition for Review. At any point the State can, and I suspect they may at some time in the future. 2.206 is available at all times, not only to the State, but to any party who feels that there is some violation of NRC regulations or safety issues raised in the design, construction, or operation of a nuclear facility. That can be raised in the form of the 2.206 petition. That doesn't stop at the time you get the license. In fact, it continues the whole time.

CHAIRMAN FARRAR: I think we've probably exhausted this subject, but I didn't want to move on if there was any need for any evidence from these witnesses. I think everyone understands everyone else's position, and for now we will leave it at that.

MS. CHANCELLOR: Could I just say, Your Honor, that 2.206 has no teeth whatsoever. It's basically just sending a letter to the NSC and hoping somebody will do something.

CHAIRMAN FARRAR: The Board has trouble enough dealing with the matters that are within its jurisdiction to deal with. So everyone will have their own opinion on that, but we will not be

discussing it here.

I think that concludes the Board's questions. Does the Applicant have any redirect?

MR. TRAVIESO-DIAZ: I think I have a half a dozen questions. I don't know whether the Board would like to take a break now or whenever it will be.

CHAIRMAN FARRAR: No.

MR. TRAVIESO-DIAZ: I can go right ahead.

CHAIRMAN FARRAR: Why don't you go right ahead?

MR. TRAVIESO-DIAZ: All right.

REDIRECT EXAMINATION BY MR. TRAVIESO-DIAZ

MR. TRAVIESO-DIAZ: Dr. Wissa, let me start from the end, which is the questions that the various Board members have been asking as to how you ensure that what is done in the field conforms to the test results and the specifications. As a practical matter, as you're the person who has field experience, how would you go, and how do you expect that this party will go, about ensuring that the work that is actually constructed, the soil cement that is installed, meets the requirements and the results of the test parameters.

DR. WISSA: The proof of the pudding, if you want to put it here, is in sampling the soil

cement or the stabilized soil and taking cores, for example, taking them back to the laboratory and testing them. That will give you the strength. The same thing with a bond between the layers. You would core the layers after construction, bring them back and test them to make sure you're getting the bonding you require. So it is a fairly straightforward and standard procedure.

What you do is two things. You take samples during placing of the soil cement. You make up molds and you test those. That happens as you're constructing. Then you come back again after it's cured in, let's say, a week or seven days or 28 days after, and recore the final product.

As far as the bonding between layers, you would not be able to do this in advance. You would have to core the final product to measure that. This would tell you that you're meeting your objectives. So you would have quantitative numbers to document what is being achieved in the field.

MR. TRAVIESO-DIAZ: So there is no possibility that you could inadvertently have an installed soil cement installation that doesn't meet the requirements of the segment of the test forum, is that correct?

DR. WISSA: I think when you say, "impossible," that's going to an extreme. The probability is extremely small that you would have a situation where you would not meet your objectives. You would not know that you have not met your objectives.

MR. TRAVIESO-DIAZ: Now you mentioned, I think in response to Dr. Lam's questions, that you expect that when the specifications for this soil cement and cement-treated soil are issued, they are not going to be in terms of a single number, but a range of values that establish the tolerance, if you will, that you are capable of living with. Is that correct?

DR. WISSA: That is correct. As far as moisture content, cement content, and so on, you can't say, "I want a 5 percent moisture or 6 percent moisture." You have to give tolerances. Just from a practical point of view, it's never given that way.

MR. TRAVIESO-DIAZ: Typically, those tolerances, what do they run in percentages?

DR. WISSA: I beg your pardon?

MR. TRAVIESO-DIAZ: Yes, typically, this type of tolerance, for example, of cement content will be 5 percent, 10 percent?

DR. WISSA: Ten percent of the number?

MR. TRAVIESO-DIAZ: Yes.

DR. WISSA: Well, it depends. Let's say if you only were using 2 percent cement, 2 percent and your five percent of that, that's very small. The larger the number, the smaller the tolerance can be. So at 10 percent, you may have half or 1 percent. Moisture content you usually specify plus or minus. In this case where you have very good control, 1, 1.5 percent, 2 percent would be fairly large. So probably with central plant mixing, you can control it to plus or minus 1 percent moisture content, for example.

MR. TRAVIESO-DIAZ: You were also asked by members of the Board the hypothetical as to assuming that you are outside the range of the values that your tolerances allow, that you may want to analyze the problem away, taking into account all the conservatisms that you have in the design, and so on. Based on your experience, how likely is it that you or PFS, for that matter, would elect to go by the way of trying to paper the problem out of the problem, as opposed to trying to fix it?

DR. WISSA: I think Paul Trudeau answered that question very well. When it comes to the soil cement, it's so easy to make sure that you meet the

objectives. As a matter of fact, our criteria of strength is probably not the controlling factor. So strength is not going to be an issue.

As far as the cement-treated soil, you have to have more flexibility, but you could have more variables in there. I think in that case you are going to be looking at moisture content and cement content and density to be able to achieve those objectives. So we're going to have to do more work to determine the flexibility we have in there.

So I think in all cases you will be able to achieve what you want before construction, and then during construction make sure it's achieved by the testing program of sampling and testing.

MR. TRAVIESO-DIAZ: But assuming that, after all is said and done, you did your installation and you found that the installed, you will say on a particular pad that you don't meet the requirements set up in the design. How likely is it to you, based on your experience, that you will elect to try to analyze the nonconformance away as opposed to trying to take corrective action?

DR. WISSA: I think there is no doubt that the contractor would be pretty upset if you closed down the job while you are trying to analyze it. It

is much easier to just rip it out and start from scratch again. I think this is usually what happens. You don't try and analyze something unless it's extensive, but by then the job would be closed down anyway, if you have had it going on for weeks on end, and then you have to go back to the drawing board. But this is unlikely in this case.

I would say I don't know of any situation where you have had to close down a job, redesign a job. I shouldn't say that; I'm sure they exist, but in my experience I haven't seen a job where we have had to close it down for redesign and then come back months later to start again this job.

MR. TRAVIESO-DIAZ: Earlier this morning you were asked to give in some detail the various steps that you followed during your test program to qualify soil cement mixtures for use. Do you remember that?

DR. WISSA: Yes.

MR. TRAVIESO-DIAZ: Were the steps that you described the same steps that appear in the ESSOW, which is Exhibit GGG, prepared by PFS?

DR. WISSA: Yes, basically I used the word ESSOW, but it is in both, but the more detailed part is in ESSOW.

MR. TRAVIESO-DIAZ: As long as we are talking about the ESSOW, is it correct to say that the ESSOW contains a quality assurance/quality control program that dictates how the various tests are going to be conducted to ensure quality?

DR. WISSA: That's correct.

MR. TRAVIESO-DIAZ: Do you expect that when a specification is issued to a contractor in the field to do the actual construction that there will be a similar QA/QC document that dictates how they are supposed to do the various steps of construction?

DR. WISSA: I'm sure there will be.

MR. TRAVIESO-DIAZ: And that will include things such as how you go about mixing the cement in the batch or how you go about placing it in the various lifts, and so on?

DR. WISSA: I'm not sure you would go to that extent, because you want to give the contractor flexibility in coming up with, considering his capabilities and equipment, with the best solution. I think it is a mistake to overspecify because, one, it prevent innovation, better ideas that the contractor may have. So I don't think you would go to that specific detail.

What you try to do is specify the testing

procedures and the final product quality, but not go through the details how you're going to achieve it.

MR. TRAVIESO-DIAZ: And you would expect to make sure that the final total quality has been achieved as per a specification?

DR. WISSA: Well, that is the QA/QC program we're talking about.

MR. TRAVIESO-DIAZ: Exactly. Yes, that's what I was asking you about, QA/QC.

DR. WISSA: That's why you have a QA/QC program, to be able to document and make sure that you are achieving your objectives, or practice achieving the design objectives.

MR. TRAVIESO-DIAZ: Typically, that is sort of the verification will be covered both by the QA/QC program of the contractor and that of the client, is that correct?

DR. WISSA: Usually the contractor has his own program, and the client has his. So there are usually two programs, and the client has the opportunity to review the contractor's work, too, but he doesn't rely solely on the contractor. He relies more on his own QA/QC.

MR. TRAVIESO-DIAZ: Mr. Trudeau, in response to one of the questions that Ms. Chancellor

asked you as to what additional tests do you expect that you will be doing with respect to the soil and the soil cement program, you indicated that you would be doing some rapid loading tests to demonstrate some well-known property, but I don't think you explained what that was. Could you elaborate or more fully provide an answer to that?

MR. TRUDEAU: That well-known property is that the dynamic strength of these clay soils is well-known to be much greater than the static strength, the strength that you would measure in static strength tests for these clay soils. We have not taken credit for that other than to list that as a conservatism in our analysis, because we haven't run any of those such tests to measure how much logically we can increase the strengths, the static strengths, that we've measured in these static tests.

I didn't say that we would be definitely doing those tests, but we have discussed the possibility of doing some of those, especially for the compacted clay soils, because we feel that there is that conservatism in there and we feel that that would certainly show that we've got much greater margins against sliding.

MR. TRAVIESO-DIAZ: Dr. Wissa, a couple of

times you have stated that you will be able to show, during the construction process, that you have achieved the proper bonding between the various layers of soil cement and the pad and the soil underneath. Could you explain how you expect that you will be able to do that demonstration?

DR. WISSA: Yes. After construction of a pad, you would go in and core, take a core sample through the pad and the underlying layers of interest. You would take these back to the laboratory and you would then take each segment where you have an interface and shear them apart and measure the strength or the force required to shear, but, more important, that the failure does not occur at the interface but rather in the parallel material, whether it's the clay or the soil cement or the concrete. Obviously, it is going to be the cement-modified soil or the clay. As long as it fails through that rather than through the interface, then you have achieved your objective of making sure you have a good bond.

MR. TRAVIESO-DIAZ: This is for either of you or both. Ms. Chancellor asked Mr. Trudeau a series of questions that the gist of which was to establish certain differences between the characteristics of the Koeberg Nuclear Power Plant in

South Africa and the situation at the PFSF. Could you explain what are the similarities that could make the Koeberg plant a proper precedent for the use of soil cement at the PFSF? Whichever wants to take a hand at this, will you --

MR. TRUDEAU: In my estimation, the shear strength of these soils was not sufficient to preclude liquefaction. So they treated them with cement to increase their shear strength, so that they can withstand the cyclic stresses due to the earthquake.

Here we are taking these loose eolian silts and mixing cement with them to increase their shear strength, so that they can resist the sliding stresses due to the earthquake. It's a shear strength issue that's similar in both cases, in my estimation.

There are seismic loadings that are earthquake-based that are similar in both cases.

MR. TRAVIESO-DIAZ: Mr. Chairman, that's all I have.

CHAIRMAN FARRAR: Any recross? Any recross by the staff?

MR. O'NEILL: Just a quick question or two.

RECROSS EXAMINATION BY MR. O'NEILL

MR. O'NEILL: This first one I direct to

both of you. Notwithstanding the uniqueness or non-uniqueness of your proposed applications of soil cement or cement-treated soil, would you characterize the particular procedures that you intend or have committed to use? I am referring to the mix proportion and construction quality control testing of soil cement. Would you characterize those as well-accepted procedures or standards?

MR. TRUDEAU: Definitely. They're all very well-accepted. This particular application of soil cement is not that much different than using structural fill to do the same thing. It is just that the soil cement has better cohesive characteristics than the structural fill does

DR. WISSA: Several agencies, including the Corps of Engineers, the Portland Cement Association, have manuals today which are pretty standard with all the testing we are describing, where the only exception is the one of a bond between layers, where that is not covered by that type of standard. But everything else is pretty routine -- is routine.

I mean it has been going on for years. You don't have to be a specialist to follow those directions. They are written in such a way that even

small contractors can build parking lots and pavements using these procedures. So you see it being used throughout the world, and based on these type of manuals which are written in fairly lay terms. So it is very easy to follow. The strength type testing is very, very simple. It is not high technology-type testing.

MR. O'NEILL: Thank you.

During cross examination, again the Koeberg plant example was brought up. Would you consider that to be an example of foundation stabilization that we had discussed earlier this morning?

MR. TRUDEAU: Definitely, it was.

MR. O'NEILL: Thank you. That is all I have.

CHAIRMAN FARRAR: Does the State have any additional cross?

MS. CHANCELLOR: Yes, I do, Your Honor.

RECROSS EXAMINATION BY MS. CHANCELLOR

MS. CHANCELLOR: Dr. Wissa, you stated that there was a QA/QC program in the ESSOW. Is this the ESSOW between Private Fuel Storage and AGEC that you're referring to?

DR. WISSA: I'm not sure. I think that's

it.

MS. CHANCELLOR: The one that is attached to your testimony as Exhibit GGG?

DR. WISSA: It is a DG --

MS. CHANCELLOR: GGG, three "G's."

DR. WISSA: That's it, yes.

MS. CHANCELLOR: And you also stated that there are manuals for testing that are written in lay terms and that's low-tech; it's easy to follow. Is that correct?

DR. WISSA: Can you repeat that?

MS. CHANCELLOR: Manuals for testing, just in response to Mr. O'Neill, you stated --

DR. WISSA: Yes.

MS. CHANCELLOR: -- that there are various manuals and that they're low-tech and that they are easy to follow?

DR. WISSA: That's correct. The PCA has put out these manuals for all types of contractors, from the very sophisticated to the very small one-man operation.

MS. CHANCELLOR: Mr. Trudeau, isn't it correct that during your deposition you stated that AGEC has an NQA 1, follows NQA 1 QA procedures?

MR. TRUDEAU: I don't recall.

MS. CHANCELLOR: Is it correct that you said that AGEC relied on Stone & Webster's review of the AGEC program for QA/QC, and AGEC basically adopted Stone & Webster's QA/QC?

MR. TRUDEAU: That I recall, yes.

MS. CHANCELLOR: Isn't it true that AGEC failed the durability tests that are conducted of the PFS soils?

MR. TRUDEAU: The first round of durability tests have not passed, that's correct.

MS. CHANCELLOR: Isn't there some question about the QA/QC procedures that AGEC followed for those durability tests?

MR. TRUDEAU: That is unknown. We just know that the tests failed. We don't know yet why they failed. We suspect they failed because they weren't compacted to a high enough density, but we haven't reached that conclusion yet.

MS. CHANCELLOR: If they weren't compacted to a high enough density, would that suggest that there is a failure of those tests and the QA/QC program at AGEC?

MR. TRUDEAU: I don't think so.

MS. CHANCELLOR: Failure to compact samples is not a quality assurance/quality control

issue?

MR. TRUDEAU: The quality assurance documents how the tests are done. I wasn't there when they did them, so I don't know exactly what happened on the molding of those specimens, but, you know, at this point it is still supposition that that's, indeed, what's happened. We need to pursue that matter further.

MS. CHANCELLOR: Is this one of the reasons that you are giving the -- that PFS is considering Dr. Wissa as the person to do the entire PFS cement program?

MR. TRUDEAU: We brought Dr. Wissa on board to help us with this litigation. Dr. Wissa has some expertise and has the ability to do these more sophisticated tests, the bond tests that we're talking about. It makes sense to have his lab do some of the follow-on durability tests, in my estimation, so that his people get familiar with working with these soils and develop some expertise in working with these soils. So that when they do get to the more sophisticated tests, they know what they are doing when they work with those soil cement mixtures.

MS. CHANCELLOR: Do you disagree with Dr. Wissa's testimony that Dr. Wissa would need to start

the testing program over by collecting soil samples, doing index testing, doing durability testing, et cetera, et cetera? Do you disagree with Dr. Wissa's assumption?

MR. TRAVIESO-DIAZ: Objection. That mischaracterizes the testimony that Dr. Wissa gave. That was supposed to be hypothetical as to whether he would consider doing that. I don't think that he said that he would do it

MS. CHANCELLOR: He said that, if he did do it, he would need to collect samples and basically start from scratch, but he would look at the data that AGEC had developed.

CHAIRMAN FARRAR: Objection's overruled.

MR. TRUDEAU: To do any additional testing, we need to collect additional samples. If these samples are going to be tested at Dr. Wissa's lab, we're going to have to collect enough of them to do the whole program, because it just doesn't make sense to a lot of different field programs to get the soils necessary to run these tests.

MS. CHANCELLOR: Do you agree that if Dr. Wissa took over the program, the program would basically need to start over again?

MR. TRUDEAU: No, I don't think so. As

Dr. Wissa has said, he would be utilizing the data that is available from the AGEC testing as comparison, if nothing else, with the soil samples that he was given or extracted from the site to test.

MS. CHANCELLOR: Do you envision that Dr. Wissa would use the AGEC testing data to date for anything other than comparison with his work?

MR. TRUDEAU: He will certainly be using the index property data, in my estimation. Once he sees that the new samples that he has done index property tests on are similar to the materials that AGEC has already tested, for instance, in the moisture density tests, then he would feel comfortable in using those moisture density test results.

Now I am not going to suggest that it is not appropriate for him to do one or more of those moisture density tests over again to develop some confidence that they, indeed, agree with what he feels is appropriate for those test results, but the soil type is the driving animal here. The index property tests are key to getting the soil type information.

MS. CHANCELLOR: Dr. Wissa, would you rely on any, if you were to do the PFS program, would you rely on any of the AGEC test data to date for anything other than a comparison of your results?

DR. WISSA: I think I have compare myself to an M.D. Doctors tend to want to do their own testing to be comfortable and not rely on another person's, not because they don't trust it, but because of liability. As far as policy and liability, you always want to be able to vouch for the work, and it's hard to vouch for somebody else's work. M.D.s are very sensitive to this issue. We have learned from them.

As a matter of fact, I think they have learned from us because the geotechnical field developed some of these programs, the loss prevention programs which are being used. This is ASFE has done a fantastic job of minimizing this liability issue.

So, to answer your question, I would definitely want to rely on my data more than somebody else's data, at least confirm that their data is in agreement with mine.

MS. CHANCELLOR: So you're still talking with PFS? Is that right?

(Laughter.)

DR. WISSA: Am I still talking to them? Maybe after today they will stop talking to me.

(Laughter.)

MS. CHANCELLOR: Dr. Wissa, you mentioned,

in answer to Mr. Travieso-Diaz, that in order to demonstrate bonding, you take a core sample through the pad and then send it to the lab for tests. Would you do this with all 500 pads?

DR. WISSA: A program like this, what you would do is, during early stages of a program, you do fairly frequent testing. If the testing proves that there are no failures, you would gradually decrease the number of tests required to confirm that you're achieving it.

So I don't think -- you would probably have a minimum number of tests you would require, but the frequency I would see, envision that initially during the first stages of construction I would have quite a few of these tests. If they are all passing, then you can reduce the number of tests required to confirm that you are achieving the objectives.

MS. CHANCELLOR: However, if it is phased construction and that construction takes place over several years with different contractors, would you need to go back to more testing to demonstrate bonding, if you are changing contractors, for example?

DR. WISSA: I think that each time you start a new contractor you would start maybe not as -- you would start by frequent testing to make sure

things are going right, and then you would reduce it. You may be able to reduce the frequency more rapidly after the first go-round than, let's say, the first time around. So, obviously, you are going to use some experience, but I think that in each case you are going to find that the contractors may not be using the same type of equipment. There are variables. So I think, to answer your question, at the beginning of each new phase, if you want, you would start by having more frequent testing and then gradually decrease it, if -- and I qualify that -- if things are proving to be satisfactory and you have no failures.

MS. CHANCELLOR: Thank you.

Mr. Trudeau, you stated that PFS would probably have a batch plant to make the soil cement/cement-treated soil, is that correct?

MR. TRUDEAU: That's correct.

MS. CHANCELLOR: There's nothing in the SAR that states this, is that correct?

MR. TRUDEAU: I don't recall.

MS. CHANCELLOR: And the rapid loading test that you referred to that PFS may or may not do, would that change your calculations, the GB 4 calculation?

MR. TRUDEAU: It certainly could if that

was warranted, but the calculations right now demonstrate that we have a factor safety of in excess of 1.1 without using this increase in strength. The purpose of running the test would be to demonstrate that, for the compacted clay soils that we think we may need to use under one or more of the pads, that we definitely had a comfort margin for those soils that are not currently in GB 4.

MS. CHANCELLOR: So this comfort knowledge then would not be part of the calculation that you submitted to the NSC? You wouldn't amend that calculation, is that correct?

MR. TRUDEAU: I don't know what would drive the need to revise that calc again.

MS. CHANCELLOR: Maybe a ruling by the Board?

(Laughter.)

MR. TRUDEAU: Well, okay.

MS. CHANCELLOR: Dr. Wissa, I would like to concentrate on the cement-treated soil under the pads, not the soil cement around the pads or the CTB. My understanding is that it would be your intent to separate out materials and reserve non-plastic materials for construction of that soil treatment?

DR. WISSA: I don't believe I said that.

I think it was Paul Trudeau who suggested that.

MS. CHANCELLOR: Okay. Would you agree with that concept?

DR. WISSA: It makes sense to some extent.

MS. CHANCELLOR: In response to one of the questions by the judges where you talked about having a certain -- you have a fairly wide tolerance in whether you meet the design criteria in the field, where you could change the moisture content, the percentage of cement, et cetera. Isn't it true that for the cement-treated soil your tolerances are much smaller than it is for soil cement, because of Young's modulus?

DR. WISSA: Well, not the tolerances. You have two criteria you have to satisfy here, versus in the case of stabilized soil you only have one criteria. In the case of a stabilized soil cement, you are really looking at your ability and strength. Modulus is not an issue.

Fortunately, there is a correlation between modulus and strength, and --

MS. CHANCELLOR: In both or --

DR. WISSA: Let me get it right. The stronger the soil cement, the higher the margin. So it's not inverse.

MS. CHANCELLOR: Okay.

DR. WISSA: So it is a direct correlation. So in this case we are speaking about low strengths. It is really the low range of stabilized soils, soil cement strengths, it's really, in which case you are going to be talking about low moduli. Here, remember, the modulus cannot exceed -- if the modulus is much less, all the better as long as you get the strength. So you have a range here where in one case you have an upper limit, which is a 75,000 psi, at the same you also have an upper limit -- or lower limit on strength.

