NUCLEAR REGULATORY COMMISSION

In the Matter of:

SOUTH CAROLINA ELECTRIC & GAS COMPANY	)	
	)	DOCKET NO. 50-395-OL
Summber Nuclear Station, Unit 1	)	

DATE: June 22, 1981 PAGES: 669 thru 843

AT: Columbia, South Carolina

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UNITED STATES OF AMERICA

BEFORE THE

NUCLEAR REGULATORY COMMISSION

In the Matter of:	)	
SOUTH CAROLINA ELECTRIC & GAS COMPANY	)	Docket No. 50-395-OL
Summer Nuclear Station, Unit 1	)	

Deauville Room 4
The Town House Inn
Columbia, South Carolina

Monday, June 22, 1981

PURSUANT TO ADJOURNMENT, the above-entitled matter came on for further hearing, at 9:30 a.m.

APPEARANCES:

Board Members:

HERBERT GROSSMAN, ESQ., Chairman
Administrative Judge
Atomic Safety and Licensing Board Panel
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

GUSTAVE A. LINENBERGER
Administrative Judge
Atomic Safety and Licensing Board Panel
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

FRANK HOOPER
Administrative Judge
Atomic Safety and Licensing Board Panel
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

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APPEARANCES (continued):

For the NRC Staff:

STEVEN GOLDBERG, ESQ.
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

MS. MITZI YOUNG
U. S. Nuclear Regulatory Commission
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and

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For the Intervenors:

BRETT ALLEN BURSEY
Route 1
Little Mountain, South Carolina

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PROCEEDINGS

JUDGE GROSSMAN: The evidentiary hearing is now convened.

This is an evidentiary hearing in the matter of the application by the South Carolina Electric & Gas Company and the South Carolina Public Service Authority for a license to operate the Virgil C. Summer Nuclear Station, Unit I.

On April 18, 1977, the Nuclear Regulatory Commission published a notice in the Federal Register indicating that the application for operating license had been filed and permitting persons to file notices or applications for leave to intervene in these proceedings.

A petition for hearing was received from Mr. Brett Bursey and a prehearing conference was held in which the contentions submitted by Mr. Bursey were discussed. The Atomic Safety and Licensing Board that had been designated to consider the petitions granted Mr. Bursey's request for a hearing an admitted him as an intervenor in this proceeding on February 3, 1978.

On February 8, 1978, a Notice of Hearing was issued indicating that an evidentiary hearing would be scheduled and also indicating that limited appearance statements would be heard at the evidentiary hearing. We have subsequently scheduled the hearing for this date and indicated that limited appearance statements would be heard today or this morning or carrying over

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into the afternoon if necessary. That will be the first order of business for us. But before that, I would like to introduce the Board.

As most of you are aware, health, safety and environmental matters pending before the NRC are usually heard by Boards that consist of an attorney as Chairman and two scientists, usually a nuclear scientist and an environmental scientist, as the other two Administrative Judges. Serving on the Board with me on my left is Judge Frank Hooper, who is our environmental scientist. He has a PhD from the University of Minnesota. He is currently a professor of zoology at University of Michigan and the Chairman of the Ecology, Fisheries and Wildlife Program at Michigan. He is a part time member of the Board.

On my right, is Judge Gustave Linenberger, who is a full time member of the Board. He is a nuclear physicist. He has extensive experience in industry as a nuclear physicist and engineer and has been a President and Board Chairman of a nuclear engineering company.

My name is Herbert Grossman. My experience has been as a trial attorney and appellate attorney for the Department of Justice for a number of years.

I would like now for counsel and the parties to introduce themselves, starting with Mr. Bursey, the intervenor, on my left.

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MR. BURSEY: Thank you, Judge Grossman. I am Brett Allen Bursey and I live in the proximity of the V.C. Summer plant and I'm the intervenor.

MR. KNOTTS: Judge Grossman, members of the Board, my name is Joseph P. Knotts, Jr., I represent the applicants South Carolina Electric & Gas Company and South Carolina Public Service Authority. With me at the counsel table this morning is Randolph Mahan, who is an attorney with the Electric & Gas Company.

MR. GOLDBERG: Yes, Judge Grossman. My name is Steven Goldberg, I am an attorney with the U. S. Nuclear Regulatory Commission. I represent the Commission staff in this proceeding. With me at counsel table is Mitzi A. Young who entered an appearance in this case on Friday. To my right, Mr. William Kane, Project Manager for the Summer License Application.