MS. CHANCELLOR: How much cement do you anticipate you will need to add to the soils to achieve a 40 psi compressive strength and a 75,000, less than 75,000 Young's modulus for the cement-treated soil?

DR. WISSA: I can't answer it. I can't answer it. If I knew the answer, we wouldn't need to do the testing program. In actual fact, this is one thing which will require investigation. It is a function of soil. It is a function of a lot of factors which, unfortunately, I am not in a position to be able to predict at this time.

MS. CHANCELLOR: Could you give any

ranges? Would it be less than 5 percent, for example?

MR. TRAVIESO-DIAZ: I instruct the witness not to guess.

MS. CHANCELLOR: I'm asking him for a range.

DR. WISSA: I don't know. It depends really on the soil, whether it's a sandy or non-cohesive, non-plastic material or if it has plasticity. So with the plastic materials it may be higher than the non-plastic. I would think probably with the non-plastic silt it may be 3 percent -- I'm using this, but you can't hold me to it -- while with the more plastic soils it may be 5 or more. It's not going to be 10 and 12 percent, if that is what you are asking. You're seeing it's in the low range of cement contents that you would be using.

MS. CHANCELLOR: So is it fair to say, then, that you couldn't add a whole lot more cement, portland cement, in the field to make sure you've got a high enough compressive strength because in that instance, if you add more cement, you would violate, you may violate the limitations of the Young's modulus?

DR. WISSA: Let me clarify this a bit. In the case of a non-cohesive or the non-plastic soils,

sandy soils, there two things which control, the cement content, but also the moisture content. It's like in concrete; it's a water/cement ratio, the ratio of water to cement, as well as the amount of cement. So you have flexibility there. If you increase your cement content, if you want to get the lowest strength, you would increase your moisture content, too. That is something well-known; I'm speaking about portland cement concrete.

That applies to sandy soils and non-cohesive soils. So you have flexibility there if you are having trouble with your cement content. But in the case of today with the automation of continuous plants or even batch plants, for that matter, you are able to control your cement very accurately, I think, and your moisture. So control is going to be fairly easy in these today automated, very accurate plants which are available.

MS. CHANCELLOR: You mentioned sandy soils. Was that a hypothetical? There aren't -- you're not talking about sandy soils at surficial layer at PFS, are you?

DR. WISSA: No, when I said, "sandy," it's non-cohesive. I should have said the silts, the non-plastic silts is what I am talking about here, versus

the ones with low or medium plasticity. So when you have a non-cohesive material, the water/cement ratio plays a bigger role than in cohesive materials.

MS. CHANCELLOR: How are you going to determine if you have met the Young's modulus under dynamic conditions?

MR. TRAVIESO-DIAZ: Objection. He testified that they are not going to test for dynamic Young's modulus.

MS. CHANCELLOR: Well, that's why I tried to rephrase it, but I obviously didn't do it correctly.

How are you going to test whether you meet the 75,000 psi modulus of elasticity?

DR. WISSA: I am going to use stress strength curve obtained from non-confined compression tests.

MS. CHANCELLOR: That's all I have, Your Honor.

CHAIRMAN FARRAR: Dr. Wissa, at one point about 10 minutes ago, Ms. Chancellor asked you a question about whether certain practice made sense and you said, "To some extent," which leaves open the question of to what extent it doesn't.

DR. WISSA: I'm not sure --

CHAIRMAN FARRAR: Was this the laying down -- removing the soil and stockpiling it?

MS. CHANCELLOR: Maybe it was the plastic/non-plastic --

MR. TURK: I think it was using a certain eolian silk for use directly underneath the pads, depending upon its elasticity.

MR. TRAVIESO-DIAZ: I don't want to testify, but the question was, I think that Mr. Trudeau said that preserving the material that has more of a silty nature, and using what he called the "preferred material" as the one to be used for the cement-treated soil -- that was the question.

CHAIRMAN FARRAR: Yes, thank you.

DR. WISSA: The reason I said "to some extent," obviously, that would be the preferred material, but let's assume there isn't enough of it onsite. Then, obviously, we're not in a box. We have other options. That's why I said, "to some extent."

CHAIRMAN FARRAR: Okay, fine. Thank you.

Does that do it or --

MS. CHANCELLOR: Oh, I forgot to move my exhibits into -- I don't have Jean here to remind me.

(Laughter.)

State's Exhibit 212 and 213 I'd like to

move into evidence.

CHAIRMAN FARRAR: Any objection to those?

MR. TRAVIESO-DIAZ: No objection.

MR. O'NEILL: No objection.

MS. CHANCELLOR: Thank you, Mr. Travieso-Diaz. If I didn't do it, then I would probably forget again.

MR. TRAVIESO-DIAZ: Better late than never.

CHAIRMAN FARRAR: Okay, those will be admitted.

[Whereupon, the above-referred-to documents marked as State Exhibits 212 and 213 for identification were received in evidence.]

Go ahead, Mr. Travieso-Diaz.

MR. TRAVIESO-DIAZ: I have two questions.

REDIRECT EXAMINATION BY MR. TRAVIESO-DIAZ

MR. TRAVIESO-DIAZ: One is for Dr. Wissa, and it is very simple. You said that an organization called PCA had issued certain simple manuals. You didn't get around to describing or saying what "PCA" is. Could you explain?

DR. WISSA: Yes, it's the Portland Cement

Association.

MR. TRAVIESO-DIAZ: Thank you.

Mr. Trudeau, this is for you. Ms. Chancellor asked you a few questions about the durability test failure experienced during the testing by AGEC. My reading of her questions was that she was trying to establish there has been quality assurance/quality control failure in that process.

Now how was that failure to meet the durability test discovered?

MR. TRUDEAU: Well, when I reviewed the results, I noticed that it didn't meet the criterion in the ASTM test for passing those tests.

MR. TRAVIESO-DIAZ: And, therefore, you rejected the results?

MR. TRUDEAU: Essentially.

MR. TRAVIESO-DIAZ: Looking at the overall QA/QC program, would you consider that to be a quality assurance failure or success?

MR. TRUDEAU: Well, the failed test didn't get past my review. So I would call it a success, I guess.

MR. TRAVIESO-DIAZ: Thank you very much. That's all I have.

MR. O'NEILL: Just a couple of real quick

points.

CHAIRMAN FARRAR: All right.

RECROSS EXAMINATION BY MR. O'NEILL

MR. O'NEILL: On the issue of QA, Mr. Trudeau, in the event that a license were granted and some of this soil cement testing and placement work was farmed out to contractors, any QA program of these contractors or subcontractors, for that matter, would implement would be subject to NRC approval, right?

MR. TRUDEAU: That's my understanding, yes.

MR. O'NEILL: With respect to the 75,00 psi Young's modulus, that's design criterion, correct?

MR. TRUDEAU: That's correct.

MR. O'NEILL: And it's driven by the hypothetical, non-mechanistic cask tipover analysis, correct?

MR. TRUDEAU: Yes.

MR. O'NEILL: I presume that you wouldn't have committed to testing to prove that you can have a combination of 40 psi and 75,000 psi for the Young's modulus if you didn't think it was at least technically possible, correct?

MR. TRUDEAU: Yes, we think that this technically achievable.

MR. O'NEILL: Thank you.

I should go back to the QA. Mr. Turk has brought something to my attention with respect to the QA issue that the contractors or subcontractors would be required to conform with NRC QA program requirements, correct?

MR. TRUDEAU: Again, that's my understanding. I don't know the regulations involved, but --

MR. O'NEILL: Okay, thank you.

MS. CHANCELLOR: Just one question, Your Honor. Oh, sorry.

MR. O'NEILL: I'm set, thank you.

CHAIRMAN FARRAR: You were finished, Mr. O'Neill?

MR. O'NEILL: Yes, I'm sorry.

MS. CHANCELLOR: I'm sorry, Your Honor.

CHAIRMAN FARRAR: Go ahead.

RECROSS EXAMINATION BY MS. CHANCELLOR

MS. CHANCELLOR: Mr. Trudeau, do you know with respect to Stone & Webster's QA/QC program as it relates to Part 72 of NRC regulations that govern apices, do you know if NRC actually comes in and approves any sort of QA/QC program?

MR. TRUDEAU: I don't know specifically

with respect to Part 72, but I do know that they have been through Stone & Webster's QA Department and have approved our SWS cap, I think it's called, Stone & Webster's something Quality Assurance Program.

MS. CHANCELLOR: Approved or audited it?

MR. TRUDEAU: Excuse me?

MS. CHANCELLOR: Have they approved it or have they audited it?

MR. TRUDEAU: Well, I know they've audited it. I'm pretty sure they have approved it, but I'm not positive.

MS. CHANCELLOR: Okay, thank you.

JUDGE LAM: I have a quick question for the staff.

Is it true that, whether or not the NRC staff would exercise its oversight and enforcement responsibility regarding the QA and QC program, that is immune from Intervenor challenges? Is that true?

MR. TURK: Actually, Your Honor, there was a contention at one time that dealt with QA/QC. I believe that was resolved either -- I believe it was after the contention was admitted. I think Contention Utah G, if I'm not mistaken.

MS. CHANCELLOR: It was one of those early alphabet numbers, that's correct.

MR. TURK: So I wouldn't say that QA/QC is immune from contention. Whether or not they have developed a program that is acceptable I think was the question that was raised by that contention.

JUDGE LAM: But that is not what I meant. What I meant was whether or not the staff would properly exercise its oversight responsibility in that arena, is immune from challenge?

MR. TURK: Oh, in terms of, is the staff performing its function properly?

JUDGE LAM: Right.

MR. TURK: Yes. Yes, I would agree with that.

JUDGE LAM: Okay, thank you.

MR. TURK: If I may, Your Honor, I wanted to supplement briefly my response to your question on the legal issue. May I do that? I think you want to take a break, but this will take about one minute.

CHAIRMAN FARRAR: Go ahead.

MR. TURK: You had asked me about nuclear power plant licensing in the old days, and I had referred to the fact that there is a new regulation for future nuclear power plants. I would point out that is in our Part 52, and specifically in that part of the NRC regulations there's specific provision that

states that the Applicant must define the tests and acceptance criteria that it must achieve, and the NRC may license based upon that. There is then a post-licensing inspection under the regulations.

If you look at NCFR 52.79, 52.97, and 52.99, those regulations address the way in which new nuclear power plant applications that choose to use single-step licensing would be then inspected for whether or not they have achieved the test and acceptance criteria that they had defined previously, which were found to be necessary to assure safety.

Let me point one other thing out. In those regulations there's a specific provision that states that any change in the test or acceptance criterion would require a license amendment. Under Part 72, in contrast, there is a specific two-tier method for reviewing changes to tests. Again, that goes back to what I was stating about whether or not there's an unreviewed safety question.

Under 72.48, a license amendment would be required if certain conditions existed, such as where the tests, the change in the tests would result in more than a minimum delta in safety. The specific words are in the regulation. But if beyond the minimum delta is not involved, then the Applicant is

-- I'm sorry, a licensee would be free to go ahead and make that change, once they have done the analysis that's required under that Section.

CHAIRMAN FARRAR: All right. Thank you, Mr. Turk.

Rather than hear from anyone else on that, we will save the appropriateness of those analogies for argument later.

Mr. Trudeau, you waited patiently in Salt Lake City for your various turns. We thank you and Dr. Wissa for your testimony. We appreciate your being here.

MR. TRUDEAU: Thank you.

CHAIRMAN FARRAR: Thank you.

MR. TRAVIESO-DIAZ: Mr. Chairman, if I could clarify? Unfortunately, Mr. Trudeau has some more to go before he is totally excused.

(Laughter.)

CHAIRMAN FARRAR: Okay, well, we will take a break now, and then we will have the staff witness. Do we have a cross examination plan from the Applicant?

MR. TRAVIESO-DIAZ: No.

CHAIRMAN FARRAR: No? Okay. Then it is almost 25 after. Let's be here at 20 of, and are we

going to finish the staff witness today? Good. Be back at 20 of.

(Whereupon, the foregoing matter went off the record at 3:23 p.m. and went back on the record.)

CHAIRMAN FARRAR: We're ready to go with the staff witness.

Dr. Ofoegbu, you've previously been sworn in this case. So you can consider yourself still under oath.

Whereupon,

DR. GOODLUCK I. OFOEGBU

was recalled as a witness by counsel for the Nuclear Regulatory Commission and, having been previously duly sworn, was examined and testified further as follows:

MR. TURK: Your Honor, may I note for the record we've distributed a slightly revised version of Dr. Ofoegbu's testimony on Part C. There is a typo that has been corrected on page 10.

In addition, following page 20 of the testimony, we have added a reference list, and all parties have had that information for some time. We've given three copies to the Board members as well as three copies to the court reporter.

CHAIRMAN FARRAR: All right.

MR. O'NEILL: I would note, Your Honor,

that the reference list is being provided to reflect the full citations, documents that were referred to through partial or short citations in Dr. Ofoegbu's testimony.

DIRECT EXAMINATION

BY MR. O'NEILL:

Q Dr. Ofoegbu, would you please state your full name for the record?

A Yes, my name is Goodluck I. Ofoegbu.

Q Dr. Ofoegbu, have you prepared written direct testimony for filing in this proceeding?

A Yes, I did.

Q Do you have a copy of that testimony in front of you now?

A Yes.

Q Is that testimony entitled "NRC Staff Testimony of Goodluck I. Ofoegbu Concerning Unified Contention Utah L/QQ Part C"?

A That's correct.

Q Dr. Ofoegbu, I believe your statement of professional qualifications was attached to your prefiled testimony through Part D of this proceeding, correct?

A Yes, it is.

Q Okay. It's also attached to this

testimony now before you, your Part C testimony?

A Yes.

Q Do you have any corrections, revisions, additions or deletions that you would like to make at this time either to your prefiled testimony or to the attached statement of professional qualifications?

I know we have already made these corrections.

A Okay, okay. On page 10, where it has 2001A, the A has been crossed out.

Q And that's the only correct, correct?

A That's the only -- that's one correction. The other one is the list of references that is now attached.

Q Thank you.

With these corrections and the addition of the reference list, is your written testimony and your attached statement of professional qualifications true and correct to the best of your knowledge?

A Yes.

Q Do you adopt this as your written testimony, as now revised?

Do you adopt your written testimony as now revised as your sworn testimony in this proceeding?

A Yes.

MR. O'NEILL: Your Honor, at this point I'd like to request that Dr. Ofoegbu's written testimony be admitted into evidence and found in the record as if read.

CHAIRMAN FARRAR: Any objection?

MR. TRAVIESO-DIAZ: No objections.

MS. CHANCELLOR: No objection, Your Honor.

CHAIRMAN FARRAR: All right. Then the reporter will bind the testimony in the record at this point as if read.

(Insert prefiled testimony of Dr. Ofoegbu.)

6/17/02
~~April 1, 2002~~

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
PRIVATE FUEL STORAGE, L.L.C.	)	Docket No. 72-22-ISFSI
	)	
(Independent Spent Fuel Storage Installation)	)	

NRC STAFF TESTIMONY OF GOODLUCK I. OFOEGBU
CONCERNING UNIFIED CONTENTION UTAH L/QQ, PART C

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

A1. My name is Goodluck I. Ofoegbu. I am employed as a Principal Engineer at the Center for Nuclear Waste Regulatory Analyses ("CNWRA"), which is a division of the Southwest Research Institute ("SwRI"), in San Antonio, Texas. I am providing this testimony under a technical assistance contract between the staff of the Nuclear Regulatory Commission ("NRC Staff" or "Staff") and the CNWRA at the SwRI. A statement of my professional qualifications is attached hereto.

Q2. Please describe your current responsibilities.

A2. In my position as Principal Engineer at the CNWRA, I have served as Principal Investigator for several projects involving geological engineering. My work includes mechanical analysis of underground excavations, foundations, earthworks, and natural geological processes, such as faulting and volcanism.

Q3. Please explain what your duties have been in connection with the NRC Staff's review of the application filed by Private Fuel Storage, L.L.C. ("PFS" or "Applicant") for a license to construct and operate an Independent Spent Fuel Storage Installation ("ISFSI") on the Reservation

of the Skull Valley Band of Goshute Indians, geographically located within Skull Valley, Utah (the "proposed PFS Facility").

A3. As part of my official responsibilities, I assisted the NRC Staff in its evaluation of the Applicant's site characterization and geotechnical evaluations for the proposed PFS Facility. Further, I assisted the Staff in the preparation of its "Safety Evaluation Report Concerning the Private Fuel Storage Facility," issued on September 29, 2000 ("SER"). I also assisted in the preparation of Supplement No. 2 to the SER, dated December 21, 2001 ("SSER Supplement No. 2"). Those two documents have been incorporated into the NRC Staff's "Consolidated Safety Evaluation Report Concerning the Private Fuel Storage Facility," issued in March 2002 ("Consolidated SER").

In addition, I assisted the NRC Staff in preparing its responses to several sets of discovery requests filed by the State of Utah ("State"), including the "NRC Staff's Objections and Responses to the 'State of Utah's Eleventh Set of Discovery Requests directed to the NRC Staff,'" dated December 11, 2000; "NRC Staff's Objections and Responses to the 'State of Utah's Eighteenth Set of Discovery Requests directed to the NRC Staff,'" dated February 1, 2002; and "NRC Staff's Objections and Responses to the 'State of Utah's Twentieth Set of Discovery Requests directed to the NRC Staff,'" dated February 27, 2002.

Q4. What is the purpose of this testimony?

A4. The purpose of this testimony is to provide the NRC Staff's views concerning the acceptability of the Applicant's characterization of subsurface soils, which is the subject of Unified Contention Utah L/QQ, Part C. I am also providing separate testimony on selected portions of Part D of this contention in the NRC Staff's testimony of Goodluck I. Ofoegbu and Daniel J. Pomerening, filed herewith.

Q5. Please identify the Commission's requirements related to the characterization of subsurface soils for the design of an ISFSI.

A5. The Commission's requirements governing the characterization of subsurface soils for an ISFSI are set forth in 10 C.F.R. Part 72. In general, 10 C.F.R. § 72.90 requires an evaluation of site characteristics that may directly affect the safety or environmental impact of the proposed facility. Specific requirements for the characterization of the subsurface soils are defined in 10 C.F.R. § 72.102. Specifically, 10 C.F.R. § 72.102(c) states: "Sites other than bedrock sites must be evaluated for their liquefaction potential or other soil instability due to vibratory ground motion." Additionally, 10 C.F.R. § 72.102(d) states: "Site-specific investigations and laboratory analyses must show that soil conditions are adequate for the proposed foundation loading."

Pursuant to 10 C.F.R. § 72.122(b)(1), structures, systems, and components important to safety ("SSCs") must be designed to accommodate the effects of, and be compatible with, site characteristics and environmental conditions associated with normal operation, maintenance and testing of the ISFSI, and to withstand postulated accidents. Further, 10 C.F.R. § 72.122(b)(2) requires that SSCs be designed to withstand the effects of natural phenomena, including earthquakes, without impairing their capability to perform safety functions.

Q6. Are you familiar with Unified Contention Utah L/QQ, Part C.?

A6. Yes. As admitted by the Licensing Board, Unified Contention Utah L/QQ, Part C., states as follows:

> **Unified Contention Utah L/QQ (Geotechnical)**
>
> * * *
>
> **C. <u>Characterization of Subsurface Soils.</u>**
>
> 1. <u>Subsurface Investigations</u>
>
> The Applicant has not performed the recommended spacing of borings for the pad emplacement area as outlined in NRC Reg. Guide 1.132, "Site Investigations for Foundations of Nuclear Power Plants, Appendix C."

2. Sampling & Analysis

The Applicant's sampling and analysis are inadequate to characterize the site and do not demonstrate that the soil conditions are adequate to resist the foundation loadings from the design basis earthquake in that:

a. The Applicant has not performed continuous sampling of critical soil layers important to foundation stability for each major structure as recommended by Reg. Guide 1.132 Part C6, Sampling.

b. The Applicant's design of the foundation systems is based on an insufficient number of tested samples, and on a laboratory shear strength testing program that does not include strain-controlled cyclic triaxial tests and triaxial extension tests.

3. Physical Property Testing for Engineering Analyses

a. The Applicant has not adequately described the stress-strain behavior of the native foundation soils under the range of cyclic strains imposed by the design basis earthquake.

b. The Applicant has not shown by case history precedent or by site-specific testing and dynamic analyses that the cement-treated soil will be able to resist earthquake loadings for the CTB and storage pad foundations as required by 10 CFR § 72.102(d).

c. The Applicant has not considered the impact to the native soil caused by construction and placement of the cement-treated soil, nor has the Applicant analyzed the impact to settlement, strength and adhesion properties caused by placement of the cement-treated soil.

d. The Applicant has not shown that its proposal to use cement-treated soil will perform as intended – *i.e.*, provide dynamic stability to the foundation system – and the Applicant has not adequately addressed the following possible mechanisms that may crack or degrade the function of the cement-treated soil over the life of the facility:

(i) shrinkage and cracking that normally occurs from drying, curing and moisture content changes.

(ii) potential cracking due to vehicle loads.

(iii) potential cracking resulting from a significant number of freeze-thaw cycles at the Applicant's site.

(iv) potential interference with cement hydration resulting from the presence of salts and sulfates in the native soils.

(v) cracking and separation of the cement-treated soil from the foundations resulting from differential immediate and long-term settlement.

e. The Applicant has unconservatively underestimated the dynamic Young's modulus of the cement-treated soil when subjected to impact during a cask drop or tipover accident scenario. This significantly underestimates the impact forces and may invalidate the conclusions of the Applicant's Cask Drop/Tipover analyses.

Q7. In Subpart C.1. of the contention, concerning subsurface investigations, the State asserts that the "Applicant has not performed the recommended spacing of borings for the pad emplacement area as outlined in NRC Reg. Guide 1.132, "Site Investigations for Foundations of Nuclear Power Plants, Appendix C." Do you agree with this assertion?