MR. WILSON: Mr. Chairman, I'm Richard P. Wilson, an Assistant Attorney General with the State of South Carolina representing the State. And with me is Dr. Samuel L. Finklea III, who is our technical assistant from the Department of Health & Environmental Control.

JUDGE GROSSMAN: As I indicated before, the first order of business is to entertain limited appearance statements. We would like the speakers to limit their statements to five minutes apiece; however, if time is not critical and there are

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not that many limited appearance statements, we will allow some leeway in that.

Mr. Paul Hamilton, who is the Panel Technician, is in the back of the hearing room and he will take names of those who do want to make a statement.

We will take a ten minute recess now while he collects the names.

Thank you.

(Short recess.)

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JUDGE GROSSMAN: We will begin with the limited appearance statements and we would like the first four speakers to be seated here at the table; Ruth Thomas, Sandra Jones, Patsy Bianchi and Travis Bianchi and we will start with Ruth Thomas, as the first speaker.

MS. THOMAS: Do you want me to come up there?

JUDGE GROSSMAN: Yes, please, at this table here. (Indicating.)

(Brief pause.)

In beginning your statements, would you each please, when beginning that statement, give your full name and address?

Ms. Thomas, you may sit or stand as you prefer.

MS. THOMAS: I think better on my feet.

JUDGE GROSSMAN: Fine.

MS. THOMAS: Is this coming over all right?

JUDGE GROSSMAN: That is the problem with standing, you are further from the mike. If you could get closer, that would be fine.

MS. THOMAS: Is that all right? Is that better?

JUDGE GROSSMAN: Yes.

STATEMENT OF RUTH THOMAS

MS. THOMAS: My name is Ruth Thomas and I live at 1339 Sinkler Road in Columbia. I am here as a private citizen but I am the authorized representative of several South Carolina organizations and I am a member of the Advisory Committee

to the Department of Health and Environmental Control.

On October 20, 1970, J. D. Bond who is Chairman of another Atomic Safety and Licensing Board gave his talk before the hearing. He pointed out that meaningful--is it too loud now?

No?

Meaningful participation by the public could only be done through intervention, and being a party to a proceeding, and today we are involved in limited appearances, so I was interested in looking up how limited appearances compare.

There is no oath and so I understand that whatever I say is not considered evidence. This was kind of disturbing to me, and looking into the views of other hearing Boards in relation to their being Intervenors, and a number of reports and documents indicated that hearing Boards felt as if intervenors added a great deal and were able to bring out local issues and were able to raise questions that the Board could follow up on, and I understand that this is the view of your Board, and--I didn't address each one of you--but, I am glad to be here before this Atomic Safety Licensing Board.

By accepting intervenors, you showed that you felt as though they could contribute and from my own experience, I have felt that intervenors contributed. I was an intervenor at the Barnwell Nuclear Field Plant and at the first hearing, there were no intervenors and this is the transcript which covered it

(indicating), 177 pages. I did not bring the transcript of the later hearing in which there were intervenors because it is this tall (indicating), and it is something like 37 times the number of pages. Of course, it is not complete yet either, so these 6,000 pages certainly contain more evidence on which to base a decision.

As I understand it, the purpose of Licensing Hearings are to compile as complete and accurate a record of evidence as possible. It is difficult for me to understand the Appeal Board's reversing of your decision to allow Fairfield United to be a party to this hearing, particularly since I had read of Appeal Board's opinions on this having intervenors. In 1977, the Appeal Board members, one of them was quoted as saying:

"Many substantial safety and environmental issues . . were raised first by intervenors and they do have a contribution to make".

This was before Three-Mile Island so it would seem as though there is more need for intervenors now than there was at that time.

I attended a meeting of the Advisory Committee on Reactor Safeguards in which I offered testimony...In later years in Washington, the topic of the Summer plant was discussed particularly in relation to South Carolina Electric and Gas's never having operated a nuclear plant before. They spoke of it "as being a somewhat unique plant in that the utility has not had an operating plant before".

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I would like to have it on the record that someone whose interests would be affected by the Summer plant is raising questions about there not being local intervenors and there not being people who lived right here having an opportunity to represent directly their interests.