A7. No.

Q8. Please provide the bases for this conclusion.

A8. NRC regulatory guidance in Regulatory Guide 1.132 (and Draft Reg. Guide DG-1101) provides general guidelines concerning site investigations, including the spacing and depth of borings for safety-related structures. This guidance document appropriately recognizes that the spacing and depth of borings or other site-characterization activities depend on the

complexity of the site-specific subsurface conditions and the particular information needed for the engineering design of structure foundations. Indeed, Reg. Guide 1.132 states:

> Because the details of the actual site investigations will be highly site dependent, the procedures described herein should only be used as guidance and be tempered with professional judgment. Alternative and special investigative procedures that have been derived in a professional manner will be considered equally applicable for conducting foundation investigations.

The specific regulatory requirement for the geotechnical site characterization for an ISFSI is contained in section 72.102(d), which provides that site-specific investigations and laboratory analyses must show that the soil conditions are adequate for the proposed foundation loading. The primary purpose of the site-specific investigation and associated laboratory analyses is to classify the site subsurface materials and to identify variations in important properties of these materials both laterally and with depth. As set forth in the Staff's Consolidated SER and discussed herein, the Staff has determined that the Applicant achieved this purpose through a combination of borings and other test methods, including cone penetrometer testing. Further, the geotechnical site characterization information provided by the Applicant in the PFS Safety Analysis Report ("SAR") satisfies the regulatory requirement of 10 C.F.R. § 72.102(d), by showing that soil conditions are adequate for the proposed foundation loading

The following considerations support these Staff findings:

First, standard penetration and cone-tip resistance data provided in the SAR (*see* Consolidated SER, page 2-55) support the Applicant's classification of the subsurface materials at the site as consisting of a relatively compressible top layer (layer 1) that is approximately 25–30 feet thick and underlain by much denser and stiffer material (layer 2), which is classified as dense sand and silt.

Second, the profiles of cone-tip resistance provided in the SAR Figures 2.6-5 (Sheets 1–14) and 2.6-21 through 2.6-23 illustrate the lateral and vertical variations of shear strength and

compressibility for layer-1 soil. As described in the Consolidated SER (page 2-56), the profiles support a subdivision of layer-1 soil into four sublayers, and show that the second sublayer from the top (a mixture of silty clay and clayey silt referred to as layer 1B soil in the Consolidated SER, page 2-56) is the weakest and most compressible sublayer.

Third, the bearing capacity of the storage pads was calculated using the undrained shear strength of layer-1B soil. *See* Consolidated SER, pages 2-58 and 2-61. The permissible value of undrained shear strength for evaluating the bearing capacity of the storage pads consists of the average undrained shear strength through a depth of 30 feet below the base of the pads. *Cf.* Terzaghi et al., 1996, page 406. Because layer-1B is the weakest sublayer, the value of undrained shear strength used by PFS is therefore a conservative lowerbound estimate of the permissible value.

Fourth, the bearing capacity of the canister transfer building ("CTB") foundation was calculated using an average undrained shear strength for layer-1 soil estimated using laboratory data for layer-1B and the cone penetrometer test data. *See* Consolidated SER, pages 2-63 and 2-65. The permissible value of undrained shear strength for evaluating the bearing capacity of the CTB foundation consists of the average undrained shear strength through a depth of 240 feet below the base of the foundation. *Cf.* Terzaghi et al., 1996, page 406. The value of the average undrained shear strength at the proposed PFS site would thus be determined mainly by layer-2 soil, which is much stronger than the layer-1 soil used by PFS to obtain an average undrained shear strength value for its CTB foundation bearing capacity calculations. The value of undrained shear strength used by PFS is therefore a conservative lowerbound estimate of the permissible value.

Fifth, the potential settlement of the storage pads and CTB was estimated using the laboratory compressibility data for layer-1B soil. Because layer-1B is the most compressible

sublayer, the estimated settlement values therefore represent the upperbound values. *See* Consolidated SER, pages 2-58 and 2-63.

In sum, the preceding considerations collectively support the Staff's findings that PFS, through its existing site-specific investigations and laboratory analyses, has satisfactorily classified the subsurface materials, identified lateral and vertical variations in the relevant properties of those materials, and demonstrated that the site-specific soil conditions are adequate for the proposed foundation loading. Therefore, because the Applicant has satisfied the regulatory requirement of 10 C.F.R. § 72.102(d), it is not necessary that the Applicant follow the particular spacing of borings recommended in Reg. Guide 1.132.

Q9. In Subpart C.2. of the contention, the State asserts that the "Applicant's sampling and analysis are inadequate to characterize the site and do not demonstrate that the soil conditions are adequate to resist the foundation loadings from the design basis earthquake." Do you agree with this assertion?

A9. No.

Q10. Please provide the bases for this conclusion.

A10. As discussed above, the Staff finds that the Applicant has satisfied the geotechnical site characterization requirement set forth in 10 C.F.R. § 72.102(d), including the sampling and analysis to characterize the site. The Applicant has provided sufficient geotechnical data in its SAR to demonstrate that the site-specific soil conditions are adequate for the proposed foundation loading.

Q11. More specifically, in Subpart C.2.a. of this contention, the State asserts that the "Applicant has not performed continuous sampling of critical soil layers important to foundation stability for each major structure as recommended by Reg. Guide 1.132 Part C6, Sampling." Do you believe that this presents a valid concern?

A11. No.

Q12. Please provide the bases for this conclusion.

A12. The purpose of "continuous sampling" is to determine the continuous variation of soil properties with depth. The continuous sampling of soil layers referred to in Reg. Guide 1.132 represents one method available for determining the continuous variation of soil properties with depth. PFS instead successfully determined the variation of soil properties with depth through the use of an alternative method, *i.e.*, *in situ* cone penetrometer testing. As discussed above, Reg. Guide 1.132 provides guidance [as opposed to establishing a regulatory requirement like 10 C.F.R. § 72.102(d)], and recognizes that alternative procedures which have been derived in a professional manner will be considered equally applicable for conducting foundation investigations. In the Staff's view, *in situ* cone penetrometer testing, as used by the Applicant, is one such alternative procedure for determining the continuous variation of soil properties with depth.

Q13. In Subpart C.2.b. of the contention, the State asserts that the "Applicant's design of the foundation systems is based on an insufficient number of tested samples." Do you agree with this assertion?

A13. No.

Q14. Please provide the bases for this conclusion.

A14. In the Staff's view, the relevant inquiry is whether the geotechnical site characterization data obtained by the Applicant is adequate to support the specific values or parameters used in the Applicant's foundation stability analyses, not how many samples *per se* the Applicant has taken. As set forth in the Staff's Consolidated SER and discussed herein, the Applicant has provided in the PFS SAR sufficient geotechnical data -- in the form of both cone penetrometer and laboratory test data -- to demonstrate that the site-specific soil conditions are

adequate for the proposed foundation loading in accordance with 10 C.F.R. § 72.102(d). This is further discussed in response to Questions 8 and 16, herein.

Q15. The State also asserts, in Subpart C.2.b. of this contention, that the Applicant's design of the foundation systems is based "on a laboratory shear strength testing program that does not include strain-controlled cyclic triaxial tests and triaxial extension tests." Do you believe that this presents a valid concern?

A15. No.

Q16. Please provide the bases for this conclusion.

A16. As indicated in response to Question 8, *supra*, the geotechnical information used for the PFS foundation system designs was obtained from laboratory test data for layer-1B soil (including laboratory compression test results) and the cone penetrometer test data. Information presented in a PFS calculation (Stone and Webster, 2001a, Appendix C) supports the undrained shear strength value of 2,200 psf for layer-1B soil. This value, in turn, was combined with information determined from the cone-penetrometer test data to establish the basis for the soil-strength parameter values used for stability analyses of the storage pads and canister transfer building foundation. As stated in the Consolidated SER (page 2-57), the Staff reviewed the geotechnical information provided in the PFS SAR and concluded, *inter alia*, that (1) the index properties and strength and compressibility of the soil layers were determined by the Applicant using an appropriate combination of field and laboratory testing, and (2) the information presented is sufficient to support appropriate engineering analyses of the proposed structures. Thus, the specific combination of tests performed by the Applicant provided the data needed to obtain the soil-strength parameter values used in its stability analyses of the storage pads and canister transfer building foundation; strain-controlled cyclic triaxial tests or triaxial extension tests of site soils are therefore not necessary.

Q17. In Subpart C.3.a. of this contention, concerning physical property testing for engineering analyses, the State asserts that the "Applicant has not adequately described the stress-strain behavior of the native foundation soils under the range of cyclic strains imposed by the design basis earthquake." Do you agree with this assertion?

A17. No.

Q18. Please provide the bases for this conclusion.

A18. The information provided by the Applicant in the SAR regarding the stress-strain characteristics of the native foundation soils is sufficient to demonstrate that the soil conditions are adequate for the proposed foundation loading, as required by 10 C.F.R. § 72.102(d). Adequate information on the following aspects of stress-strain characteristics was provided by the Applicant: (1) undrained shear strength, based on laboratory triaxial-compression and direct-shear testing; (2) soil compressibility, based on laboratory oedometer testing; (3) the lateral and vertical variations of shear strength and compressibility at the site, based on in situ cone penetrometer testing data; (4) elastic parameters (Young's modulus, Poisson's ratio, and shear modulus), determined using shear and compressional wave velocities from field seismic reflection, refraction, and cross-hole velocity measurements and cone penetrometer testing; and (5) shear modulus and damping versus cyclic strain relationships, derived from a combination of laboratory data developed by PFS and information available in the literature.

One aspect of the stress-strain behavior of soils is the stiffness of the soils, which can be characterized through shear-wave velocity profiles obtained from field refraction data. Accordingly, the Applicant provided upper and lower bounds of shear-wave velocity profiles, in addition to the best estimate soil profile, to account for uncertainties in the average shear-wave velocity of the native foundation soils. The Applicant also performed sensitivity analyses to define the effects of the variability of the shear modulus and damping versus cyclic strain relationships on the calculated

seismic site-response factors. *See* Appendix F of Geomatrix Consultants, Inc., 2001a, *Fault evaluation study and seismic hazard assessment study—final report.* Revision 1. Oakland, CA: Geomatrix Consultants, Inc. (cited in Section 2.3 of the Consolidated SER). The modulus-reduction and damping versus strain curves provided by PFS were generated using accepted engineering practices and are consistent with other curves generated from comparable data.

In sum, the Applicant provided sufficient information on the behavior of the native foundation soils to demonstrate that: (1) the value of soil strength used for foundation-stability analyses is a lowerbound estimate of the applicable value; (2) the value of soil compressibility used for foundation-settlement analyses resulted in upperbound estimates of the potential foundation settlement; and (3) the values of shear-wave velocity used to determine the elastic-parameter values for the soils account for the variability of shear-wave velocity at the site. Based on the foregoing considerations, and as discussed in Section 2.1.6 of the Consolidated SER, the Staff therefore concludes that PFS has adequately described the stress-strain behavior of the native foundation soils, to support the various engineering analyses of the facility structures, systems, and components important to safety.

Q19. The State contends, in Subpart C.3.b. of this contention, that the "Applicant has not shown by case history precedent or by site-specific testing and dynamic analyses that the cement-treated soil will be able to resist earthquake loadings for the [ ] storage pad foundations as required by 10 CFR § 72.102(d)." Do you agree with this assertion?

A19. No.

Q20. Please provide the bases for this conclusion.

A20. My conclusion is based on several considerations. First and foremost, the soil cement around the storage pads and the cement-treated soil under the storage pads are not being

relied upon to support any safety function of the pads. This fact is reflected in the Staff's stability evaluation of the cask-storage-pad foundation in the Consolidated SER (pages 2-57 to 2-62).

Second, PFS has committed to demonstrate through testing that the stiffness of the cement-treated soil under the pads will not exceed the specified design value (*i.e.*, it will have a dynamic Young's modulus not exceeding 75,000 psi).

Third, with respect to the specific requirements of 10 C.F.R. § 72.102(d), the regulation states: "Site-specific investigations and laboratory analyses must show that soil conditions are adequate for the proposed foundation loading." The regulation by its terms does not require the use of "case history precedent" or "dynamic analyses," although the Staff does recognize the utility and value of such analytical tools (*see, e.g.*, references to prior uses of soil cement in discussion below concerning the proposed use of soil cement around the CTB foundation to provide additional lateral resistance). Therefore, to the extent that the State might be asserting that the use of these tools is explicitly required by 10 C.F.R. § 72.102(d), the Staff believes that the State's assertion is misplaced. As noted above, the Staff finds that the geotechnical site characterization information provided by the Applicant in the PFS Safety Analysis Report ("SAR") shows that the site-specific soil conditions are adequate for the proposed foundation loading, in compliance with 10 C.F.R. § 72.102(d).

Q21. The State similarly contends, again in Subpart C.3.b. of this contention, that the "Applicant has not shown by case history precedent or by site-specific testing and dynamic analyses that the cement-treated soil will be able to resist earthquake loadings for the CTB [ ] foundations as required by 10 CFR § 72.102(d)." Do you agree with this assertion?

A21. No.

Q22. Please provide the bases for this conclusion.

A22. My conclusion with respect to the CTB is also based on several considerations, which differ from those discussed in connection with the storage pads. This is due to the fact that the soil cement around the CTB is required to provide additional lateral resistance to increase the factor of safety against sliding of the CTB foundation.

First, to provide the necessary lateral resistance, the soil cement around the CTB foundation must have a minimum unconfined compressive strength of 250 psi, a value based on Staff-reviewed PFS calculations. Therefore, PFS is required (and has committed) to demonstrate through testing that the soil cement will meet this minimum strength requirement.

Second, in support of this proposed use of soil cement, PFS provided references to previous uses of soil cement within and outside of the United States (*see* SAR, Rev. 22, pages 2.6-113 to 114) as precedents for the use of cement stabilization to enhance the engineering characteristics of natural soils. The precedents cited by PFS are supported by other cases gleaned from the literature and reviewed by the Staff, which indicate that: (a) the soil-property changes that result from cement stabilization can be considered long-lasting (*see, e.g.,* Roberts, 1986); and (b) soil cement has been used as a buttress - *i.e.*, as a structure that provides lateral resistance to another structure - in several other engineering projects. *See, e.g.,* Van Riessen, 1992; Lambrechts, 1998.

Third, PFS has committed in the SAR (Rev. 22, pages 2.6-117 to 118) to follow the standards, procedures, and recommendations contained in the "State-of-the-Art Report on Soil Cement," developed by ACI Committee 230 [ACI 230-1R-90 (Reapproved 1997)]. This report describes the state-of-the-art procedures and identifies the applicable standards for mix proportioning, construction, quality-control, and testing of soil cement. The report, for example, lists ASTM D 559-82 ("Standard Methods for Wetting-and-Drying Tests of Compacted Soil-Cement

Mixtures") and ASTM D 560-82 ("Standard Methods for Freezing-and-Thawing Tests of Compacted Soil-Cement Mixtures"), which specify test procedures for evaluating the durability of soil cement. Adherence by PFS to these and the other standards contained in the ACI report provides further assurance that the proposed soil-cement layer around the CTB will provide the specified amount of lateral resistance for the proposed duration of the PFS ISFSI facility.

Q23. In Subpart C.3.c. of this contention, the State asserts that the "Applicant has not considered the impact to the native soil caused by construction and placement of the cement-treated soil, nor has the Applicant analyzed the impact to settlement, strength and adhesion properties caused by placement of the cement-treated soil." Do you believe that these represent valid concerns?

A.23 No.

Q24. Please provide the bases for this conclusion.

A24. As I understand Subpart C.3.c. of the contention, the State is raising two principal concerns associated with the construction and placement of the cement-treated soil: (1) that the cement-treated soil will form a relatively impermeable cap over the natural soil, resulting in an increase in the water content of the soil because of reduced evapotranspiration, and consequently, a decrease in shear strength and an increase in compressibility of the natural soil; and (2) that the use of heavy placement equipment for construction of the cement-treated soil may cause significant remolding of the underlying natural soil, which in turn could cause a significant decrease in the shear strength of the natural soil.

Based on this understanding, I do not believe that the State has presented any valid concerns in Subpart C.3.c. of the contention. In my professional opinion, both of the aforementioned concerns are based on phenomena that are either unlikely to occur or, if they were

to occur, would not have an adverse effect on the safety of the proposed facility, for the reasons discussed below.

First, the depth to the water table is approximately 120 feet below the base of the facility structures. Therefore, there is no supply of water close enough to feed the postulated water-content increase.

Second, data provided by PFS (*see* SAR, Rev. 22, pages 2.6-42 to 44 and Table 2.6-1) on the effects of inundation of five specimens of the natural soil indicate that an increase in water content is not likely to have any appreciable effect on the compressibility of the soil. Inundation of the specimens during consolidation testing caused an additional vertical strain of only about 0.001 (*i.e.*, an additional settlement of about 0.12 inch for a 10-foot thick soil layer).

Third, a small decrease in shear strength occurring over a large area (such as may result from the postulated water-content change) or a localized larger decrease (such as may result from the postulated remolding) would not have a significant effect on the bearing capacity of either the storage pads or the CTB foundation. It is important to note that the shear strength actually used by the Applicant to determine the bearing capacity of each of the foundations is much smaller than the permissible shear strength for the calculation of bearing capacity, given the foundation widths and depth profile of shear strength below the foundations. As such, it is unlikely that a sufficient decrease in shear strength can occur over an area large enough to significantly affect the average shear strength within the applicable depth for each foundation (30 feet for the pads and 240 feet for the CTB).

Q25. In Subpart C.3.d. of this contention, the State contends that the "Applicant has not shown that its proposal to use cement-treated soil will perform as intended – *i.e.*, provide dynamic stability to the foundation system," citing in support of this assertion the Applicant's alleged failure to adequately address five "possible mechanisms that may crack or degrade the function of the

cement-treated soil over the life of the facility." Do you believe that the State presents any valid concerns in this subpart of its contention, with respect to the Applicant's proposed use of cement-treated soil under the storage pads or soil cement around the pads?

A25. No.

Q26. Please provide the bases for this conclusion.

A26. As I noted earlier, the proposed cement-treated soil/soil cement under or around the storage pads is not being relied upon to support any safety function of the pads. As set forth in Section 2.1.6.4 of the Consolidated SER and discussed herein, the Staff's acceptance of the storage-pad design relative to the capability of the underlying soil to provide adequate support to the storage pads is based on the following considerations.

First, calculations provided by PFS demonstrate adequate safety margins against bearing capacity failure of the pads under combined static loads and potential dynamic loading from the design-basis earthquake. The calculations do not rely on any contribution of load-bearing resistance from the soil cement around the storage pads and the cement-treated soil under the storage pads.

Second, calculations provided by PFS demonstrate that the storage pads can be expected to undergo post-construction settlement of about 3 to 4 inches, taking into account both static loads and potential dynamic loading from the design-basis earthquake. The stiffness of the soil cement around the pads and the cement-treated soil under the pads was not relied upon to reduce the potential settlement of the pads. PFS has committed to perform maintenance repair of the pad-emplacement area as necessary to correct any changes caused by settlement. One such type of maintenance repair includes the scraping of aggregates from between the pads to maintain the top surface of the aggregate layer at the same elevation as the top surface of the pads.

Third, calculations provided by PFS demonstrate that potential sliding of the storage pads under seismic loading does not constitute a safety hazard, as there are no safety-related external connections to the pads or casks that may rupture or become misaligned as a result of pad sliding. Indeed, the Staff agrees with the Applicant that the storage casks are less likely to tip over if the pads are free to slide. The Staff's evaluation of the potential effects of sliding of the pads does not rely on any property of the soil cement or cement-treated soil.

For these reasons, even if cracking or other degradation of the soil cement/cement-treated soil in the vicinity of the storage pads were to occur -- and be of the type and occur by the various mechanisms specifically postulated by the State in Subpart C.3.d. of this contention -- it would not have any adverse effects on the safety functions of the storage pads.

Q27. Likewise, do you believe that the State presents any valid concerns in Subpart C.3.d. of this contention with respect to the Applicant's proposed use of soil cement around the canister transfer building foundation?

A27. No.

Q28. Please provide the bases for this conclusion.

A28. Notwithstanding the Applicant's proposal to use soil cement around the CTB to provide additional lateral resistance, the potential cracking or other soil-cement degradation mechanisms adduced by the State in Subparts C.3.d.(i)-(v) of this contention could not have an adverse effect on the safety functions of the CTB foundation, for the following reasons.

First, as I noted previously, PFS has committed (in the SAR, Rev. 22, pages 2.6-117 to 118) to follow the standards, procedures, and recommendations contained in the "State-of-the-Art Report on Soil Cement," developed by ACI Committee 230 [ACI 230-1R-90 (Reapproved 1997)], which describes the state-of-the-art procedures and identifies the applicable standards for mix proportioning, construction, quality-control, and testing of soil cement. These standards and

procedures were developed to reduce the likelihood and mitigate the effects of the type of soil-cement cracking/degradation cited by the State in Subpart C.3.d. of its contention. For example, the effects of any salts or sulfates in the native soil would necessarily be considered in the mix design. In this regard, the Applicant has committed to performing the appropriate tests to determine the proportions of natural soil and cement needed to achieve the soil-cement properties specified for the CTB foundation.

Second, even if vertical and/or near-vertical cracks were to form in the soil cement via the various mechanisms identified by the State in Subpart C.3.d. of this contention, the expected vertical/near-vertical orientation of the cracks would allow them to close up, and the small size of the cracks would be such that any resulting increase in the amount of lateral movement of the foundation necessary to close the cracks and mobilize the passive resistance of the soil cement would be small. Therefore, the Staff does not expect such cracking - assuming it occurs - to significantly affect the passive resistance of the soil cement, nor does it expect any associated small lateral movement of the CTB foundation to impact any safety function of the structure, as there are no external safety-related connections associated with the CTB.