I have a long history of interest in the Summer plant. It began in the fall of 1972 when I was with the Conservation Department of the Womens' Club. I raised questions in a letter to the Attorney General of South Carolina. I asked--this was one of my Committee members that wrote the letter, and she asked to be notified. We expressed our interest in the hearing and asked such questions as would South Carolina be a party? Would they cross examine witnesses and represent the interest of the public through having contentions?

The state did not respond to this and we were not notified of the hearing. We were all pretty new at representing ourselves and coming before various Boards, state and federal.

We learned that it is not a good idea to depend on anyone else, including the Attorney General, to let you know about meetings in relation to representation.

I urge you, Chairman Grossman, and your fellow Board members to use the contentions of the local intervenors and to use particularly those contentions of Fairfield United which relate to emergency planning and management and those issues which are of concern to the local people.

I also ask that the Board take an adversary role in place of the local groups, that is in case the local groups are not accepted.

It is my understanding that raising of safety issues and requiring proof from the Applicant applies with or without intervenors.

At the February 26, 1981 Advisory Committee on Reactor Safeguards, I raised the question in relation to the Summer plant on the instrumentation and controls and the emergency planning.

I would like to submit these to the Board. Some of these questions have not been answered. I will also submit a list of recommendations which relate to emergency planning and in respect to the Federal Emergency Management Agent. This was on May 12 and there has not been a response to this list of recommendations.

Members of the public often get the feeling that they are not really having a conversation with people in government who are representing them, and I would like to do whatever I can to promote more of a cooperative feeling, so that we would feel less like outsiders. I know it is not the policy in limited appearances for you to ask questions, or maybe it is, but at least I know that you don't cross examine people who give limited appearances. That probably makes them feel more comfortable too, but I think when there is an exchange--

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and I know I really felt as though my over two years of experience in hearings on the Barnwell plant, I felt as though I had a good relationship with the people on the Board. Sometimes I would have to take over the cross examination because we didn't have money for a lawyer and I can remember times when I was asking questions that were of a very technical nature, on technical subjects, and I do not have an engineering degree and I do not have a law degree and the Board members would help me. They would tell me what I was trying to ask, which I didn't know and I appreciated that.

The people who are intervenors, we work pretty hard I can tell you and we are trying to represent the interests of the public, and it really hurts our feelings when people call us subversives and act as though we are trying to stand in the way of progress. We do not feel that we are doing that. We feel that we are making a contribution.

We are actually, in a way, offering free services and we can't understand when they are turned down.

Thank you.

JUDGE GROSSMAN: I might say that we are called that too, on occasion.

JUDGE LINENBERGER: Well, Ms. Thomas, I would like to observe, I think your statements and observations are well reasoned and well presented and indicate, at least from what we can hear so far, a legitimate interest on your part and that of your

associates.

I am interested in a couple of things that you have said. Somewhere along the way you indicated that you felt there was not an adequate opportunity for local people with interest in say this proceeding to achieve status of intervenors and that I think is very unfortunate; and, I gather also, from the content of your remarks, that you feel that had you been, you personally been better informed about the development and progress of the earlier days of this proceeding, you or your associates might have gone the route of formal intervention, is that correct?

MS. THOMAS: Well, yes. At one time we did think about this but we were involved in a hearing which took a great deal of our time. We were also a party of this organization as Environmentalists, Incorporated. We were also a party to the hearings on plutonium recycled uranium called Table S, whatever that was. We were also involved in the law suit which was related to both the Barnwell hearings and plutonium recycle.

JUDGE LINENBERGER: The point I was trying to elicit here was whether your lack of being an intervenor now reflects more a commitment of your time to other things or more a lack of information given you about how this proceeding was progressing and I gather it was primarily a conflict of your time on other matters.

MS. THOMAS: Also I had the feeling that there were other intervenors and that there was somebody else working on this and I was glad and would do what I could to help them but I felt like I was spreading myself pretty thin as it was and our organization was too because we are a very small group.

JUDGE LINENBERGER: Fine. Thank you very much.

JUDGE HOOPER: Ms. Thomas, your questions and concerns about emergency planning, will they be--can you make those a part of this record in some way? I think they should be. I am not sure whether we would have those but it seems to me that these are very appropriate, it would be appropriate to have these somewhere in this record.

MS. THOMAS: Yes, I will be glad to give you those. (Handing.)

JUDGE GROSSMAN: Thank you, Ms. Thomas.

[Submissions above-referred to are appended to this transcript.]