Q29. In Subpart C.3.e. of this contention, the State asserts that the "Applicant has unconservatively underestimated the dynamic Young's modulus of the cement-treated soil when subjected to impact during a cask drop or tipover accident scenario." Do you agree with this assertion?

A29. No.

Q30. Please provide the bases for this conclusion.

A30. The State's assertion appears misplaced, insofar as the dynamic Young's modulus of the cement-treated soil underneath the pads is a design specification and not an estimated property. As stated earlier, PFS will be required to demonstrate through testing that the stiffness

of the cement-treated soil under the pads will not exceed the specified value -- *i.e.*, a dynamic Young's modulus of 75,000 psi.

Q31. What is your overall conclusion with respect to the various issues described by the State in Part C. of Unified Contention Utah L/QQ, concerning the Applicant's characterization of the subsurface soils underlying the proposed site of the PFS facility and its proposed use of soil cement/cement-treated soil?

A31. For the reasons discussed above and in the Consolidated SER, the Applicant has satisfied the Commission's requirements related to the characterization of subsurface soils for the design of an ISFSI, as set forth in 10 C.F.R. Part 72. The information obtained by the Applicant through its site characterization and geotechnical evaluations concerning the behavior of the native foundation soils is adequate to support the various engineering analyses of the facility structures, systems, and components important to safety. Further, with respect to the Applicant's proposed use of soil cement/cement-treated soil in the vicinity of the storage pads and CTB, the Applicant has committed to demonstrate through appropriate testing that any Staff-approved soil cement/cement-treated soil design specifications will be achieved.

Q32. Does this conclude your testimony?

A32. Yes.

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Education:
B.Sc., Geology, University of Nigeria, Nsukka, 1977
M.A.Sc., Geological Engineering, University of Toronto, Canada, 1981
Ph.D., Geological Engineering, University of Toronto, Canada, 1985

Qualifications:
Dr. Ofoegbu is a geological engineer specializing in the mechanical analyses of geological processes, finite element modeling, and the constitutive modeling of geological materials. He has a background in geoscience, geomechanics and computer software development; and about 20 years of experience in teaching, research, and consulting.

Prior to assuming his current position as Principal Engineer in March 2002, Dr. Ofoegbu served as a senior research engineer at the Southwest Research Institute. In that position, Dr. Ofoegbu led several numerical modeling projects to investigate technical issues related to possible licensing of a geologic repository for high level nuclear waste at Yucca Mountain, such as: Evaluation of a finite element code, ABAQUS, for modeling thermal-mechanical-hydrological coupled processes; and investigations of ground motion patterns resulting from numerically simulated normal fault earthquakes, effects of perched water on thermally driven moisture flow, effects of spatial and time-dependent rock-mass property variations on the stability of underground openings and groundwater flow, and effects of regional crustal density variations on patterns of small-volume basaltic volcanism. Other numerical modeling investigations led by Dr. Ofoegbu include finite element analyses of geologic finite strain for fracture distribution predictions and numerical simulation of a deforming salt body. He has also participated in the development of review procedures for an anticipated license application for the proposed Yucca Mountain repository, technical review of uranium recovery site reclamation plans under the Uranium Mill Tailings Radiation Control Act, and a safety evaluation report for an Independent Spent Fuel Storage Installation.

Dr. Ofoegbu was a research engineer at the University of Toronto for five years, during which time he was the Principal Investigator for an industrial contract on the development and numerical implementation of a constitutive model for geological materials. He developed constitutive models for intact rock, non-lithified soils, and regularly jointed rock mass; implemented the models as user-defined code modules in ABAQUS (a commercially available finite element code); and conducted finite element modeling of the Atomic Energy of Canada Limited's mine-by experiment tunnel.

As an Assistant Professor at the Ahmadu Bello University, Nigeria, in the Department of Civil Engineering, Dr. Ofoegbu taught courses and supervised student research projects in the areas of soil mechanics, earthwork, and foundation engineering, and served as Principal Consultant on industrial site-investigation contracts.

Dr. Ofoegbu has published 25 articles in refereed journals and conference proceedings, as well as several technical reports. He is a member of the International Society for Rock Mechanics and the American Rock Mechanics Association. He is a registered professional engineer in Canada.

Professional Chronology:

Principal Engineer, Southwest Research Institute, March 2002-Present; Senior Research Engineer, Southwest Research Institute, 1993–2002; Consulting Engineer, GI-Johnson Engineering, 1991–93; Research Engineer, University of Toronto, 1987–92; Assistant Professor, Ahmadu-Bello University, 1985–87; Teaching/Research Assistant, University of Toronto, 1980–85; Hydrogeologist, Lower Benue Development Authority, 1978–79; Mathematics/Physics Teacher, Ogun State of Nigeria, 1977–78.

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CHAIRMAN FARRAR: Anything else, Mr. O'Neill?

MR. O'NEILL: Yes, Your Honor. I'd note that Dr. Ofoegbu's testimony covers both soil and soil submit issues, but obviously you were limiting cross today to soil submit issues.

CHAIRMAN FARRAR: All right. He's ready for cross then?

MR. O'NEILL: Yes, he is.

CHAIRMAN FARRAR: Mr. Travieso-Diaz?

MR. TRAVIESO-DIAZ: I have no questions for this witness at this time.

CHAIRMAN FARRAR: Thank you.

State, Ms. Nakahara?

MS. NAKAHARA: I have very few. You'd like the same answer from us, but we do have very few.

(Laughter.)

CROSS EXAMINATION

BY MS. NAKAHARA:

Q Good afternoon, Dr. Ofoegbu. For the record, my name is Connie Nakahara, and I represent the State of Utah.

Dr. Ofoegbu, you yourself have not designed or engineered an engineered foundation soil using either soil cement or cement treated soils, have

you?

A Using soil cement or cement treated soil, no, I haven't.

Q And you have not developed a testing program for either soil cement or cement treated soil, correct?

A No, I haven't.

Q You have not used either cement treated soil or soil cement in the construction of a facility, correct?

A No, I have not, but we need to understand that the soil cement and cement treated soil in the proposed design are material that are assigned material properties. I have reviewed designs that cover a wide range of material properties.

Q Prior to the PFS application, in your review of designs with material properties, have you evaluated designs to implement cement treated soil or soil cement?

A Not cement treated soil or soil cement, but comparable materials with comparable properties, yes.

Q And what are comparable materials with comparable properties?

A Well, in this case, the properties that

are at issue are the shear strength and the confined compressive strength (phonetic), which is the semi-such (phonetic), which is related to the shear strength; the Young's modulus, stiffness of material. Those are properties that compacted soil, concrete, steel, or any other kind of material can have.

Q And have you designed a soil property mixture to achieve a particular set of soil properties in the past?

A Actually I don't understand that question.

Q Is it true you believe your experience with other material property or other materials with similar material properties relates to the application of soil cement and cement treated soil in this case?

A Okay. What I said is I'm experienced with the use of the properties of engineering materials.

Q And isn't it also true that you are unaware of any prior application of cement treated soil used to resist sliding?

A I'm aware of this one being proposed right now, but I'm not aware of other applications. Previous to this application, I wasn't aware of other applications in which the similar materials are bonded to resist sliding, but that doesn't mean they don't exist. In fact, on review of literature, I found that

there have been others that are.

Q You're aware that there are other applications where cement treated soil was used to resist sliding; is that --

A No, where the similar materials are bonded together.

MR. O'NEILL: Just for clarification, when you say "resist sliding," you're referring to sliding of the pads or the CTB in this particular case?

MS. NAKAHARA: Of the foundation.

MR. O'NEILL: The foundation?

BY MS. NAKAHARA:

Q Dr. Ofoegbu, in response to Question 22, at the last sentence of the second paragraph, you state, "PFS is required (and has committed) to demonstrate through testing that the soil cement will meet this minimum strength requirement"; is that correct?

A That is correct.

Q And this minimum strength requirement is the 250 psi compressive strength, correct?

A That is correct.

Q PFS has not performed any tests to show the compressive strength of its soil cement -- to show that its soil cement is at least 250 psi, correct?

A That's correct, to the best of my knowledge.

Q And at this time, PFS has not shown that the cement treated soil -- strike that.

Then at this time, PFS has not shown that the soil cement is adequate for the proposed foundation load, correct?

A They have shown that material with this property would be adequate for the proposed foundation loading, and they are reserving this in the literature that this property can be achieved by mixing soil and cement.

Q But there is no evidence in the literature that demonstrates the particular soils at PFS could achieve a 250 psi compressive strength, correct?

A There's evidence in the literature that shows that soil with that kind of description and looking at the particle size glass, whether it's plastic or non-plastic. The soils with that range of properties could be mixed with the cement to achieve an increase in compressive strength similar to the type that PFS is seeking.

The particular soil at discovery site, I'm not aware that somebody has done these tests and presented the results in publicly available format.

Q Dr. Ofoegbu, do you agree that the cement treated soil will be placed on a silty clay, clay silt layer called the Bonneville clays?

A Yes, it will be played on that soil layer.

Q And you yourself have no prior experience evaluating Bonneville clays; is that correct?

A I think I have prior experience in evaluating that kind of soil. I have not specifically worked with Bonneville clay.

Q In response to Question 24, is it true that you essentially state that the water table is 120 feet below the surface, and thus you conclude there is no water source to increase the water content in the native soils? Is that essentially your --

A Yeah, what I said is that because the water table is that far below the foundation, that I don't see any source of water nearby to feed the post related (phonetic) water content increase.

Q Notwithstanding the location of the water source, the storage pad in the cement treated soil will, in fact, essentially form a relatively impermeable cap over the Bonneville clays; isn't that right?

A It is believed that, yes, it will be essentially to be relatively impermeable, yes.

Q And I'm handing you State's Exhibit 2 --

THE REPORTER: You need to be at the microphone.

CHAIRMAN FARRAR: By the way, was that last work permeable or impermeable, about the cap?

THE WITNESS: Relatively impermeable.

MR. O'NEILL: Could you identify the exhibit or --

MS. NAKAHARA: I've handed Dr. Ofoegbu State's Exhibit 213.

BY MS. NAKAHARA:

Q Are you familiar with this document, which is Applied Geotechnical Engineering Consultants, Inc.? It's dated March 27th, 2001, and includes four pages of Table 1, Summary of Laboratory Testing.

A I saw it when it was presented earlier today.

Q You were present for the testimony earlier today of Dr. Wissa and Mr. Trudeau, correct?

A Yes, I was.

Q Do you agree with either Dr. Wissa or Mr. Trudeau that the depth at four to six feet essentially represents the Bonneville clays at the PFS site?

A What I -- what I know is that the Bonneville clay lies beneath the material described as

eolian silt, and the thickness of the eolian silt varies. In that range of five feet, four to six feet, maybe you see Bonneville clay, but there is a variation across the site.

Q Do I understand you correctly that the eolian silts are approximately five feet deep at the PFS site, but it varies across the site?

A The initial listing was five feet, but after the trenches that were done at the last year, PFS revised that estimated and said that they believed now that it's less. The earlier silt may not be as thick as five feet.

Q If the four to six foot layer represented the Bonneville clays in Table 1 of State's Exhibit 213 --

MR. O'NEILL: Is this a hypothetical question?

MS. NAKAHARA: Yes.

BY MS. NAKAHARA:

Q -- the moisture content at a depth of four to six appears to range from 27 percent to 53 percent. If you'll look at Test Pit 5 on page 4, which shows a moisture content at a depth of four to six feet of 27 percent, ranging to Test Pit No. 12 on page 5, at a depth of four to six feet, which shows a moisture

content of 53 percent; is that correct?

A Those numbers are correct, yes.

Q Now with my hypothetical: assuming that the depth of four to six feet represent the Bonneville clays, with this range of moisture content between the four to six foot samples, wouldn't the impermeable cap, relatively impermeable cap presented by the storage pad in the cement treated soil cause the moisture content to change their equilibrium in the four to six foot range?

A I don't see numbers that suggest that they're not at equilibrium.

Q And the placement of an impermeable cap, wouldn't that change the equilibrium?

A The placement of an impermeable cap will prevent water from going in or from going out. There would be some mandatory (phonetic) distribution, but that would not lead to an increase in water content that would cause an appreciable increase in -- I mean, decrease in shear strength because the assumption here is the water remains the same.

Now, if an influx of new water was postulated and there was -- my feeling is that based on the location of the water table, that the influx, such influx of new water would be unlikely.

Q In your opinion, what would the percentage in water content -- strike that.

In your opinion, what would the percentage of moisture content change would cause a decrease in the shear strength?

A As a matter of fact, there are tests that PFS has performed in which five soil specimens were inundated, and this was compressibility test. This wasn't a shear, but the change in compressibility was insignificant for those.

Q How does shear strength relate to compressibility?

A They are now related to something. There might be relationships. There are empirical -- empirical data in the literature that may suggest that shear strength -- well, not may suggest -- actually shear strength would be expected to increase as compressibility decreases for a given soil.

Q PFS has not performed any test to actually analyze the effect of the cement treated soil layer on the moisture content of the Bonneville clays; isn't that correct?

A Could you specify which effect you think they needed to test for?

Q That whether there would be an increase in

the moisture content on the Bonneville clays for the cement treated soil layer.

A To the best of my knowledge, we did not do that test. Again, we did not think that that test was needed, considering the factors that there -- there are two factors. One is the fact that the relative wall (phonetic) is more than 100 feet below the foundation.

But a more important one is the fact that there will be a thermal gradient actually that will drive -- would tend to drive moisture away from the foundation.

Q Could you repeat that last part? I'm sorry.

A It's that there will be a thermal gradient that will tend to drive moisture away from the foundation.

Q PFS is proposing to bond the cement treated soil to the Bonneville clays, correct?

A That is correct underneath the pads.

Q And PFS has not demonstrated that this bond can, in fact, be achieved, correct?

A No, that is part of the testing program. That bond strength was in the calculation -- I mean, was specified as a property in the calculation.

Q And PFS is proposing to bond the cement treated soil lifts with additional lifts, correct?

A That is correct.

Q And PFS has not demonstrated that that bond can, in fact, be achieved; is that correct?

A They have not demonstrated that the bond would exist for the material because they haven't constructed it, but they have made reference in the literature that shows that --

THE REPORTER: Dr. Ofoegbu, could you move about six inches back from the mic?

THE WITNESS: Oh, I'm too loud?

THE REPORTER: Yes.

THE WITNESS: Okay.

(Laughter.)

THE WITNESS: Okay. They have made reference to information in the literature that shows that that kind of bonding can be achieved, and there are tests available for determining whether they have been achieved.

BY MS. NAKAHARA:

Q And that would be the same for the bond between the concrete pad and the cement treated soil?

A That is the same, yeah.

Q Dr. Ofoegbu, in your prior oral testimony

on May 3rd, in response to a question by Ms. Chancellor, who asked -- and this is on page 6647 for May 3rd -- "And NRC has not independently developed that data, has it, concerning a bond between the cement treated soil layer?" you responded not that you know -- "Not that I know of."

And then Ms. Chancellor asked, "How many other nuclear facilities have you signed off on where there is data yet to be developed for the design of a nuclear facility?"

And you testified, "Well, PFS is really the first facility of that kind that I've been involved in. And, again, where you say 'sign off,' we issue findings, a document that in the safety evaluation report I don't know whether that is equivalent to signing off."

Dr. Ofoegbu, if PFS is the first facility where you've allowed testing to occur post licensing, what factors in this case gave you comfort to allowing the testing to occur post licensing versus not having done that in previous situations?

MR. O'NEILL: Your Honor, I have to state an objection. I don't think Dr. Ofoegbu is solely responsible for allowing or making the determination that testing will be conducted post licensing. I

mean, I think he was -- had a very specific task, I mean, to evaluate the application and the proposed design against the applicable regulatory standards for purposes of the staff's safety evaluation report.

MR. TRAVIESO-DIAZ: I would also note that the question assumes that, in fact, this is the first instance in which the staff allows such testing, and I don't think there's any basis on the record for that.

MS. NAKAHARA: The first facility that Dr. Ofoegbu's been involved in.

CHAIRMAN FARRAR: We will overrule the objection, and he can -- if the explanations you all have suggested make sense to him, he can state them himself.

MR. TURK: Your Honor, there was an objection to form. The witness testified previously that this is the first application that he has personally been involved in. Ms. Nakahara's question is, well, if this is the first one that the staff has done, and there is the disconnect.

CHAIRMAN FARRAR: I'm sorry. I didn't hear that. If you'd restate the question and take that -- deal with that objection.

BY MS. NAKAHARA:

Q With respect to the first facility that you've been involved in, what in this case has given you comfort to allow testing, assuming that it was your decision to allow testing to occur after the license has been issued versus previous licenses that you've been involved in, license proceedings?

MR. TURK: That he's been involved in?

MS. NAKAHARA: Yes.

THE WITNESS: Well, first of all, I didn't allow; I don't have the authority to allow anything of any applicant. What we were tasked to do was review the design submitted, and that is calculations, material properties, and determine whether this design satisfies the regulatory requirement.

Now, of course, in reviewing the material properties, we will look to see whether they have specified something that is, you know, out of this world that is not likely to be achieved, and that's what we did, and our finding based on the information we presented by the applicant and information available in the literature is that the design satisfies the regulatory requirement and that the material properties that are proposed are within the range of what is available in the literature.

BY MS. NAKAHARA:

Q Whose decision was it to not require the testing to occur before the SER was issued, essentially approving the design? Was it your decision?

A No, it wasn't my decision, but we did inquire about it and found that there is in NRC -- there is provisions within the NRC licensing program that provides for tests being done to satisfy material property requirement as specified in design, and that such tests can be done as part of post licensing activity.

CHAIRMAN FARRAR: Dr. Ofoegbu, I take it that even though it wasn't your decision, but it was your recommendation that the matter be handled this way? Even though you don't have final decision making power, you were comfortable with that decision?

THE WITNESS: Yes, I'm comfortable with it because we were told that there is regulatory precedence for it.

BY MS. NAKAHARA:

Q And do you know what the regulatory precedence is?

A I think that report have a longer history in the analyses.

THE REPORTER: If you would just stay back

from that mic, we really would appreciate it.

MS. NAKAHARA: We need to combine our voices.

THE WITNESS: The people have a longer history with in the analysis program can answer that question better. We were told that there is regulatory precedence for testing being approved based on specified material properties, and such properties being demonstrated by testing.

BY MS. NAKAHARA:

Q And do you know a specific regulation that allows that?

A No, I don't, but I don't think it's -- I think it's a range of requirements in it.

Q From a technical perspective, would you prefer to see the tests conducted now prior to licensing or after licensing?

A Actually there is no reason to take an opinion on that because as I told you, what we did in our review was determine whether the specified properties are achievable based on information in the literature. And that information, the available information shows clearly that the specified properties are achievable.

So when it is done is really not important

to our review of the design.

Q And if the properties are not achieved, what happens then?

A Well, achievable, I said. If we have determined that the properties were not achievable, I made that known to the Nuclear Regulatory Commission.

Q But post licensing, if, in fact, PFS could not achieve the required properties, material properties, what happens then?

A Well, my understanding is these are specified properties. That's part of the design. So if they cannot meet the design, they will have to come back to analysis. NRC --

MR. O'NEILL: Your Honor --

THE WITNESS: -- with an amendment application or something, I don't know.

MR. O'NEILL: Your Honor, I think we may be delving into the realm of legal consequences or, you know, the specific legal regulatory mechanisms that may come into play. So it calls for a legal conclusion.

CHAIRMAN FARRAR: You have a point, but I think this is sufficiently close to the point that State is trying to make that we'll allow it.

MR. TURK: May we note also, Your Honor,

that Dr. Ofoegbu works for the Center for Nuclear Waste Regulatory Analyses. He's not a direct NRC employee. Asking him to state NRC regulatory requirements may be a bit of a stretch.

MS. NAKAHARA: To the extent he knows is all I'm asking, sir.

MR. TURK: Yes, but the question seemed to call for the legal conclusion which at best would be offered by counsel and at worse would be offered by NRC employees who are used to applying the regulations.

CHAIRMAN FARRAR: There is a difference between staff managers, staff employees, and consultants to the staff. So there's only a limited range allowable for the questions here, but keep going. You're all right.

BY MS. NAKAHARA:

Q Dr. Ofoegbu, in your opinion, has PFS demonstrated their design without the test to show that they can achieve the material properties specified?

MR. O'NEILL: Do you understand the question, Dr. Ofoegbu?

THE WITNESS: I don't understand the question, and I would prefer you repeat or so.

BY MS. NAKAHARA:

Q In your opinion, has PFS proven their design using cement treated soil and soil cement will work without having conducted the test program?

A Yes, they have.

Q And that's based on the literature?

A Well, that's based on the analysis they conducted and the information in the literature that shows that these properties are within the range that can be achieved.

Q Will you explain how PFS' analyses demonstrate material properties?

A I didn't say the analyses demonstrate material properties. You asked me about safety of their design. I said the analyses they conducted demonstrated that their design would be safe, and that the analysis in addition to information in the literature that demonstrates that the material properties used in their design are achievable.

Q In your opinion, would PFS' design for the use that they propose with cement treated soil and soil cement -- has that been shown without these tests?

MR. O'NEILL: Excuse me. What do you mean by show the design or prove the design? Are we --

have they demonstrated the adequacy of the proposed design as opposed to demonstrated the specific material properties that are, you know, part of that design?

MS. NAKAHARA: Okay. Let me withdraw that question.

BY MS. NAKAHARA:

Q In your opinion, has PFS shown that its design will work as proposed without the tests to be conducted at some time in the future for the cement treated soil or soil cement?

A Yes.

Q And how have they done that?

A Well, through the analysis that they presented which are reviewed and the result of our review documented in the safety evaluation report. We can discuss specific aspects of that based on your questions.

MS. NAKAHARA: I have no further questions. Thank you, Dr. Ofoegbu.

THE WITNESS: Thank you.

CHAIRMAN FARRAR: Thank you, Ms. Nakahara.

Judge Lam has a question.

JUDGE LAM: Dr. Ofoegbu, I do not know if you are the right expert to answer this question. If

you have any doubt, please decline to answer it.

within this proceeding the State of Utah has consistently raised this issue, that the Applicant is caught in the dilemma regarding the cement treated soil underneath the storage page. The dilemma that the State has raised is this, before the Applicant.

On one hand, the Applicant needs to have a strength of 40 psi for the cement treated soil to successfully resist sliding.

On the other hand, the Applicant does not need a Young's module to excess 75,000 psi so that it would meet the cask drop and the tip-over requirement.

My question to you is twofold. Is this, indeed, the dilemma, Part 1?

Part 2, is this something that's relatively easy or difficult to resolve?

THE WITNESS: Actually I don't think it is a dilemma, and that's based on two considerations. One of them is information available in the literature that indicates that for a 40 psi soil, the Young's modulus, dynamic Young's modulus may actually not exceed about 40,000 psi, and this is based on published research.

Of course, the Applicant would not rely on that. What that shows is that this is achievable.

You have to do tests to show that they have achieved the specification.

The other one is that the NRC staff evaluation of the sliding safety of the parts relies on the argument that says that sliding of the parts will be small if it did occur; that there are no safety -- there are no connections to the parts that will be ruptured or misaligned as a result of sliding, and that sliding, that the potential for cask tip-over would, in fact, be reduced if the pads were free to slide.

So the uncertainty then regarding meeting the 40 psi specification which is -- which they are required to meet the factor safety of 1.1 through the status analysis of sliding stability; the uncertainty there is then reduced because of the analysis of the potential effects of sliding on the safety function of the study parts.

JUDGE LAM: Thank you.

CHAIRMAN FARRAR: Any redirect by the staff?

MR. O'NEILL: Just a few points, Your Honor.

CHAIRMAN FARRAR: All right.

MR. O'NEILL: Can we possibly take a few

minutes to consult?

CHAIRMAN FARRAR: Sure.

MR. O'NEILL: Thank you.

CHAIRMAN FARRAR: Do you want to take a break or --

MR. O'NEILL: In place.

CHAIRMAN FARRAR: In place. All right.

MS. NAKAHARA: Your Honor, I have one question, a follow-up.

CHAIRMAN FARRAR: All right. Go ahead.

CHAIRMAN FARRAR: To Judge Lam's.

FURTHER CROSS EXAMINATION

BY MS. NAKAHARA:

Q Dr. Ofoegbu, could you name the literature reference that you responded to Judge Lam in which a 40 psi strength was in the range of a 40,000 psi dynamic Young's modulus?

A Yes. Actually this particular reference was cited in my testimony not in relation to this, but is the paper by Lambridge (phonetic) and the group of others that discussed the analysis for the Boston panel. And on page 167 of that paper, they refer to published research from a Japanese group that shows -- that gives these numbers, which they give the ratio of unconfined compressive strength to Young's -- I mean,

elastic modulus to unconfined compressive strength being in the range of 350 to 1,000.

There is another paper. This I have cited before. It's publicly available. It's called "Estimations of Dynamic Modulus of Soil Cement." It has charts.

If we go 90 -- page 94, Figure 9 of that paper, it shows the range of values, and when we were reviewing this subject, I did some calculations using these just to look the range of values that could be expected.

MS. NAKAHARA: Thank you.

CHAIRMAN FARRAR: All right. We'll take a short break in place here.

(Whereupon, the foregoing matter went off the record at 4:26 p.m. and went back on the record at 4:31 p.m.)

CHAIRMAN FARRAR: All right. The staff is ready for its redirect.

Go ahead, Mr. O'Neill.

MR. O'NEILL: Just a few quick questions, Dr. Ofoegbu.

REDIRECT EXAMINATION

BY MR. O'NEILL:

Q There was some discussion of the

compressive strength of 250 psi. In your view this is -- do you consider this to be a value that is achievable, technically achievable, a compressive strength of 250 psi?

A Yes, that is achievable, and as the Applicant witnesses have testified, because there isn't a stiffness restriction ont this particular -- on those two soil cement layers, the one around the part and the one around the canister transfer building, the minimum strength specified -- I mean the strength doesn't have to be cut at the minimum. In fact, it appears that the durability requirements work upon the mixed design for that, and the strength may end up being much higher than 250 psi.

Q In response to questions from Ms. Nakahara, I believe you stated something to the effect that you had prior experience with that kind of soil. You're referring to the Bonneville clays, but you had not necessarily worked specifically with Bonneville clay.

Could you elaborate or amplify on that a little bit?

A Well, what I was trying to -- what I was referring to was the fact that this is silty clay, clay in silt, and there are a lot of materials that

fall within that classification through a lot of soils, and that maybe specific about Bonneville clay, but not that any testing has shown that the Bonneville clay is different from other clays that -- it is sufficiently different from other clays within that category to request that somebody has to have specifically as walk-in in order to review a design conducted on it.

Q And with respect to the significance of specific properties of Bonneville clay or properties that may be of significance to obtaining an appropriate soil-cement mix, you would expect the testing that the applicant has committed to to bring out such significant properties, assuming they exist, correct?

A Of Bonneville clay?

Q Yes, yes. Well, I'm sorry. We're dealing with the eolian sites, silts. Okay.

A The Bonneville clay is not --

Q Directly being used?

A -- directly involved in the --

Q I'm sorry, sir. I misspoke.

You made reference to a particular professional paper or literature study. You mentioned Figure 9 in particular that relates to the

dynamic Young's modulus and the compressive strength that could be achieved either simultaneously or exist simultaneously in the soil cement.

Could you provide a full reference for that paper?

A Yes, I can provide a copy of full reference for that. I have the paper here.

Q Would that be "Assignations of Dynamic Modulus of Soil Cement" by S.N. Doshi (phonetic) or Doshee (phonetic) and M.S. Misderry (phonetic)?

A That's correct. It was published in the Australian broad -- Volume 15, Number 2, 1985.

Q And Figure 9 is located on page 94 of that document, correct?

A That is correct.

MR. O'NEILL: I think that's all I have for now. Thank you.

CHAIRMAN FARRAR: Mr. Travieso-Diaz?

MR. TRAVIESO-DIAZ: I have just a question.

RECROSS EXAMINATION

BY MR. TRAVIESO-DIAZ:

Q Good Afternoon, Dr. Ofoegbu.

A Thank you.

Q During the cross examination by Ms.

Nakahara, you testified that there would be a thermal gradient that would drive moisture away from the native soil underlying the pad. So despite the fact that there could be an impermeable barrier above, there still would be no accumulation of moisture on that soil. Do you remember that?

A Yes, I remember that.

Q Can you give us a reference or the basis for that view? In other words, is there any paper or any other preference that provides the basis for that view of yours?

A Well, I couldn't give a reference right here, but there are -- it's a well known phenomenon. In fact, there's a textbook in my office that discusses the interactions of moisture and heat and all such with that soil. Moisture flows down the temperature gradient. So if you increase the heat at the point in the soil mass, you tend to drive moisture away.

Q So this is kind of a well known phenomenon that is even discussed in textbooks; is that right?

A That's correct.

MR. TRAVIESO-DIAZ: That's all I have.

CHAIRMAN FARRAR: Ms. Nakahara?

MS. NAKAHARA: No further questions, Your

Honor.

CHAIRMAN FARRAR: All right. All right. We're getting better at this.

(Laughter.)

CHAIRMAN FARRAR: Less than an hour on and off.

Dr. Ofoegbu, thank you for you testimony. You're excused for now.

(The witness was excused.)

CHAIRMAN FARRAR: I take it then we're ready for the State's panel, Dr. Bartlett and Dr. Mitchell; is that right?

MS. NAKAHARA: That's correct.

CHAIRMAN FARRAR: All right. Why don't we get them on and get their testimony in place, and then we'll see where we are.

(Pause in proceedings.)

CHAIRMAN FARRAR: Dr. Bartlett, it seems we've seen you before. So you're -- consider yourself still under oath.

Whereupon,

DR. STEVEN BARTLETT

was recalled as a witness by counsel for the State and, having been previously duly sworn, was examined and testified further as follows:

CHAIRMAN FARRAR: Dr. Mitchell, would you stand and raise your right hand, please?

Whereupon,

DR. JAMES MITCHELL

was called as a witness by counsel for the State and, having been first duly sworn, was examined and testified as follows:

CHAIRMAN FARRAR: Thank you.

(Pause in proceedings.)

MS. CHANCELLOR: I was just waiting. I didn't know if you were set.

CHAIRMAN FARRAR: Oh, we're ready. Go ahead.

DIRECT EXAMINATION

MS. CHANCELLOR: Good afternoon, Dr. Mitchell and Dr. Bartlett. Do you have in front of you "State of Utah Testimony of Dr. Steven F. Bartlett and Dr. James K. Mitchell on Unified Contention Utah L/QQ (Soil Cement)," dated April 1, 2002?

MR. BARTLETT: Yes.

MS. CHANCELLOR: Are there any changes you wish to make to this testimony?

DR. MITCHELL: Not to my responses.

MR. BARTLETT: No.

THE REPORTER: I couldn't hear your

response.

DR. MITCHELL: Not to my responses.

MR. BARTLETT: No.

MS. CHANCELLOR: Was this testimony prepared by you or under your direction?

MR. BARTLETT: Yes.

DR. MITCHELL: Yes.

MS. CHANCELLOR: Do you accept this testimony as your sworn testimony in this proceeding?

DR. MITCHELL: Yes.

MR. BARTLETT: Yes.

MS. CHANCELLOR: Your Honor, I request that the testimony of Drs. Bartlett and Mitchell be bound into the record as if read.

CHAIRMAN FARRAR: Any objections?

MR. O'NEILL: No.

PARTICIPANT: No.

CHAIRMAN FARRAR: All right. Then the testimony will be bound into the record at this point as if read.

(Insert prefiled testimony of Drs. Mitchell and Bartlett.)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	Docket No. 72-22-ISFSI
PRIVATE FUEL STORAGE, LLC (Independent Spent Fuel Storage Installation)	)	ASLBP No. 97-732-02-ISFSI
	)	April 1, 2002

STATE OF UTAH TESTIMONY OF DR. STEVEN F. BARTLETT AND DR. JAMES K. MITCHELL ON UNIFIED CONTENTION UTAH L/QQ (Soil cement)

Q. 1: Please state your name, affiliation, and qualifications.

A. 1: (SFB) My name is Dr. Steven F. Bartlett. I am an Assistant Professor in the Civil and Environmental Engineering Department of the University of Utah, where I teach undergraduate and graduate geotechnical engineering courses and conduct research. I hold a B.S. degree in Geology from Brigham Young University, a Ph.D. in Civil Engineering from Brigham Young University and I am a licensed professional engineer in the State of Utah.

My qualifications are described in my soils testimony, which is being filed concurrently with this prefiled testimony. Relevant to this testimony, my tenure at the Utah Department of Transportation and Woodward-Clyde Consultants in Salt Lake City have given me a background knowledge and understanding of local soil conditions, especially the upper Lake Bonneville sediments. I have also been involved in the design and performance monitoring that used lime-cement column stabilization underneath a mechanically stabilized earth wall for the I-15 Reconstruction Project. My curriculum vitae is included with my soils testimony as State's Exh. 92.

Q. 2: Dr. Bartlett, do you consider it necessary to present testimony with another witness?

A. 2: (SFB) Yes. Dr. James K. Mitchell has expertise specific to soil cement. His testimony will overlap my testimony especially with respect to the effect soil cement may have on native soils. It would be expedient for the Board to hear our testimony together.

Q. 3: Please state your name, affiliation, and qualifications.

A. 3: (JKM) My name is Dr. James K. Mitchell. I hold a Sc.D. in civil engineering earned in 1956 from the Massachusetts Institute of Technology. Presently I am a University

Distinguished Professor Emeritus at Virginia Tech and Professor Emeritus at the University of California at Berkeley. I serve as an individual consultant on geotechnical problems and earthwork projects of many types, particularly soil stabilization, ground improvement for seismic risk mitigation, earthwork construction, and environmental geotechnology, to numerous national and international governmental and private organizations. My curriculum vitae listing my qualifications, experience, and training is included as State's Exhibit 105.

I have more than 40 years' experience in the field of geotechnical engineering. I was on the faculty of the University of California, Berkeley, Department of Civil Engineering for more than 35 years, serving as Department Chair for five years. I developed and taught graduate courses in soil behavior, soil and site improvement, and foundation engineering as part of the Geotechnical Engineering Program within the Civil Engineering Department. At the same time, I was Research Engineer in the Institute of Transportation Studies and in the Earthquake Engineering Research Center. Since 1994, I served on the faculty of Virginia Tech, Via Department of Civil and Environmental Engineering, and was appointed University Distinguished Professor in 1996 and University Distinguished Professor, Emeritus, in 1999.

My primary research activities focused on experimental and analytical studies of soil behavior related to geotechnical problems, admixture stabilization of soils, soil improvement and ground reinforcement, physico-chemical phenomena in soils, the stress-strain time behavior of soils, in-situ measurement of soil properties, and mitigation of ground failure risk during earthquakes. I have authored more than 350 publications, including two editions of the graduate level text and reference, "Fundamentals of Soil Behavior," and several state-of-the-art papers and guidance documents on soil stabilization, ground improvement, and earth reinforcement.

Some of my recent and currently active projects include the evaluation of seismic stabilities and design of liquefaction mitigation options for Success Dam in California (U.S. Army Corps of Engineers) and Pineview and Deer Creek Dams in Utah (U.S. Bureau of Reclamation); ground improvement aspects of the Port of Oakland Wharf and Embankment Strengthening Program (Harding Lawson Associates); ground improvement and fill stabilization for the proposed San Francisco Airport Expansion (Fugro West); design review – ground improvement for the I-95/Rt.1 Interchange section of the Woodrow Wilson Bridge replacement project (Haley & Aldrich, Virginia Geotechnical Services, URS, HNTB); and as a member of the Peer Review Panel for the Seismic Vulnerability Study of the Bay Area Rapid Transit System in California.

I am licensed as a Civil Engineer and as a Geotechnical Engineer in California, and as a Professional Engineer in Virginia. I am a Fellow and Honorary Member of the American Society of Civil Engineers, and have served as an officer of the Geotechnical Engineering Division of ASCE; the United States National Committee for the International

Society for Soil Mechanics and Foundation Engineering; the ASCE Committee on Soil Properties, the Committee on Placement and Improvement of Soils; the San Francisco Section of ASCE and the California State Council of ASCE; the Transportation Research Board Committee on Physico-Chemical Phenomena in Soils; the Geotechnical Board of the U.S. National Research Council; the International Society for Soil Mechanics and Foundation Engineering. I recently completed service as Vice Chair of an NRC study committee for development of science needs for remediation of contaminated Department of Energy weapons sites and as a member of an NRC study committee to advise the Department of Energy on Remediation Science and Technology for the Hanford Site. I presently serve as Chair of a National Academies panel to develop recommendations for peer review of U.S. Army Corps of Engineers civil works projects.

Specifically relevant to soil cement are my many years of research on the properties of cement stabilized soils and the use of soil cement in pavement structures, involvement as a consultant on the Koeberg nuclear power plant project in South Africa, and my current work involving deep soil mixing.

Q. 4: Dr. Mitchell, do you consider it necessary to present testimony with another witness?

A. 4: (JKM) Yes. Dr. Steven Bartlett's expertise in native soils in Utah will complement my testimony. In addition, he has had more involvement than I have in the overall review of PFS's analyses relating to soils and the dynamic forces imparted to foundations and soils. Together, we can better inform the Board on PFS's proposed use of soil cement than if we were to testify independently.

Q. 5: What is the purpose of your testimony?

A. 5: (SFB, JKM) The purpose of our testimony is to explain the basis for our professional opinion that (1) PFS's proposal to use soil-cement and cement-treated soil to provide additional seismic sliding resistance and stability to shallowly embedded foundations subjected to intense strong ground motion is a new and unique application of this technology; (2) to our knowledge, there is no prior precedent for PFS's proposed use of this technology; (3) site-specific analyses and testing is required to verify the design at the PFS site to ensure that the soil cement and cement-treated soil will perform their intended functions during earthquake shaking and that target performance requirements are met for cask drop and tipover scenarios; (4) the potential impact of construction and placement of the soil cement and cement-treated soil on the underlying native soils has not been addressed; and (5) PFS's proposal to conduct a soil cement testing program after, rather than before, it obtains a license will not prove the design concept that will form the basis of a licensing decision.

Q. 6: What has been your involvement in reviewing and analyzing PFS's intended use of soil cement and cement-treated soil? NEW

A. 6: (SFB) I have been assisting the State since 1999 and have reviewed PFS's sliding and stability calculation both prior to PFS's intended use of soil cement and also where, through design creep, PFS has expanded its use of soil cement and cement-treated soils. I assisted and gave technical support to the State in filing Contention Utah QQ and the two modifications thereto. I am familiar with sections of PFS's Safety Analysis Report ("SAR") and calculation packages with respect to PFS's characterization of soils, the cone penetrometer testing, PFS's stability analyses and its seismic exemption request. Some of these topics are described in my soils and dynamic analysis testimonies filed concurrently with this testimony.

(JKM) I began assisting the State shortly before the State filed Contention Utah QQ. I provided technical support for filing that contention. My role is generally limited to review of PFS's most recent proposal for use of soil cement and cement-treated soil.

Q. 7: Please describe PFS's intended use of soil cement and cement-treated soil at the proposed Skull Valley ISFSI site?

A. 7: (SFB) PFS states that it intends to use soil cement around the Canister Transfer Building ("CTB") and around the storage pads. Under the storage pads, PFS will use a weaker cement mix, a cement-treated soil.

The placement of soil cement around the perimeter of the foundation for the CTB is intended to provide additional resistance against sliding during the design basis earthquake by acting as a buttress. Without the additional resistance provided by the soil cement around the CTB, the Applicant has calculated that sliding of the CTB is possible (Calc. G(B)-13-4). Thus, the concept of using soil cement as buttress for the CTB has become an integral part of the seismic design of the CTB design.

The placement of cement-treated soil underneath the storage pads is intended to act as an "engineered mechanism" to transfer inertial forces of the casks and pads to the underlying upper Lake Bonneville sediments in order to prevent sliding. SAR, p. 2.6-61. Shear stresses are intended to be transferred through the approximately 2-ft thick cement-treated soil layer to the underlying silty-clay/clayey-silt. The Applicant also implies that additional sliding resistance will be provided by the continuous layer of soil cement between the pads (SAR, p. 2.6-61). Like the CTB, the concept of using cement-treated soil underneath the pads and soil cement between the pads has become an integral part of the seismic design of the storage pads.

The soil cement between the pads is also intended to provide a stabilized base for the support of the cask transport vehicle. SAR, p. 2.6-67d.

Q. 8: Has PFS conducted tests and analyses that are necessary to determine whether soil cement will provide additional resistance against sliding and whether cement-treated soil will act as an "engineered mechanism" in transferring shear stresses to the native soils?

A. 8: (SFB, JKM) No. PFS has conducted a few tests, which we describe later in our testimony. Basically, PFS has decided to wait until after it obtains a license to conduct most of the testing and analyses.

There are only two documents that describe PFS's soil cement program: (1) SAR 2.6-108 through -121 (Rev. 22), included as State's Exhibit 106, and (2) Engineering Services Scope of Work for Laboratory Testing of Soil-Cement Mixes between Stone and Webster and Applied Geotechnical Engineering Consultants, Inc. ("AGEC"), ESSOW No. 05995.02-G010 (Rev. 0), dated January 21, 2001, included as ~~State's Exhibit 107.~~[1] PFS EXHIBIT G69

Those two documents describe what PFS intends to do in the future. We do not understand how PFS can go forward with its seismic design not knowing whether soil cement and cement-treated will perform its intended seismic function. We see no practical reason why PFS should not perform testing and analyses now rather than at some future date. Some of the questions – but not all of them – we raise here would be resolved through such testing and analyses. Also, if in the future PFS finds that soil cement and cement-treated soil will not support PFS's seismic design, then the licensing basis for approving the PFS facility design will be invalid.

Q. 9: Dr. Mitchell, do you consider there to be any direct precedent for PFS's soil-cement program?

A. 9: (JKM) For pavement structures and as a structural fill – yes; as a restraining buttress and for development of sliding resistance – no.

Q. 10: What is the basis of your opinion?

A. 10: (JKM) Over my 40 year career, I have been involved with or had an academic interest in numerous projects that have used cement to increase certain properties of soils. The use of soil cement for pavement bases and sub-bases goes back to the early 1900s and today it is widely used as a strengthening base for pavement structures. Starting in the late 1950s soil cement has been used for hydraulic structures such as slope protection on dam faces or reservoirs and for canal linings.

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[1] ~~The State obtained a copy of the ESSOW under a PFS confidentiality agreement; PFS claims that the methodology that may be contained in the ESSOW still remains confidential. As a precaution, the State is filing Exhibit 107 as a proprietary filing but in doing so the State does not agree that the document is confidential.~~

More recently, soil cement has been used as structural fill in seismic areas and for constructing roller-compacted concrete to build dikes and dams. The latest development in the use of soil cement is deep soil mixing.

Q. 11: Does the use of soil cement as a strengthening base for pavements and for hydraulic structures provide a precedent for PFS?

A. 11: (JKM) Not as regards the proposed development of sliding resistance and a buttressing effect.

Q. 12: Are there examples of using soil cement in seismic design?

A. 12: (JKM) Yes. But none of the cases apply to PFS's intended use. The one application I am most familiar with is in Koeberg, South Africa - one of the cases PFS cites in the SAR at 2.6-113 (Rev. 22), State's Exh. 106.

During the late 1970s and early 1980s, I was involved as a consultant on the soil cement issues at the Koeberg nuclear power project located in the coastal area of Cape Town, South Africa. The project required a large excavation, approximately 24 meters deep, to remove an eight meter thick potentially liquefiable layer of saturated loose sand. The sand was mixed with cement, then replaced and recompacted.