JUDGE GROSSMAN: The next speaker is Sandra Jones.

STATEMENT OF SANDRA JONES

MS. JONES: My name is Sandra Jones and I live at Route 1, Blythewood. I live in the Cedar Creek Community and we are only fifteen miles from the V.C. Summer plant.

I am here today because I do not want the V. C. Summer plant to go on line. I have two small children; a little girl age 5, and a little boy, age 7, who will have to grow up with the

fact that this plant is so nearby to the environment in which they are being nourished. I am here because of them. I am a mother who is deeply concerned about the welfare and the future of my two children. To offer them a future which includes the effects of the nuclear industry is not a satisfactory option to me. I have to speak out against nuclear plants for me, for my children and for those I care about. I can do no else.

All our tomorrows are too important for me to remain silent. Thank you.

JUDGE GROSSMAN: Thank you, Ms. Jones.

Patsy Bianchi.

STATEMENT OF PATSY BIANCHI

MS. BIANCHI: My name is Patsy Bianchi and I too live in the Cedar Creek Community.

We thank you gentlemen for giving the people a chance to speak. We speak sincerely and we trust you will hear sincerely.

If I knew the risks of living next to the V. C. Summer plant were to be inflicted just on us who use the electricity it produces for thirty years, I would be home this morning weeding the tomatoes. If I believed that nuclear power production was as clean and cheap as the nuclear industry tries to convince us it is, I would probably have my garden sprinkler turned on and my mind would be concentrating on how well the green peppers are holding up to the heat; but, I feel that I have to be a bit

subversive this morning. I know that the V. C. Summer plant will affect my descendants for thousands of years, not just us who like to flip a switch and have light in the middle of the night from 1982 to the year 2012. During those thirty years, my family will be receiving low level radiation from the plant in addition to what nature and man have already blessed us with.

Of course we live with the constant stress factor of wondering if the accident will happen that will make everyone decide nuclear power risks are not worth it.

Then there will be the cost of dealing with and storing spent nuclear fuel and even the plant itself after it becomes so radioactive it is no longer feasible to pay enough people to run it.

My child and his children and their offsprings for thousands of years will be paying for space and guardians for something so deadly it should never have been allowed to exist. It should never have become atoms for peace because something so menacing in its possibilities can surely become toys for evil.

That nuclear power production was ever allowed to progress before a way to store the fuel was perfected is to me a blatant disregard to reality and common sense.

Building a house without a bathroom would make its inhabitants pretty uncomfortable. The johnny at V. C. Summer will fill up in ten years. Even if an efficient septic tank

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is designed for storing radioactive waste, the sewer lines will involve hauling the radioactive feces along the highways near our community.

In North Carolina a drunk driver got lost one night with his load of radioactive waste and was rescued by the Highway Patrolman who stopped him for drunk driving. Something we always hear is how much safer nuclear power is than driving on our nation's highways. Almost everyone who drives has chosen to do so, knowing the statistical risks he is taking. Those of us living near the V. C. Summer plant would never choose to absorb the risks we ourselves are subjected to and even less would we choose to pass on the risks to future people who would get absolutely no benefits from the plant, but who will pay dearly for a few years of convenience for their forebearers.

If ever there is a sin of the fathers which will be visited on our children, this is it.

I have here a copy of our Petition that we at Cedar Creek signed and circulated stressing our hopes that the plant won't be allowed to go on line until the questions concerning waste storage is answered satisfactorily. (Handing.)

[Submission referred to above is appended to this transcript.]

JUDGE GROSSMAN: Thank you Ms. Bianchi.

Mr. Bianchi.

STATEMENT OF TRAVIS BIANCHI

MR. BIANCHI: My name is Travis Bianchi. I live at Route 1, Blythewood. I live within sight of the V. C. Summer Nuclear plant, which is shortly to go on line.

I would like to state that the restriction from public involvement in this hearing are typical of response to those of us concerned to the dangers of nuclear power have met with for the last several years.

Despite the fact that this plant will only operate thirty years, yet produce tons of toxic radioactive waste that will exist for tens of thousands of years, public participation is limited to a few minutes per person per half day of the hearing.

Your attitude towards the residents surrounding the V. C. Summer station is further given away by scheduling the limited appearance public statements before the actual hearing is even started.