Q. 13: Why is the South Africa case not analogous to the PFS case?

A. 13: (JKM) The Koeberg case is not analogous because the soils there were loose, saturated sands. The soils at PFS are plastic, fine grained, cohesive materials. At Koeberg the purpose was to eliminate the potential for liquefaction of the loose sand beneath the reactor building under seismic loading. The fine-grained soils at the PFS site are not liquefiable, and the purposes of the soil cement and cement-treated soil are to provide sliding resistance and buttressing, as stated above.

Q. 14: Are there other examples of soil cement used in seismic design?

A. 14: (JKM) Yes, but again the application is not really relevant to the PFS site. The latest use of soil cement for seismic design is in deep soil mixing. In this application, mix-in-place columns and walls extend down as much as a hundred feet below the ground surface for both support of structures and excavations and for containment of potentially liquefiable soils.

Q. 15: Is deep soil mixing analogous to the PFS case?

A 15: (JKM) No. Deep soil mixing applications are not at all like the proposed PFS use of soil cement.

Q. 16: What is the difference between soil cement and cement-treated soil and why is the difference important?

A. 16: (JKM) Cement-treated soil may contain any amount of cement. To be a soil cement requires that the cement content and compaction conditions be sufficient to attain minimum durability standards as measured by American Society for Testing and Materials ("ASTM") wet-dry and freeze-thaw tests. More cement is needed as the fines content in the soil to be treated increases. The strength of soil cement generally decreases as soil plasticity increases. At treatment levels less than those needed to produce a soil cement, the durability may be inadequate under severe exposure conditions, such as at the PFS site, to prevent degradation of the material over time.

Q. 17: Specific to the PFS site, approximately how much cement is needed to create soil cement and cement-treated soil?

A. 17: (JKM, SFB) The Applicant has not submitted the design of the soil cement and cement-treated soil for the PFS site, so this has not been determined. However, the SAR (p.2.6-67c), State's Exh. 106, implies that about 1 percent cement will be required to create cement-treated soil and about 6 percent will be required to create soil cement in order to meet the target compressive strengths of 40 and 250 psi, respectively. It should be noted that by itself, attainment of a designated compressive strength cannot guarantee a material to be a soil cement. Durability testing is required for this purpose.

Q. 18: The term soil cement seems to imply a fairly strong material. How does the compressive strength of 250 psi soil cement compare with the compressive strength of concrete?

A. 18: (JKM, SFB) Concrete is much stronger. It has typical compressive strengths of at least 3000 to 4000 psi. Also, the concrete that PFS plans to use for the cask storage pads and CTB mat foundation has steel reinforcement so that it can withstand tensile as well as compressive forces.

Q. 19: Why is it important to have reinforcing steel to resist tensile forces in reinforced concrete design?

A. 19: (SFB) Concrete is relatively weak in tension and steel has high tensile capacity. Thus, the reinforcement allows the pad or mat to resist tensile stresses created by bending and torsion of the foundation during the design basis earthquake.

Q. 20: Were the concrete storage pads designed to resist tensile and bending stresses?

A. 20: (SFB) Yes, the storage pads were analyzed and designed for dynamic

loading conditions using a soil-structure analysis that was performed by International Civil Engineering Consultants Inc. (Calc. G(PO17)-2).

Q. 21: Does a similar analysis exist to evaluate the dynamic stresses developed in the soil cement and cement-treated soil?

A. 21: (SFB) No.

Q. 22: In your opinion, is a similar calculation necessary to assess the feasibility of the proposed treatment and if so, why?

A. 22: (SFB) Yes. The Applicant has assumed that the soil cement and cement-treated soil will act as an integral mat, thereby keeping each individual pad in place and in-phase with the other adjacent pads during strong ground motion (SAR, pp. 2.6-61 and 62). The Applicant has not considered the potential for out-of-phase motion between pads in the longitudinal direction and the consequences of this out-of-phase motion. However, to act as an integral mat, the soil cement and cement-treated soil mat must resist compressional, shear, bending, torsional and tensile stresses induced by the design basis earthquake both underneath the pads and between the pads. The Applicant has not performed soil-structure interaction analysis to evaluate the magnitude and orientation of these stresses in the mat and how these forces will impact the seismic performance. The magnitude of bending, torsional and tensile stresses developed in the mat could be important because of the very low tensile strength of the soil cement and cement-treated soil. The tensile strength of these materials is typically only about a fifth to a third of the unconfined compressive strength. Thus, even rather low tensile stresses can cause cracking. The Applicant has not calculated the magnitude and orientation of these stresses; thus a rational assessment cannot be made of the seismic performance of the proposed cement treatment.

Q. 23: In your opinion, are there other possible mechanisms that may cause cracking of the soil cement and cement-treated soil beside the dynamic forces?

A. 23: (SFB, JKM) Yes. Other potential mechanisms for cracking of the soil cement and cement-treated soil may include: (1) delamination or debonding along a soil cement lift interface or an interface with the concrete pad or the native soil during a seismic event; (2) shrinkage cracking during curing and drying; (3) settlement cracking resulting from differential settlement at the perimeter of the pads and CTB mat foundation; (4) frost penetration and expansion cracking; and (5) cracking or overstressing due to vehicle loads (*e.g.*, canister transport vehicle).

Q. 24: Of these possible mechanisms, which one would seem to be of most concern?

A. 24: (SFB, JKM) Of most concern is shrinkage cracking of the soil cement

between and around the pads and of the soil cement surrounding the CTB. Shrinkage cracks form during the process of curing and aging of soil cement. These are relatively thin generally vertical cracks to subvertical cracks that will develop in the soil cement. From a seismic performance standpoint, the real issue is not thickness of the crack, but its potential for continuity. If these cracks are somewhat continuous, then the tensile resistance has been completely lost along the surface of the crack. This loss of tensile capacity in the mat is extremely deleterious when the mat has to resist dynamic tensile stresses. Lost of tensile capacity will in turn impact the mat's capacity to act as an integral mat and resist out-of-phase motion between individual pads or out-of-phase motion between the CTB concrete mat foundation and the perimeter soil cement mat. Such out-of-phase motion will introduce inertial interaction as discussed in the dynamic analysis testimony by Drs. Farhang Ostadan and Steven Bartlett.

Q. 25: What might be other consequences of cracking and inertial interaction?

A. 25: (SFB) If the cracking or interaction is significant, then there can be a loss of the buttress effect (*i.e.*, passive earth pressure) that is relied upon by the Applicant to resist sliding of the CTB foundation. Also, there can be a reduction or loss the cement-treated soil's ability to transfer shear stresses to the underlying upper Lake Bonneville sediments. These losses, depending on their magnitude, will reduce the factor of safety against sliding, or if large enough, lead to sliding.

In addition, the cracks would provide a pathway for ingress of water through the soil cement between the pads and around the CTB. This water could cause a strength reduction in the underlying Bonneville clay.

Q. 26: In addition to shrinkage cracks, are there other mechanism that may lead to cracking?

A. 26: (SFB, JKM) Differential settlement around the perimeter of the CTB and pads, as well as beneath the pads may be important. The Applicant has estimated about 2 inches of total settlement of the pads (SAR, p. 2.6-50) and 3 inches of total settlement for the CTB. It is anticipated that much of this settlement will be distributed around the perimeter of the pads and CTB due to the abrupt change in vertical static loading conditions between relatively heavily loaded foundations (about 1.5 to 2 kip per square foot) and the adjacent unloaded perimeter area. Also, it is important to keep in mind that the most compressible layer (*i.e.*, the upper Lake Bonneville sediments) lies just below the foundations.

Q. 27: Beyond the target compressive strength of 40 and 250 psi for cement-treated soil and soil cement, respectively, identified by PFS in the earthquake sliding calculations, has PFS identified any other requirements for the cement-treated soil and soil cement?

A. 27: (SFB, JKM) It has. The soil cement between the pads must have a target strength of 250 psi to provide a good subbase for the cask transporter (SAR p. 2.6-67d). The cement-treated soil beneath the pads must have a Young's modulus of 75,000 psi, or less.

Q. 28: What is the purpose of limiting Young's modulus to 75,000 psi?

A. 28: (SFB) In the drop/tipover analysis of the casks (*PFSF Site-Specific HI-STORM Drop/Tipover Analyses*, Rev. 0 and Rev. 1, Holtec Report No. HI-2012653, Apr. 3, and May 7, 2001 respectively), Holtec places constraints on the thickness and modulus of elasticity (*i.e.*, Young's modulus) of the cement-treated soil. The cement-treated soil is limited to a maximum thickness of 2 feet and Young's modulus is limited to a maximum value of 75,000 psi. These constraints are placed on the cement-treated soil in an attempt to limit the decelerations from a hypothetical cask tipover event or end drop accident. The Holtec calculation shows that there is a very small margin against the deceleration limit. If the Young's modulus exceeds 75,000 psi, then the deceleration limit is likely to be exceeded. The Stone and Webster stability analysis of the casks identifies the 75,000 psi as the static Young's modulus of the cement-treated soil. Dr. Ostadan has testified, in the Dynamic Analysis testimony, that the use of the static Young's modulus to analyze dynamic impact is not appropriate for the cask drop/tipover scenario. Furthermore, the Geomatrix calculation for development of ground motion, soil springs and damping effectively assigns a much higher modulus to the cement-treated soil.

(SFB, JKM) The Applicant has not provided any site-specific test data that demonstrate this rather low modulus can be achieved for a cement-treated soil with a minimum compressive strength of 40 psi. There is not very much published test data for these low modulus values. Further, the cement content and the placement conditions are tremendously important in determining the strength and stiffness properties of the cement-treated soil. In sum, whether or not PFS can achieve a Young's modulus of 75,000 psi or less, while meeting the minimum compressive strength requirement of 40 psi, depends on the quantity of cement that is used, the site soil, and the placement conditions (water content and density).

Q. 29: To your knowledge, who is working on the PFS soil-cement program?

A. 29: (SFB) From deposition testimony, it appears that Mr. Paul Trudeau of Stone & Webster was primarily responsible for authoring the description of PFS's soil-

cement program in SAR 2.6-108 through -121 (Rev 22). Trudeau Tr.[2] at 18. Mr. Trudeau also developed the ESSOW No. 05995.02-G010 for the Laboratory Testing of Soil-Cement Mixes between Stone & Webster and AGEC. Id. at 54-55. AGEC has conducted a few tests and reported the results to Mr. Trudeau but most of the AGEC testing program is on hold for now. Trudeau Tr. at 67, 72-73.

(SFB, JKM) PFS may retain Dr. Anwar Wissa to assist it with its soil-cement program but as of the date of his deposition on March 15, 2002, there was no formal agreement between Dr. Wissa and PFS. Wissa Tr.[3] at 42-44; Trudeau Tr. at 89, 110, State's Exh. 108.

Q. 30: How will PFS construct the soil cement in its foundation system?

A. 30: (SFB, JKM) From the deposition testimony it appears that PFS has not yet developed a plan for the specific construction techniques that will be employed in excavating the eolian silts and mixing them soil cement and replacing them. State's Exh. 109, Wissa Tr. at 15-34; State's Exh. 108, Trudeau Tr. at 91-92. Irrespective of the methods that are used, it is important that the native soils upon which the soil cement will be placed not be disturbed as this would likely lead to loss of subgrade support and increased post-construction settlement. If PFS chooses to haul eolian silt off site to a central plant for mixing, the time between mixing the water at the central plant and final compaction could affect the properties of the soil cement. Wissa Tr. at 24.

Q. 31: What effect would there be from potential disturbance or remolding of the native clays?

A. 31: (SFB) As I described in my soils testimony, the engineering properties of the native clays – *i.e.*, upper Lake Bonneville sediments – are very important because PFS relies on the shear strength of this layer to provide resistance to sliding. Any disturbance or remolding of these clays could substantially decrease their shear strength.

During his deposition testimony, Mr. Trudeau acknowledged that cohesion available in the upper Lake Bonneville sediments is required as part of the design of the pads and that construction equipment and techniques have the opportunity to destroy the surface of the subgrade if PFS is not careful in protecting those soils. State's Exh. 108, Trudeau Tr. at 96.

The SAR at 2.6-108 (State's Exh. 106) describes the following regarding the

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[2] Excerpts from the deposition transcript ("Tr.") of Mr. Paul Trudeau (March 6, 2002) are included as State's Exhibit 108.

[3] Excerpts from the deposition transcript ("Tr.") of Dr. Anwar Wissa (March 15, 2002) are included as State's Exhibit 109.

construction of the soil cement:

> The layer of soil cement beneath the storage pads will have a minimum thickness of 12 inches and a maximum thickness of 24 inches. In the event the eolian silt layer extends to a depth greater than 2 ft below the elevations of the bottoms of the storage pads, compacted clayey soils will be used to raise the elevation of the subgrade that will support the soil cement layer to an elevation of 2 ft or less below the design elevations of the bottoms of the pads.

Mr. Trudeau estimated that only about two percent of the entire pad area would need to be recompacted with compacted clayey soil. Trudeau Tr. at 33-34, 97-99, State's Exh. 108.

There is insufficient evidence to suggest that only two percent of the site will be affected. In any event, recompacted clay will have a decrease in shear strength from the design values PFS is relying upon for the native soils. PFS is again constrained by Holtec's cask tipover analysis because PFS cannot construct cement-treated soil that is deeper than two feet without exceeding Holtec's bounding conditions on cask tipover. Therefore, PFS must use recompacted and remolded clays.

(SFB, JKM) Another way in which there can be remolding of native clays is from traffic and heavy construction equipment disturbing the crust of the clays. Even small disturbances could cause a decrease in shear strength.

Q. 32: Are there any concerns about the potential changes in moisture content of the clays, and if so, what are they?

A. 32: (SFB, JKM) Yes. When clays gain moisture they soften and there is a decrease in their undrained shear strength. PFS is only testing undrained shear strength of samples at their moisture content as collected from the site. When a cement cap – such as the storage pads – is placed over cement-treated soils and the native soils, there is a potential to increase the moisture content of the native soils.

Experience has shown in conditions such as those at the PFS site you can accumulate water beneath the paved area. This will have a detrimental consequence on the engineering properties of the clay layer.

Changes in moisture content can occur from upward migrating moisture that can no longer evaporate because of the sealed surface above. You do not need to have saturated conditions to cause changes in moisture content of the native soils. By changing the evapo-transpiration environment of the soils, you can actually change the moisture content, and, therefore, the strength of those soils. Moisture that is already present in the soil will likely be

redistributed until a new equilibrium is established.

Precipitation, runoff and construction activities could also cause a change in the moisture content of the native soils.

Q. 33: Please describe PFS's soil cement program.

A. 33: (SFB) The PFS soil cement program is described in SAR 2.6-108 through -121 (Rev 22) and the ESSOW between Stone & Webster & AGEC (State's Exhs. 106 and 107, respectively). Trudeau Tr. at 88-89, State's Exh. 108. The ESSOW calls for AGEC to complete the testing program in 13 months. State's Exh. 107 at 5.5. AGEC starting the testing program in about March 2001. Trudeau Tr. at 71-72. To date, AGEC has completed Phase1 (indexing property) and Phase 2 (moisture density) testing. PFS experienced problems with Phase 3 testing for durability and placed the entire testing program on hold. Trudeau Tr. at 72, 110.

Q. 34: Will the tests that PFS has conducted to date prove its design concept?

A. 34: (SFB) No. There are several tests that PFS says it will conduct in the future, most likely after PFS obtains a license from NRC. First, PFS must re-do the failed durability tests. The durability tests are to show that the soil cement around the pads and CTB can withstand freeze/thaw wet/dry cycles and will take approximately two months to complete. The next tests will be the compressive tests to show what mix of Portland cement PFS needs to add to the silts to obtain 250 psi for the soil cement around the pads and around the CTB. Moduli testing of the cement-treated soil to determine whether PFS could achieve a mix that complies with the limitations of the 75,000 psi Young's modulus could be conducted in parallel with the compressive tests. These two phases of testing would take about 2 to 3 months. Trudeau Tr. at 77-81, State's Exh. 108. Thus, there is about 4 to 5 months of testing to be completed before PFS can determine whether it has the correct "recipe" for the soil cement and whether it can concoct a cement-treated soil mix that will not exceed 75,000 psi.

This is not the end of the soil cement program. Next PFS will have to conduct interface strength tests and a bonding study to determine whether there is sufficient adhesion between the cement-treated soil with both the underlying native soils and the bottom of the concrete storage pads. Trudeau Tr. at 80-81. Mr. Trudeau admitted than only then will PFS have proven the design. Trudeau Tr. at 81

Even if PFS does complete all the tests described above, there still will not be proof of the design concept. As described in greater detail in the dynamic analysis testimony that I have presented with Dr. Ostadan, there could be cracking of the cement-treated soil under the pads and separation of the soil cement around the pads and the CTB. In other words,

PFS has not shown that the use of soil cement and cement-treated soil will provide an acceptable seismic design for Skull Valley site where up to 4,000 spent nuclear fuel casks will be stored.

Q. 35: Does this conclude your testimony?

A. 34: (SFB, JKM) Yes.

JAMES KENNETH MITCHELL
University Distinguished Professor, Emeritus
Virginia Polytechnic Institute and State University, Blacksburg, Virginia
Consulting Geotechnical Engineer

Dr. James K. Mitchell received his Bachelor of Civil Engineering Degree from Rensselaer Polytechnic Institute in 1951, Master of Science Degree from the Massachusetts Institute of Technology in 1953, and the Doctor of Science Degree, also from M.I.T., in 1956.

He joined the faculty of the University of California, Berkeley in 1958 and held the Edward G. Cahill and John R. Cahill Chair in the Department of Civil Engineering at the time of his retirement from Berkeley in 1993. Concurrently he was Research Engineer in the Institute of Transportation Studies and in the Earthquake Engineering Research Center. He developed and taught graduate courses in soil behavior, soil and site improvement, and foundation engineering as part of the Geotechnical Engineering Program within the Civil Engineering Department. He served as Chairman of the Department of Civil Engineering from 1979 through 1984. He was appointed the first Charles E. Via, Jr. Professor in the Via Department of Civil Engineering at Virginia Tech in 1994, University Distinguished Professor in 1996, and University Distinguished Professor, Emeritus, in 1999.

His primary research activities have focused on experimental and analytical studies of soil behavior related to geotechnical problems, admixture stabilization of soils, soil improvement and ground reinforcement, physico-chemical phenomena in soils, the stress-strain time behavior of soils, in-situ measurement of soil properties, and mitigation of ground failure risk during earthquakes. He supervised the dissertation research of 72 Ph.D. students. He has authored more than 350 publications, including two editions of the graduate level text and reference, "Fundamentals of Soil Behavior," and several state-of-the-art papers and guidance documents on soil stabilization, ground improvement, and earth reinforcement. During the 1960's and early 1970's he served as the NASA Principal Investigator for the Soil Mechanics Experiment, which was a part of Apollo Missions 14-17 to the Moon.

State's
Exhibit 105

Dr. Mitchell serves as a consultant on geotechnical problems and earthwork projects of many types, especially soil stabilization, ground improvement for seismic risk mitigation, earthwork construction, and environmental geotechnology, to numerous governmental and private organizations, both nationally and internationally. Recent and currently active projects include the evaluation of seismic stabilities and design of liquefaction mitigation options for Success Dam in California (U.S. Army Corps of Engineers) and Pineview and Deer Creek Dams in Utah (U.S. Bureau of Reclamation), peer reviewer for geotechnical design and construction issues in the proposed depressed Reno Rail Corridor (Kleinfelder), ground improvement aspects of the Port of Oakland Wharf and Embankment Strengthening Program (Harding Lawson Associates), ground improvement and fill stabilization for the proposed San Francisco Airport Expansion (Fugro West), design review – ground improvement for the I-95/Rt.1 Interchange section of the Woodrow Wilson Bridge replacement project (Haley & Aldrich, Virginia Geotechncial Services, URS, HNTB), and the Embankment Technical Review Board for the Third Runway at Seattle-Tacoma International Airport.

He is licensed as a Civil Engineer and as a Geotechnical Engineer in California, and as a Professional Engineer in Virginia. He is a Fellow and Honorary Member of the American Society of Civil Engineers. He served as Secretary (1966-69), Vice-Chairman (1970), and Chairman (1971) of the Geotechnical Engineering Division of ASCE and as Chairman of the United States National Committee for the International Society for Soil Mechanics and Foundation Engineering. He was Chairman of the ASCE Committee on Soil Properties and Chairman of the Committee on Placement and Improvement of Soils, as well as a member of the Environmental Geotechnics Committee. He served as President of the San Francisco Section of ASCE and Chairman of the California State Council of ASCE during 1986-87. He was Chairman of the Transportation Research Board Committee on Physico-Chemical Phenomena in Soils from 1966-1973, and was a member of the TRB Executive Committee from 1983-1987. He was Chairman of the Geotechnical Board of the U.S. National Research Council from 1990 through 1994. He recently completed service as Vice Chair of a NRC study committee for development of science needs for remediation of contaminated Department of Energy weapons

sites. He now is a member of a NRC study committee to advise the Department of Energy on Remediation Science and Technology for the Hanford Site. He was Vice President of the International Society for Soil Mechanics and Foundation Engineering from 1989-1994.

Dr. Mitchell was awarded the Norman Medal in 1972 and 1995, the Thomas A. Middlebrooks Award (three times), the Walter L. Huber Research Prize and the Karl Terzaghi Award, all from the American Society of Civil Engineers; the Distinguished Teaching Award and the Berkeley Citation from the University of California; the Western Electric Fund Award of the American Society for Engineering Education; the Medal for Exceptional Scientific Achievement from the National Aeronautics and Space Administration, and has been selected as the recipient of the 2001 Kevin Nash Gold Medal of the International Society for Soil Mechanics and Geotechnical Engineering. He was elected to the United States National Academy of Engineering in 1976 and to the U. S. National Academy of Sciences in 1998.

Lists of projects and publications are available on request.

April 2001

MS. CHANCELLOR: There are certain exhibits to the testimony. Exhibit 105 is the curriculum vitae of James Kenneth Mitchell. I'll go through them all and move them all in and then see if there are any objections.

CHAIRMAN FARRAR: All right.

MS. CHANCELLOR: One, oh, six are portions from PFS SAR, Section 2.6.4.11, Revision 22.

I'll skip 107 for the moment, Your Honor. There may be a problem with that.

One, oh, eight, excerpts from a transcript of a deposition of Paul J. Trudeau, dated March 6, 2002.

One, oh, nine are excerpts from a deposition of Dr. Wissa, dated March 15, 2002.

And I would move that Exhibits 105, 106, 108 and 109 be bound into the record.

CHAIRMAN FARRAR: Or admitted?

MS. CHANCELLOR: Be moved into evidence.

CHAIRMAN FARRAR: ny objection on any of these?

MR. TRAVIESO-DIAZ: No.

MR. O'NEILL: No, Your Honor.

CHAIRMAN FARRAR: All right. Then 105, 106, 108 and 109 will be admitted.

(Whereupon, the documents referred to were marked as State's Exhibit Nos. 105, 106, 108, and 109 for identification and were received in evidence.)

CHAIRMAN FARRAR: What do you want to do with 107, Ms. Chancellor?

MS. CHANCELLOR: One, oh, seven, if you will recall, Your Honor, we submitted this as a confidential document because that's how we received it from PFS. PFS has since removed the confidentiality claim on this document.

And while it is duplicative of PFS' GGG, as it's referred to in Dr. Bartlett and Dr. Mitchell's testimony, I would request that this also be -- that 106 nevertheless be admitted into evidence.

CHAIRMAN FARRAR: One, oh, seven?

MS. CHANCELLOR: One, oh, seven.

CHAIRMAN FARRAR: I take it this is referred to in their testimony.

MS. CHANCELLOR: It's actually a PFS Exhibit GGG. We both filed the same exhibit.

CHAIRMAN FARRAR: No, but in --

MS. CHANCELLOR: Oh, in --

CHAIRMAN FARRAR: -- in Dr. Bartlett's and

Dr. Mitchell's testimony they refer to 107 rather than GGG?

MS. CHANCELLOR: That is correct, Your Honor.

Same objection from the parties; same ruling by the Board?

MR. TRAVIESO-DIAZ: Well, let me clarify, however, Exhibit GGG is properly on the record now, has been admitted with all of the proprietary markings removed. My problem with State Exhibit 107 is that it shows those markings.

I am willing to stipulate for the record that wherever they refer to State Exhibit 107, the reference should be read as meaning Applicant Exhibit GGG, but I would object to having State 107 because it appears that we have let a proprietary document in the record.

CHAIRMAN FARRAR: Yeah.

MS. CHANCELLOR: I have another suggestion, Your Honor. We'll take PFS' new Exhibit GGG and substitute that for State's Exhibit 107, without the proprietary marketings.

MR. TRAVIESO-DIAZ: We end up then with a duplicative exhibit. I just don't see the point on that.

CHAIRMAN FARRAR: How many -- where in the written testimony?

MS. CHANCELLOR: It's footnote on page 5, and it's Footnote 1 on page 5, as well as the second paragraph of --

CHAIRMAN FARRAR: Wait a minute.

MS. CHANCELLOR: -- AH.

CHAIRMAN FARRAR: Footnote on five?

MS. CHANCELLOR: As well as the text on five.

CHAIRMAN FARRAR: Right. There's one on 13, Answer 33.

MS. CHANCELLOR: You're faster than I am. That's correct. Just those two places, I think.

CHAIRMAN FARRAR: Given the problems that either proprietary documents or documents that look like they're proprietary, even if they aren't, given the problems that causes, let's go to Plan B here, and you all can make sure in your written proposals, and we will make sure in our opinion that we footnote this and indicate that anything in this testimony that refers to State Exhibit 107 is now taken as a reference to PFS GGG.

MS. CHANCELLOR: Is it too late to change the testimony that's being bound into the record?

CHAIRMAN FARRAR: No. You gave the reporter three copies?

MS. CHANCELLOR: I have given her three copies of the testimony and of 107.

CHAIRMAN FARRAR: But why don't you before we leave tonight just interlineate that in the three copies the several places we've noted?

MR. TRAVIESO-DIAZ: Also, Your Honor, and this is only a technicality, but Footnote 1 refers to the document being confidential being filed separately, and so on. I would suggest that that footnote needs to be changed as well.

The footnote could be deleted actually.

CHAIRMAN FARRAR: Yes. Good idea. We'll delete the footnote, change the three or four references in the text. Just handwrite those in, and then with the steps we'll take later, there won't be any confusion.

And so then there is now both -- well, State Exhibit 107 will not be admitted.

MS. CHANCELLOR: That's correct.

The witnesses are now available for cross examination, Your Honor.

CHAIRMAN FARRAR: All right.

MS. CHANCELLOR: The witnesses are not

available for cross examination, Your Honor.

CHAIRMAN FARRAR: All right. How much time do you need, Mr. Diaz?

MR. TRAVIESO-DIAZ: Well, I expect that I will be finished with these witnesses by lunch time tomorrow. It is going to take me approximately three hours.

CHAIRMAN FARRAR: Where do we stand on two things, first we started a little late, today. We could either argue that we would go a little late, past five. But you all, particularly the State, did a lot of moving over the weekend, to get themselves here.

So if you want to adjourn, and --

MS. CHANCELLOR: I'm happy to stay at it, Your Honor. I'm just concerned that we are going to get everything done this week, and I would rather put in the extra time.

CHAIRMAN FARRAR: Well, that was my second question. Where, in terms of the outline you gave us this morning of what we hope to accomplish this week, are we ahead, or behind where you had hoped we would be at 10 of 5 today?

MR. TRAVIESO-DIAZ: I think we are slightly behind, but not seriously so. I would have

expected to start with this witness like at 3 p.m., that was my calculation.

CHAIRMAN FARRAR: But all you wanted to do was finish them by tomorrow night, is that not right?

MR. TRAVIESO-DIAZ: That is correct.

CHAIRMAN FARRAR: Well, that is what you told me, that you had these witnesses for Monday and Tuesday.

MS. CHANCELLOR: That is correct. There was a hope that we might get to them, finish by noon tomorrow, because we have, Mr. Trudeau has some rebuttal left over from Section D, and that may promote rebuttal by our witnesses.

CHAIRMAN FARRAR: I got you.

MS. CHANCELLOR: And then we don't know how long the Luk testimony will take, rebuttal.

CHAIRMAN FARRAR: How much cross will the Staff have of these witnesses?

MR. O'NEILL: Your Honor, I have two and a half pages of questions. Of course it is conceivable that some of them will be answered. An hour to two, tops.

CHAIRMAN FARRAR: All right.

MR. O'NEILL: I don't want to shortchange myself.

(Pause.)

CHAIRMAN FARRAR: Let's see how much we can get done by 5:30, and that is not an encouragement, Mr. Travieso-Diaz for you to talk fast.

MR. TRAVIESO-DIAZ: I was going to promise to talk fast.

CHAIRMAN FARRAR: But let's see what we can get done, but keep an eye on your watch, and when you reach a stopping point, a break in topics, let us know, and we will adjourn some time before 5:30.

MR. TRAVIESO-DIAZ: Thank you.

CROSS EXAMINATION

MR. TRAVIESO-DIAZ: Good afternoon, gentlemen.

DR. BARTLETT: Good afternoon.

DR. MITCHELL: Good afternoon.

MR. TRAVIESO-DIAZ: My name is Matias Travieso-Diaz, I'm an attorney representing PFS in this Proceeding.

I'm going to be asking you, today, and perhaps tomorrow, some questions with respect to what has been identified as the soil cement portion of subsection C-3 of contention LL-QQ in this Proceeding.

Since you are testifying today as a panel, I will be directing questions to one of you, or the

other, and I will ask that the person that I ask the question to answer it first. If the other person perhaps has something to add, that may be appropriate.

But in any event I would ask that the person that I ask the question to be the first one to answer. And sometimes I may ask the question of both of you, in which case either of you can answer, or both.

The only thing that I ask is that you don't talk to each other while a question is pending. Is that correct, understood? That you don't talk to each other while a question is pending. Is that understood?

While a question is still on the floor, and it is unanswered, I'm asking that you don't confer with each other.

DR. MITCHELL: Yes.

DR. BARTLETT: Yes.

MR. TRAVIESO-DIAZ: Let me ask a few preliminary questions of both of you. Are you aware that the Applicant, and the NRC Staff, have filed direct testimony for this hearing on the soil cement issue, or portion of Section C of contention L/QQ?

DR. MITCHELL: Yes.

DR. BARTLETT: Yes.

MR. TRAVIESO-DIAZ: And this is for you, Dr. Mitchell. Have you reviewed that testimony filed by the Applicant and the NRC Staff?

DR. MITCHELL: Yes.

MR. TRAVIESO-DIAZ: And have you had occasion to review the transcripts of the other testimony previously given by the Applicant, the Staff, and the State witnesses, in the prior seismic hearings in Salt Lake City?

DR. MITCHELL: No.

MR. TRAVIESO-DIAZ: You have reviewed, however, the testimony that has been prefiled by the other parties on this issue, and you sat today while they testified, is that correct?

DR. MITCHELL: Yes.

MR. TRAVIESO-DIAZ: And, of course, Dr. Bartlett, you have been in the same condition, only more, because you have sat through this hearings, haven't you?

DR. BARTLETT: Yes.

MR. TRAVIESO-DIAZ: Is there anything that you have read, or heard, given by the other parties, that would cause you to want to change or modify any portion of the testimony that you presented as your prefile direct testimony?

DR. BARTLETT: The only thing I'm aware of is some more thermal calculations have been done that I haven't seen, or reviewed, regarding the thermal gradients underneath the pads, and in the Bonneville clay.

But I don't think I will change an opinion, yet, until I've heard that presented and reviewed it.

MR. TRAVIESO-DIAZ: But, so at this point you are not going to make, or don't think you need to make any changes to your testimony, is that right?

DR. BARTLETT: Not at this point.

MR. TRAVIESO-DIAZ: How about you, Dr. Mitchell?

DR. MITCHELL: Not at this point.

MR. TRAVIESO-DIAZ: Dr. Bartlett, talking about the Utah hearings, a few days ago I asked you whether you consider yourself a soil cement expert. And you deferred to Dr. Mitchell in those issues, although later you clarified that your contribution to soil cement was to discuss how it would perform seismically, is that correct?

DR. BARTLETT: Yes. To understand the soil cement and its application for resisting sliding, overturning, bearing capacity during a seismic event.

MR. TRAVIESO-DIAZ: Thank you. Now, when I took, I took the depositions of both of you at various points in March. And both of you indicated that you had not performed any analysis, calculations, or tests, in connection with soil cement issues.

Is that still the case?

DR. BARTLETT: That is correct.

MR. TRAVIESO-DIAZ: How about you?

DR. MITCHELL: You are referring to with respect to this project?

MR. TRAVIESO-DIAZ: To the soil, yes, to this project.

DR. MITCHELL: That is correct.

MR. TRAVIESO-DIAZ: I would like Dr. Mitchell, as we said, I took your deposition back in March. I would like to mark for, as Applicant's PFS exhibit 228, the transcript of that deposition.

MR. TRAVIESO-DIAZ: While this document is being distributed let me advise the Board what my intent here is. I intend, from time to time, to refer to Dr. Mitchell's deposition, to summarize some of the views that he presented there.

And these views are offered in more detail in the deposition itself. But what I intend to do is to try to summarize some of those views, at this

point, with the witness. And I think that that will be efficient in terms of saving time during the cross examination.

CHAIRMAN FARRAR: The Reporter will mark, and this is the entire deposition, not excerpts?

MR. TRAVIESO-DIAZ: Yes, it is.

CHAIRMAN FARRAR: The reporter will mark Dr. Mitchell's deposition as PFS exhibit 228 for identification.

(Whereupon, the above-referenced to document was marked as PFS Exhibit No. 228 for identification.)

DR. MITCHELL: May I ask a question?

CHAIRMAN FARRAR: Certainly.

MR. MITCHELL: I was sent a preliminary small version of the transcript, and asked to go through it, and correct any changes, which I did, and returned.

But I have not seen the transcript of the deposition since. So is it safe to assume that the corrections I made are in this version?

MR. TRAVIESO-DIAZ: I'm afraid that it is not safe to assume so. So I would encourage you, when I refer you to portions of the transcript, if what it

says in this exhibit is incorrect, would you make a correction at that time.

CHAIRMAN FARRAR: Dr. Mitchell, do you -- did you happen to keep a copy of the changes you sent in, in that little transcript?

DR. MITCHELL: I'm looking.

CHAIRMAN FARRAR: Look hard.

JUDGE LAM: And, Mr. Travieso-Diaz, do you have an extra copy for our law clerk?

MR. TRAVIESO-DIAZ: Yes.

MS. CHANCELLOR: Your Honor, I've got a copy of the changes that Dr. Mitchell made, if I could give them to him?

CHAIRMAN FARRAR: All right.

MR. GAULKER: I would suggest that we mark that as 228A so all the changes are part of the record, as well as the deposition itself, so that there be no confusion later on.

CHAIRMAN FARRAR: Why don't you give him that now, and maybe overnight we can get copies of that made.

MS. CHANCELLOR: PFS may borrow my copy and make copies, if they wish.

CHAIRMAN FARRAR: That is a fair deal.

MR. GAULKER: Could we go off the record

for a moment?

CHAIRMAN FARRAR: Yes.

(Whereupon, the above-entitled matter went off the record at 5:02 p.m. and went back on the record at 5:03 p.m.)

CHAIRMAN FARRAR: Let's proceed as planned. We will go ahead with the questioning now. Mr. Travieso-Diaz, why don't you ask questions based on the old one, and Dr. Mitchell, you answer based on the corrections you sent in, point those out, where the correction is significant.

And then by tomorrow we will have the corrected version also marked.

MR. TRAVIESO-DIAZ: Also to avoid potential problems I'm going to try to refrain from referring to this exhibit as much as I can today, and save it for tomorrow.

CHAIRMAN FARRAR: Okay.

MR. TRAVIESO-DIAZ: Dr. Mitchell, you told me, when I took your deposition back in March, that you had never visited the site. Is that still correct?

DR. MITCHELL: That is correct, I have not visited the site.

MR. TRAVIESO-DIAZ: Okay. What

involvement, Dr. Mitchell, have you had with this licensing proceedings, since I took your deposition last March?

DR. MITCHELL: The only involvement since last March is to go through the transcript, and to be sent copies, work on the testimony that has now been admitted here, and be sent copies of that, prior to coming here.

And I was sent two or three of the Applicant's documents over the weekend.

MR. TRAVIESO-DIAZ: When you say you reviewed the transcript, you mean the deposition transcript, exhibit 228?

DR. MITCHELL: Yes.

MR. TRAVIESO-DIAZ: You did not review any other transcripts, other than that?

DR. MITCHELL: Well, I was sent Dr. Wissa's transcript, and I'm trying to think if since then I've been sent any of the others. I don't believe so. I've scanned through them.

MR. TRAVIESO-DIAZ: Would you turn to your prefiled direct testimony, Dr. Mitchell? And turn to question and answer number 5, which is on page 3.

DR. MITCHELL: Yes.

MR. TRAVIESO-DIAZ: Okay. If I understand

the question and the answers given there, you indicate that the purpose of your testimony is to explain the basis for a five part professional opinion that you are rendering on the proposed use of soil cement at the PFS site, is that correct?

DR. MITCHELL: Yes.

MR. TRAVIESO-DIAZ: And since you are giving this testimony, together with Dr. Bartlett, is there any part of those opinions that are not yours, were only Dr. Bartlett's?

DR. MITCHELL: May I take a minute to read it, please?

MR. TRAVIESO-DIAZ: Please.

(Witness reviews document.)

DR. MITCHELL: Those purposes are consistent with my involvement.

MR. TRAVIESO-DIAZ: All right. Now, taking a look at just parts 1 and 2, of the opinions that are presented in answer 5, would it be fair to paraphrase those opinions as saying that the use that PFS intends to give to soil cement at the PFS facility is a new and unique application of this technology for which there is no precedent?

MS. CHANCELLOR: Objection, the testimony is what the testimony is.

CHAIRMAN FARRAR: He asked if it was fair to paraphrase it, and either it is, or it isn't.

MR. TRAVIESO-DIAZ: It is either fair or not.

DR. MITCHELL: It is fair, keeping in mind this is to the best of my knowledge.

MR. TRAVIESO-DIAZ: I take it that based on your knowledge you don't agree with the opinions that have been expressed, including today, by Mr. Trudeau and Dr. Wissa, and Dr. Ofoegbu, as to the fact that their opinion is that there is precedent for the use of soil cement in the manner that it is intended to be used at the PFS?

DR. MITCHELL: I'm not aware of a precedent for use of soil cement under seismic loading conditions in the manner that it is being proposed for this particular site.

MR. TRAVIESO-DIAZ: I would like to turn your attention, for a second, to your deposition transcript, exhibit 228, and to page 43.

And I will note, for the record, that the correction sheet that we received, which -- let me strike that question and start over again.

I am having distributed, and I would like to mark for identification as PFS exhibit 228A, a copy

of the transcript corrections that Dr. Mitchell provided.

(Whereupon, the above-referenced to document was marked as PFS Exhibit No. 228A for identification.)

MR. TRAVIESO-DIAZ: Now, first looking at what is now exhibit 228A, which are the transcript corrections --

MS. CHANCELLOR: Excuse me, I didn't get a copy. I got my own copy back, but I didn't get a copy of --

MR. TRAVIESO-DIAZ: Let me try again.

CHAIRMAN FARRAR: You want marked as?

MR. TRAVIESO-DIAZ: As 228A.

CHAIRMAN FARRAR: As 228A these three pages of --

MR. TRAVIESO-DIAZ: They are double sided, so it is actually six pages.

CHAIRMAN FARRAR: -- corrections. So this is what we were talking about a few minutes ago, as opposed to a transcript that had markings on the transcript?

MR. TRAVIESO-DIAZ: Let me ask a clarifying question of the witness.

Dr. Mitchell, would it be your understanding that exhibit 228, which is the original transcript, as corrected by the document that has been marked 228A, represents your testimony at the deposition that I took?

DR. MITCHELL: Yes.

CHAIRMAN FARRAR: And just so I'm doubly clear. Dr. Mitchell, this document is what you were referring to before, when you said you marked up something and sent it in, you did not mark up the transcript itself and sent it in, you made these notations and sent that in?

DR. MITCHELL: Yes. I was sent these forms, so I did that.

CHAIRMAN FARRAR: No criticism, I just want to make sure we know what we are talking about. Okay, fine.

MR. TRAVIESO-DIAZ: Let me go back to the question I was going to ask.

First, take a look at exhibit 228A, which are the corrections. I don't see there, any correction for page 43, is that correct?

DR. MITCHELL: Correct.

MR. TRAVIESO-DIAZ: So the transcript in 228 of what is said on page 43 is accurate as it

reads?

DR. MITCHELL: Yes.

MR. TRAVIESO-DIAZ: Okay. Now, on -- I asked you, on page 43, whether you attach any significance to your conclusion that the use of soil cement in the manner proposed by PFS was a new application.

And you said, and I'm reading from line 16, I'm not sure that there is any significance. We are always finding new applications for our materials. I don't see anything inherently wrong with the basic concept that is being proposed here.

Is this still your view?

DR. MITCHELL: Yes.

MR. TRAVIESO-DIAZ: Thank you. Would it be a correct way to characterize your view, your opinion, to say that you believe that the use that PFS intends to make of soil cement is new, or you don't see anything wrong with being new, not with the concept itself, that PFS intends to implement?

DR. MITCHELL: I think that the concept is okay, but it is based on the assumption of certain properties and behavior. And these properties and behavior have not yet been demonstrated.

MR. TRAVIESO-DIAZ: So would it be fair to

say that you think that -- you don't see anything wrong with the concept, but you would like to see it demonstrated by testing?

DR. MITCHELL: I think it is prudent to demonstrate the properties that are going to be relied upon can indeed be obtained.

MR. TRAVIESO-DIAZ: Okay. And your understanding of the PFS design concept that you think is okay is as described by Dr. Bartlett in the answer to question 7? That is on page 4 of your testimony.

DR. MITCHELL: This answer to question 7 is Dr. Bartlett's answer, not mine.

MR. TRAVIESO-DIAZ: Yes. My question is, when you said that you think that your view is that the concept, the design concept that PFS wants to implement using soil cement, is in principle correct, but you would like to see it shown by testing.

That design concept is it properly described in Dr. Bartlett's answer?

DR. MITCHELL: Oh, I see. To my understanding, yes.

MR. TRAVIESO-DIAZ: All right. Go back to, if you will please, to answer 5 on page 3. Moving to the third part of your opinion, again, would it be fair to summarize that view as saying that you believe

it will be necessary to conduct site-speCIfic testing to verify that the soil cement that PFS intends to use, meets the intent of the design?

DR. MITCHELL:. Yes, I think that is fair, that it would be, again, a prudent thing to do, once it is determined that the properties that are required can be obtained in the laboratory, to go to the field and demonstrate that the construction procedures that are proposed will give the result that is being called for.

MR. TRAVIESO-DIAZ: Dr. Mitchell, for your convenience, I'm having handed to you a copy of the prefiled direct testimony of Dr. Wissa and Mr. Trudeau, and exhibits.

Would you take a look at exhibit JJJ, which is part of the testimony? And that exhibit is section 2.64.11 of the PFSF safety analysis report. Are you familiar with this document?

DR. MITCHELL: I think I have seen it, yes.

MR. TRAVIESO-DIAZ: What is your understanding of the purpose of this document?

DR. MITCHELL: It describes what they intend to do in constructing the soil cement.

MR. TRAVIESO-DIAZ: Does it also describe

how PFS intends to qualify the soil cement mixture, or mixtures, for use?

MS. CHANCELLOR: Dr. Mitchell, you should take whatever time you need to review the document.