What are we commenting on? No evidence has been presented. No witnesses have been called or cross examined. It is obvious this simply provides an opportunity for the public to let off steam while remaining as ineffectual as ever. We know that these statements will have no impact on the licensing of the V. C. Summer station. That decision has already been made behind closed doors without public input and despite public concern.

The decision to license the V. C. Summers plant has been made despite growing evidence that malfunctioning nuclear plants have the potential to cause many thousands of people to die horrible lingering deaths from radiation induced cancer, despite increasing evidence that the constant flow of radioactive emissions given off by routinely operating nuclear plants are far more hazardous to human health than previously realized, despite NRC records which indicate accident-free operation of a nuclear plant to be a most improbable goal, despite the increasing realization that in terms of human health effect there is no such thing as an insignificant radiation release, despite inadequate incomplete and short-sighted evacuation planning that will surely fail to remove all of the endangered populus in case of an accident, despite the knowledge that a safe fool-proof system of storage of nuclear waste is yet to be perfected, and, despite the fact that SCE&G will be storing high level waste on-site for an undetermined length of time, despite the Petitions bearing hundreds of names expressing concerns for its potential to a human health disaster, despite the irrevocable evidence that SCE&G does not need the extra electricity generated by its billion dollar cancer factory, despite its potential for rendering thousands of square miles, including towns, farms and countryside uninhabitable and making the soil unproductive for the rest of our lifetime; we know that you intend to license the V.C. Summer plant.

Our families feeds itself from the crops and animals that we grow on our land. This plant presents a very real threat that might poison that land so we cannot live on it or from it.

There are many families like ours near the V. C. Summer plant. If that plant goes into operation, we will live in fear for the next thirty years that every day on our land might be our last day, and then, for the rest of our lives, we will fear the radiation seeping and leaking from that abandoned power plant.

Why in the name of God are we being subjected to this? To run the all-electric air-conditioned homes of Columbia and its suburbs? Or is it so that SCE&G can fatten its corporate self? There is no way that a corporate executive making in excess of one hundred thousand dollars annual salary can empathize with a man who plows the land his family has worked for over a century, nor can a professional bureaucrat understand the relationship that a man has with his land when he walks in the same furrows that his grandfather walked in and that he hopes his grandchildren will one day walk in.

Again, I ask you, why are we being subjected to this?

(Applause.)

JUDGE GROSSMAN: Thank you, Mr. Bianchi.

MR. BIANCHI: Thank you for listening.

JUDGE GROSSMAN: All right, I would like--thank you, ladies, and could the next three speakers take their places at the table; Doug Rogers, Betty Gilbert and Mike Lowe?

Is there anyone else here who would like to make a limited appearance statement who has not yet signed up with Mr. Hamilton?

If there is anyone else, Mr. Hamilton is there and he will take your name if you will speak to him.

Mr. Rogers.

STATEMENT OF DOUG ROGERS

MR. ROGERS: Thank you, Mr. Chairman.

My name is Doug Rogers. I live in the Bethel Community in Fairfield County about ten miles from the V. C. Summer Nuclear plant.

I am here speaking for the members of Fairfield United Action. Until three weeks ago, we expected to be a real part of these hearings. We wanted to force SCE&G officials to answer questions under oath about this plant they built in our back yard and about whether they really knew how to run it, but, as you know, the Appeal Board said you were wrong to let us try to protect ourselves and ordered you to throw us out.

SCE&G and the NRC staff asked that we be prevented from demanding that SCE&G prove their ability to run this plant safely or to get us out quickly if they failed. They said we could protect our rights by speaking here today and telling you what worries us, but we know better than that. The Appeal Board admitted that these short opening statements don't really help protect us. We can only really have a say about our health and

safety as intervenors. This Board listened very closely to our reasons for not filing until March of this year. You looked at our ability to help examine these important health and safety questions and at the ability of the other parties to protect us and you let us in; but we see that there is something bigger going on here than just this Board, this hearing, or this nuclear plant. The accident at Three-Mile Island unmasked nuclear power and the nuclear industry for what they are; badly managed, unsafe, dishonest and unprepared to handle accidents.

After the accident at Three-Mile Island, study after study called for change. Promises were made for better regulations, closer attention to safety and more citizen involvement in licensing.

Even Wall Street looked at nuclear power and said it's a bad deal. Who is to blame? Should the blame utility officials and let costs go through the ceiling? Should the public blame utility officials who built more plants than they need? SCE&G will have 59 percent more power than they need. SCE&G first thought that this one million dollar plant would cost a hundred and ninety million. Blame the people responsible? Of course not.

The nuclear industry, SCE&G, and their buddies, have unleashed an army of lobbyist and public relations people to spread the big lie.

The problem of nuclear power, they tell us, is not that

accidents like Three-Mile Island will happen. The problem of nuclear power is not that it raises rates so high that we can't pay them they tell us. The problem of nuclear power is not the waste we don't know what to do with they tell us. The problem, they tell us, is that citizens are saying no to having nuclear plants threatening their land, lives, and loved ones. The problem is that citizens are using the few legal rights they have in a system which is rigged against them from the beginning, and these citizens are being heard.

The problem for SCE&G is that the fight of people in a democracy to have some kind of say over their lives, their health, their safety might actually work, and SCE&G and their buddies in the industry say this must not happen, if the people are really heard, we will be out of business, and so, they feed false information to our Congressman to get them to lean on NRC to speed up these hearings. They convince the NRC to propose new regulations which will make real citizen intervention impossible and they get Fairfield United Action thrown out of these hearings. They don't want us in this case because they are afraid we can help you look at how this company is run.

SCE&G knows it cannot stand up under a close look. They have even managed to have Mr. Bursey so limited he cannot put up a case on half his contentions and they have had us thrown out, so despite this generous invitation of SCE&G and the NRC staff that we stand here and kid ourselves that these limited

statements will make any difference. We will put our energies elsewhere. We will not waste our energy here on ears ordered deaf by the Appeal Board. We will carry our anger and our legitimate fears to the people of South Carolina so that they can hear our message.

We expect the original order of this Board admitting us to be upheld. When we can question these people under oath then we will participate. Until then, this mockery will not mock us. This sham will not fool us.

Thank you.

(Applause.)

JUDGE GROSSMAN: Betty Gilbert.

STATEMENT OF BETTY GILBERT

MS. GILBERT: I am Betty Gilbert, 416 Maple Street, Columbia, South Carolina.

I am going to be a little bit redundant but I am a little bit concerned about Secretary Edward's statement about subversive activities flaunting environmentalists activities and I just want to state that I am just a concerned citizen and I have been concerned for about eight or nine years.

When I first became concerned, it was very--you very seldom saw anything in the newspaper concerning any of the nuclear issues. I wanted to say that just in this--these are not complete by any means, and just from the COLUMBIA RECORD, here is one on May 24, 1981, and these are just clippings; "Workers find leak

at nuclear plant" and that is at the Browns Ferry, which is--uh, February 23, Savannah River plant, tritium leak--another tritium leak in March at the Savannah River plant, and on March 1st, rodent droppings carrying radioactivities. Nothing is too small to be concerned about now.

All of these clippings (indicating), these are the things that the newspapers is showing that there is a concern of the public.

I am not afraid of an explosion. That is what they have been--the private citizenry doesn't know what they are talking about when they are afraid that the nuclear plant will explode. I am not afraid of that. I am afraid of mechanical error and human error. I am afraid that they will hurt the environment, the air we breathe and the water we drink and use.

I would like to read this last clipping pretty much in toto, from June 18th of this year, this states:

"NRC Consultant. Release of Uranium poses hazards, Oak Ridge, Tennessee, UPI.

"The Department of Energy has confirmed that 11,270 pounds of radioactive uranium was released accidentally in the last twenty-one years from the government owned nuclear fuel enrichment center.

"A Nuclear Regulatory Commission consultant says there is no doubt the release posed health hazards. "It will cause some problems but the people affected probably will not be able

to link it back with the releases" says the consultant, Dr. Rosa Lee Burkell of Toronto, Canada.

"The Department of Energy confirmed Wednesday that the Oak Ridge Gaseous Diffusion Plant in Oak Ridge in East Tennessee, where 53 workers were exposed to radioactive mist last month has accidentally released more than five and a half tons of toxic uranium hexachloride gas into the air since the facility opened in 1945.

"DOE spokesman, Jim Alexander, says the gas was released from the 121 accidents at the facility, part of the massive Atomic Energy Research and Development complex at Oak Ridge National Laboratories. Despite Burkell's assertion that there is no doubt the release posed health hazards, Alexander insisted that it does not present any measurable health threats."

Well, how can you measure health threats if you can't prove the health threat is there? And DOE officials says they do not believe the amount released is unreasonable considering the complexity of the emission system and the number of years involved. So I think that is a kind of a false assumption there in the first place.