MR. TRAVIESO-DIAZ: Yes, please.

(Witness reviews document.)

DR. MITCHELL: How many pages are you asking me to review?

MR. TRAVIESO-DIAZ: Well, I asked you a specific question, which was, is it your understanding that this document presents -- you talk about constructing the soil cement. Does it also present PFS' intended approach to testing the soil cement for qualifying it for use?

DR. MITCHELL: It says that the required characteristics of the soil cement will be engineered during detail design, which I interpret to mean that design that is determined the 40PSI compressive strength for the cement treated soil, with a modulus upper bound of 75,000 PSI. And the 250 PSI compressive strength for the soil cement.

Then it talks about the excavation, and mixing the cement to the design elevations and storage pads, the thickness of the pads. The control, so it doesn't exceed two feet in thickness.

It describes what the construction procedure will be, and the properties that the materials should have, but I haven't yet found here where it says when they are going to determine them, or how they are going to determine them.

MR. TRAVIESO-DIAZ: All right. Let me ask you, specifically, since you have taken the time to review this. Would you turn your attention to page 2.6-117 of exhibit JJJ?

CHAIRMAN FARRAR: Before you do that, counsel, Dr. Mitchell, had you reviewed this before?

DR. MITCHELL: I think I have read through it before.

CHAIRMAN FARRAR: But this is a fairly lengthy document. Before you answer a lot of questions do you need more time to review it?

DR. MITCHELL: Yes. I know that I have seen it before.

MR. TRAVIESO-DIAZ: Okay. Let's do this, Your Honor. I'm going to ask him one more question on this document tonight, give him the opportunity to review it overnight, and perhaps we will have more questions tomorrow, that way he won't have to spend a lot of time looking through it, and trying to find stuff.

CHAIRMAN FARRAR: All right, let's proceed that way.

MR. TRAVIESO-DIAZ: On the question that I have pending, if you would look at page 2.6-117 of exhibit JJJ.

DR. MITCHELL: Yes.

MR. TRAVIESO-DIAZ: Is it your reading of the document, indicate to you that this page describes the techniques that PFS intends to use to install the soil cement, and the cement treated soil at the facility?

It starts on page 2-117, and it goes into the next two pages.

DR. MITCHELL: It seems to describe, it describes the procedures.

MR. TRAVIESO-DIAZ: Okay. Starting on page, looking at the last paragraph on page 2.6-117, the paragraph that starts with the words "The design", do you see that?

DR. MITCHELL: Yes.

MR. TRAVIESO-DIAZ: That paragraph references the state of the art report on soil cement issued by the American Concrete Institute, or ACI, in 1998, as providing the basis for the mix proportioning, testing, construction, and quality

control of soil cement. Is that right?

DR. MITCHELL: Yes.

MR. TRAVIESO-DIAZ: And would you take a look at exhibit HHH in that package, and confirm for me that exhibit HHH is the state of the art report on soil cement, that is referenced on page 2.6-117 of the safety analysis report?

DR. MITCHELL: It probably is the same. The one in exhibit HHH is reapproved 1997, the reference on page 2.6-117 says ACI 1998.

MR. TRAVIESO-DIAZ: Yes. We don't have that list of references here, but I would represent to you that that is just a different publication dates. But, again, we can confirm that at a later time, if necessary.

Do you have any doubt that it is the same document?

DR. MITCHELL: I think it is the same document, yes.

MR. TRAVIESO-DIAZ: Okay. Now, do you agree, or do you believe that it is appropriate for PFS to follow the guidance of the state of the art report on soil cement with respect to the various aspects of the soil cement program described in page 2.6-117 of this --

DR. MITCHELL: Well, I think that this is a fine reference to be used as a basis for preliminary analysis and design.

MR. TRAVIESO-DIAZ: Okay. You turn to the next page now, 2.6-118. I'm going to ask you about the first paragraph that has a bullet, and the header, soil-cement mix and procedure development.

MS. CHANCELLOR: Your Honor, I thought Mr. Travieso-Diaz was going to ask one question. Dr. Mitchell, if you, as Judge Farrar mentioned, if you need to sit and study this, if you haven't seen it for some time, maybe these should be deferred until tomorrow?

MR. TRAVIESO-DIAZ: Actually, Mr. Chairman, this may be a good breaking point, because I'm going to have several more questions on this document, and it might be inefficient to spend everybody's time here waiting.

CHAIRMAN FARRAR: Now, that is a good idea. Do you have any other documents you are going to ask him about tomorrow, that might fit into the same category, where having him review them tonight would be an advantage?

MR. TRAVIESO-DIAZ: I think it might be convenient, Dr. Mitchell, if you look at the exhibits

to Mr. Trudeau and Dr. Wissa's testimony, GGG, HHH, III you don't need to look at, and JJJ, because I may have, during the course of my questions to you, refer to those from time to time.

DR. MITCHELL: Okay.

CHAIRMAN FARRAR: We appreciate your willingness to do that homework tonight.

If we finish this witness tomorrow, excuse me, after we finish this witness tomorrow, we will then have Mr. Trudeau, and that is the rebuttal that you prefiled with us in Salt Lake City, but we never got to? Is that correct, or is it some other rebuttal?

MS. CHANCELLOR: I've got to get through rebuttal on soil cement first.

MR. TRAVIESO-DIAZ: The order tomorrow will be we will have examination with this witness, then we will have the rebuttal of Dr. Wissa and Mr. Trudeau.

CHAIRMAN FARRAR: Which you had volunteered to do all at once today, but --

MR. TRAVIESO-DIAZ: But we deferred. And we will have additional rebuttal by other parties.

MS. CHANCELLOR: And then there is Dr. Singh, too, that we have to hook in by

videoconference.

CHAIRMAN FARRAR: And at the end you would like to squeeze in Mr. Trudeau, and you would like to squeeze Mr. Trudeau to Salt Lake City?

MR. TRAVIESO-DIAZ: I would like to squeeze Mr. Trudeau whenever it is possible, any time during the week.

CHAIRMAN FARRAR: Okay. Then we all know what is in front of us tomorrow. I encourage counsel to do their homework, and make sure the questions are as sharp and relevant as possible, and non-duplicative.

Is there anything else we can usefully do tonight to prepare for tomorrow, any housekeeping, or other matters that we don't want to have slow us down tomorrow?

MS. CHANCELLOR: Your Honor, can we leave our documents in this room, or should we take them back to our room, our breakout room? Is it okay to leave things on the table, stacked behind us?

CHAIRMAN FARRAR: Okay.

MS. CHANCELLOR: And second question, is the public invited to attend the hearings here?

CHAIRMAN FARRAR: Oh, yes.

MS. CHANCELLOR: They weren't sure

downstairs. We actually have someone who might come and attend.

CHAIRMAN FARRAR: Anyone from the public, downstairs meaning security?

MS. CHANCELLOR: Yes, they weren't sure whether the public would be allowed when we asked about that.

CHAIRMAN FARRAR: I mean, they have to go through normal security. It means they just have to sign in, say who they are going to see, someone has to escort them.

MS. CHANCELLOR: The security personnel weren't aware whether this hearing was open to the public. And I told them it probably was, but maybe someone needs to advise them.

CHAIRMAN FARRAR: Mac, can you have somebody get the word to them, please?

MR. TRAVIESO-DIAZ: Mr. Chairman, I just want to clarify, on the record, in the perhaps unlikely event that we have time left over tomorrow afternoon, would the plan be to proceed with Mr. Trudeau's pending rebuttal from section B?

MS. CHANCELLOR: Probably.

MR. TRAVIESO-DIAZ: Well, the only reason I'm asking is I need to prepare documents and other

things that we may need to bring to the Board's attention. So I need to be prepared one way or the other.

CHAIRMAN FARRAR: It is an ambitious schedule. It sounds like an ambitious schedule tomorrow, but --

MR. TRAVIESO-DIAZ: But in the event that there is time to, I understand that the State has a few questions for Mr. Trudeau, so it would be great if we could get that portion of the section B here finalized.

MS. CHANCELLOR: What we had planned to do, Your Honor, was to file some written rebuttal, but I have to rely on Dr. Bartlett for that, and he is on the stand. So that is why I'm hedging a little bit. He also has problems with his computer.

So we will do the best we can.

CHAIRMAN FARRAR: And what do we need to have if we are doing Dr. Singh by video, or teleconference, what documents will we need to have ready?

MR. TRAVIESO-DIAZ: There is only one document which is the thermal analysis. I could, in fact, distribute copies of that document tonight. And that way all the parties will have it. The State has

had it for a week, but the Board hasn't had it.

So perhaps I could hand copies --

CHAIRMAN FARRAR: And do you have any written rebuttal?

MR. TRAVIESO-DIAZ: No. My examination here was going to ask him to identify the document, and when he prepared it, and I will make him available for what his conclusions are, I will make him available for examination.

So my rebuttal testimony will be very brief.

CHAIRMAN FARRAR: Ms. Chancellor, we -- what is your position?

MS. CHANCELLOR: We won't make an argument, Your Honor, with respect to, at this time, with respect to having Dr. Singh offer rebuttal. We will wait to hear what he has to say, and then deal with it, either through objections, or through cross examination.

CHAIRMAN FARRAR: What he is going to say is that he believes in this report, which has just been handed to me, which you apparently have had. So what he is going to say remains a mystery to us at this moment.

You know what he is going to say.

MS. CHANCELLOR: We haven't had the report for a week, I just want to clarify that. But we will be prepared to cross examine him on this report at one o'clock, or one thirty tomorrow.

CHAIRMAN FARRAR: But what I want to know is whether if you anticipate arguing that this is not proper rebuttal? Because if you do anticipate that, I would just as soon have that argument now, rather than tomorrow morning, rather than spend time tomorrow.

MS. CHANCELLOR: I think we have to wait and see what comes up on cross examination of these witnesses.

MR. TRAVIESO-DIAZ: Mr. Chairman?

CHAIRMAN FARRAR: These right here?

MS. CHANCELLOR: These two right here.

MR. TRAVIESO-DIAZ: Mr. Chairman, as long as this --

CHAIRMAN FARRAR: Wait, he would be rebutting --

MS. CHANCELLOR: The State on soil cement, thermal effects of --

MR. TRAVIESO-DIAZ: I don't know that there is much more we can do today. The one thing that I would like to do, given that this document has

already been distributed, is to mark it for identification as PFS exhibit 229.

MS. CHANCELLOR: Your Honor, I think we should hold off. I would like to review the document, I don't see why we need to mark it now. It is rebuttal testimony, we are now in the middle of cross examination of direct testimony, it will just be too confusing.

MR. TRAVIESO-DIAZ: Well, I intend to use this document in cross examination as well, so I think it is in place.

MS. CHANCELLOR: I don't know that you can use this until it has been sponsored by a witness.

MR. TRAVIESO-DIAZ: Well, I beg to disagree, and if you don't like the way I do it, you can object. I would like to have it marked as exhibit 229, please.

CHAIRMAN FARRAR: Well, he is entitled to do that, Ms. Chancellor. He may or may not be entitled to do anything with it, but he is certainly entitled to have it marked, and so we will have it marked as 229 for identification.

(Whereupon, the above-referenced to document was marked as PFS Exhibit No. 229

for identification.)

MS. CHANCELLOR: Your Honor, I would like to place an objection, on the record, that I will object to anything that Mr. Travieso-Diaz asks about these witnesses, with respect to this document, because there is no sponsor of the document, it is not sponsored by Dr. Wissa or Mr. Trudeau, it doesn't form part of PFS' direct testimony, and there is no way to vouch for the reliability of the evidence, of the information.

MR. TRAVIESO-DIAZ: If I may remind counsel that in cross examination you are entitled to bring anything under the sun, to use it and present it to the witness, and what the witness does with that is up to the witness.

It doesn't have to be evidence, it doesn't have to be in the Proceeding, and the fact that there may not be anybody to introduce it into evidence at this point, that doesn't preclude me from asking questions related to it.

CHAIRMAN FARRAR: Mr. Travieso-Diaz you are, I think, entirely correct that you can use this on cross for whatever purpose you want. But when we get to the point of Dr. Singh, you are trying to introduce it through Dr. Singh?

We have, again, stuff showing up very late in the day.

MR. TRAVIESO-DIAZ: Well, that is what happens with rebuttal, Mr.. Chairman. I'm going to do my best to limit the scope of the document being introduced, but in the nature of having to present rebuttal sometimes you have to present materials that you were not planning on using.

And that is the nature of the beast. I will --

CHAIRMAN FARRAR: That raises, again, the question of what can fairly be anticipated in advance, and it runs us into the Contentions Rule, again. And even-handedness.

MR. TRAVIESO-DIAZ: Well, I think that conceptually that could raise that type of issue. I will indicate, for the record, and I think it should be no mystery, this calculation achieves a very simple purpose, which is to quantify the view that, in fact, even Dr. Ofoegbu would testify to that today, that it is black letter technical knowledge that if you have a heat source in the vicinity of materials where moisture can accumulate, that that moisture is going to move away.

All that this calculation does is quantify

the amount of the heat that is available to put into effect that principle.

MS. CHANCELLOR: Your Honor, I would like to note, for the record, that every time the State raises something it goes into a Holtec analysis, and we get it at the last minute.

And this is not, as you note, this is not the first document. Dr. Solar, during the seismic hearings, was cranking out more analysis than we could deal with. And here is another document.

And I would also note that until Dr. Singh sponsors this document, it should be treated as hearsay.

MR. TRAVIESO-DIAZ: Two things, Mr. Chairman. I don't want to get argumentative here. But the reason we had to introduce all the testimony by Dr. Solar at the last hearing, is because we kept on getting new claims raised by Dr. Ostadan at the time.

But putting that aside for the moment, again, hearsay is not an objection to using documents in cross examination.

CHAIRMAN FARRAR: I'm not -- the Board's concern is not the use of it on cross examination, because whatever use you make of it, it will amount to

nothing unless it is later admissible, or sponsored and so forth.

So anything you do with that is subject to being connected up. But it is just -- maybe the introduction of evidence at a trial is -- no, let me not go any further.

MR. TRAVIESO-DIAZ: Mr. Chairman, if I can only offer one thought here? Because the Applicant has the burden of proof, perhaps we tend to put more than we really need.

But the alternative is not tenable. With 99.9999999 percent of the issues, and if we lose on a single one we may have bad consequences. So you have to bear with us to the fact that we may, perhaps, engage in overkill, and putting testimony that perhaps is unnecessary, and perhaps put in late, but I don't have much of a choice.

CHAIRMAN FARRAR: I have no problem with your trial strategy, and approach, and what you just said. I just have a problem reconciling the kind of rulings you want us to make now, with the kind of rulings you wanted us to make against the State over a several year period.

That is my only problem, not with the way you are trying the case. Because you are right, if

you lose on anything you lose, and so you've got to have your case in there.

But the, at some point, in some Proceeding, the rulings that you asked for, for keeping Intervenor's contentions out of the case, are going to have to be applied to your client as well, on the same basis they are applied to the Intervenors.

MR. TRAVIESO-DIAZ: I understand the concern, and I share it. However, you have to keep in mind, also, that at the initial stages of an NRC Proceeding, particularly a complex one like this, there is a potential for having an infinitely unbounded set of issues.

And the purpose of the Contention Rule is to establish a set of agreed-upon issues upon which the parties disagree, so that we can have a road map as to what we are trying to achieve.

Having contentions and limiting when you can have them, and what you need to prove in order to bring new ones in, serves the purpose of keeping a Proceeding from becoming totally amorphous, and extended forever.

So there are different considerations, I would say, although I share your concern of trying to be fair to everybody.

CHAIRMAN FARRAR: Ms. Chancellor could take what you just said, change a few words, and say the same thing about your guys with their computers, and their reports, any time anything is said out comes something new.

And the State wasn't given that opportunity when they wanted to -- and the rulings the Board made followed the Contentions Rule, followed the jurisprudence. But at some point the imbalance becomes very difficult to deal with.

MR. TURK: Your Honor, may I address the issue?

CHAIRMAN FARRAR: Yes.

MR. TURK: I won't comment on the admissibility of a specific document that we are looking at, this document that has been marked for identification as PFS exhibit 229.

But I would like to make two points. First I wasn't present during the testimony on July 3rd and 4th. I'm sorry, June 3rd and 4th, when that other document came forth from Holtec.

But I would have to note my view that we have to be careful not to elevate form over substance. If these documents that bear these Holtec cover sheets instead of coming in as a Holtec analysis, had been

presented as question and answer testimony, then we would look at it to see, is this testimony that addresses an issue that is fairly within the contention?

In other words, it would be evidence, rather than raising a new issue. I think it is important not to rule on documents based upon whether they are in question and answer format, versus some other format.

The issue that has to be addressed is, did the contention raise the issue on which the evidence is being proffered? There is a distinction that we have to make between the Contention Rule, which says only issues that are fairly identified in the Contention are admissible, or may have evidence presented on them, and raising new evidence that addresses an issue presented in the testimony of another witness.

CHAIRMAN FARRAR: Let me interrupt you for a second. When I talk about the Contentions Rule, I'm talking about the late filed aspect of the Contentions Rule, not necessarily the Rule itself.

MR. TURK: The correct ruling on Contentions is, was something raised within the scope of the contention, such that it may be addressed in

testimony.

If an issue was raised in a contention, that is different from saying that new evidence that addresses that issue be admitted in a proceeding. The issues are defined by the Contentions.

If a witness, in its testimony, presents some evidence which another party wishes to rebut, with respect to that admitted issue, that is permissible. The only thing that would not be permissible would be for a rebuttal witness to say, here is testimony on a new issue that was never raised in the Contention itself.

CHAIRMAN FARRAR: Or a new theory. In other words, they shot down my first theory, so here is a new theory. Let's be specific about this document. As I understand this document, the witnesses, the Applicant's witnesses originally testified there was this thermal impact.

The State's witnesses are contesting that to one degree or another. So the company comes back and says, we told you there was a thermal impact, and now we are going to prove it to you.

Are you suggesting that is different than if they said, well okay, we lost on the thermal impact, but here is another theory that amounts to the

same thing? You are suggesting that?

MR. TURK: There is a difference between those two.

CHAIRMAN FARRAR: That is the difference.

MR. TRAVIESO-DIAZ: I would also make the point, if I may, that just as Dr. Solar asked to repeat, to paraphrase what you said, kept on cranking analyses, nothing prevented the State from providing additional evidence.

And, in fact, they do it every day, through cross examination, they bring new documents they are putting into evidence, cross examine the witness, get them admitted.

I think that the point that Mr. Turk made is one that bears thinking about a little bit. Just the fact that it takes the form of a report doesn't elevate it to a higher degree of weight, or admissibility, or worth of evidence, there is no different ranks of evidence.

It is what it is, and it proves what it is able to prove. But the fact that it is a report, and generated by a computer, doesn't give it any additional weight, as far as I'm concerned.

It is no different than exhibit 212 that the Staff used today, that the State used today. So

I'm sympathetic to the idea that fairness needs to be there. But I believe that evidence is different than raising claims, raising issues.

You were in a civil case, civil trial, the allegations of the Plaintiff would be bounded by the things that he says in his complaint. And if he wants to change his allegations he will have to file an amended complaint, and have the Court accept it.

That is exactly the same situation here.

MS. CHANCELLOR: Your Honor, if I could just comment on the merits of whether this is rebuttal, or not?

Dr. Wissa and Mr. Trudeau in their testimony mentioned the thermal effects. I think it is question 51 or 57. The thermal effects of the pad heating up to 190 degrees Fahrenheit, and how that will drive moisture off.

The State's witnesses do not mention thermal effects, at all. The State's witnesses mention moisture pulling under the storage pads. PFS had the opportunity to introduce this report as part of Dr. Wissa and Dr. Trudeau's testimony.

So I believe that the road map that Mr. Travieso-Diaz was talking about was well laid out in the State's issues at the time we, prior to filing

prefiled testimony. Nothing has changed between the State's position when Dr. Mitchell and Dr. Bartlett had their depositions taken.

So to the extent that the cross examination goes to whether there is a need to rebut State's witnesses, based on this thermal report by Dr. Solar, I think that we will just have to wait and see tomorrow.

But I think it could have come in earlier.

MR. TRAVIESO-DIAZ: Mr. Chairman, I hope that we are saving time for tomorrow by having this argument today, rather than tomorrow.

But answer 32 in the testimony of Dr. Mitchell and Dr. Bartlett clearly says that when, I'm reading from the second sentence, when a cement cap, such as the storage pads, is placed over cement treated soils, and the native soils, there is a potential to increase the moisture content of the native soils.

Exhibit 229 is intended to rebut that assertion by demonstrating that, in fact, it is not going to happen because there is a significant degree of heat that comes down.

So I think it is proper rebuttal, and it is addressing something raised in their testimony.

CHAIRMAN FARRAR: All right, thank you for those arguments. We will be prepared, I think, having those arguments tonight will enable us to rule more quickly tomorrow, on any matters that we need to rule on.

If there is nothing else --

MS. CHANCELLOR: I just have one point.

CHAIRMAN FARRAR: Yes?

CHAIRMAN FARRAR: On Answer 57 of Dr. Wissa's and Mr. Trudeau's testimony, there is a reference to a high storm thermal analysis report for PFS. It appears to be an older report.

And the report that Mr. Travieso-Diaz is now placing before us as exhibit 229 appears to be something that is newly generated by Holtec, it is dated June 10.

So I guess my point is that once again we have to deal with another new analysis at the last minute.

CHAIRMAN FARRAR: All right. We will bear all this in mind in getting ready for tomorrow. We will see you at 9 o'clock here, and continue with the cross examination of these witnesses. Thank you.

(Whereupon, at 5:52 p.m. the above-entitled matter was adjouirned.)

CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: Private Fuel Storage, LLC

Docket Number: Docket No. 72-22-ISFSI

ASLBP No. 97-732-02-ISFSI

Location: Rockville, Maryland

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

/s/ John Mongoven

John Mongoven
Official Reporter
Neal R. Gross & Co., Inc.