I would like to throw in here that I have sat in a Nuclear Regulatory Commission hearing and I have heard human lives discussed in the health benefit anaylsis.

This 121 accidents all involved the release of one kilogram, 2.2 pounds or more. DOE officials who compiled the

figures for reporters at the last month accident did not include any accidents in which there was less than that that was emitted. In the May 25th accident, 53 workers were exposed to the toxic uranium hydrochloride when a hose ruptured. An investigation continues and officials do not know how much material was lost.

I think that is a pretty bad indictment there also. You really can't know what happens when an accident comes.

I think that that is the kind of thing that is such a danger in any of the nuclear facilities. They could be little minor things which can create hazards that nobody really knows the total effect of and nobody can really prove what that total affect will be. I know you can't see tritium when it is released so how can you avoid it? If you can't see it to know it is present in the water, how can you avoid it?

Thank you.

JUDGE GROSSMAN: Thank you, Ms. Gilbert.

Mike Lowe.

STATEMENT OF MIKE LOWE

MR. LOWE: Judge Grossman, members of the Board, my name is Michael Lowe. I am a Columbia resident at 2812 Bratton Street and I speak on behalf of the Palmetto Alliance of South Carolina, a statewide safe energy organization.

We feel like these hearings without the intervenor, Fairfield United Action, are nothing more than a conciliatory gesture to the public. I feel like that unless you, the Board, or

unless the State of South Carolina explores these contentions and these issues that Fairfield United Action has raised, that is management capability. I have personal knowledge of the management capabilities of South Carolina Electric & Gas. I worked for them on a construction job for two years, as a crane operator, from 1974 to 1976. The financial capability of this company to handle an accident such as Three-Mile Island or to handle a large repair job such as Florida Power & Light is now encountering with steam generator repairs or with their Turkey Point three and four units, unless you explore the emergency plan issues, which I believe only Fairfield United Action has special knowledge of, the record in this case will remain incomplete.

I also feel that there is a travesty that the spent fuel storage issue is not being explored in these hearings. To have that placed in a separate hearing is a very bad mistake that the South Carolina Electric & Gas and the Atomic Safety and Licensing Board will have to address some time in the next ten years.

To build a plant that has a thirty-year lifetime with only ten years storage capacity, to build a plant that will be number seventy-four in a line of nuclear plants trying to store their spent fuel is absurd. Allied General Nuclear Services officials in their most optimistic predictions say that that plant will not be ready for operation, if it operates, or to accept spent fuel storage before 1990.

I believe you should carefully consider and take extra efforts to appeal to your superiors and have these issues heard.

Thank you.

JUDGE GROSSMAN: Thank you, Mr. Lowe.

Thank you ladies and gentlemen and Mr. Rogers, I would like to compliment Fairfield United for the high quality briefs that they have submitted to the Appeal Board and the Commission.

The last speaker we have listed is Laura A. Bagwell. Ms. Bagwell, please come forward.

STATEMENT OF LAURA A. BAGWELL

MS. BAGWELL: Thank you.

My name is Laura Bagwell. I live at 4813-B North Main Street in Columbia, South Carolina. I don't have a prepared speech to offer to you this morning, but I am uncomfortable here and it is not because of that fact. I am uncomfortable because there are ten nuclear facilities in this state under construction or working right now and I live, you know, I think about what would happen to my family. I have lived in this state all my life and I love this state and I don't want to see it ruined.

I worked at the Cherokee Nuclear plant while it was being constructed and I saw how things got put together. If we could get off early, if it meant us not having to work until 9:30 at night which we did frequently, sure we would cut corners, we would let in a load of dirt with roots and stumps which would

go underneath a barrier for the sedimentation dam. We would use bad debars--I am sure you know what that is--which had not been passed by quality control.

It scares me when I hear what has happened to the people who live around Three-Mile Island and. The dairy farmers could no longer sell their milk to anybody. The people who grow grapes there, nobody will buy the grapes to make wine from them anymore.

I am just scared. I don't want this here and I appreciate your letting me come and speak this morning. Thank you.

JUDGE GROSSMAN: Thank you, Ms. Bagwell.

(Applause.)

Do we have anyone else who would like to make a limited appearance statement?

(No response.)

JUDGE GROSSMAN: All right, then that concludes limited appearances. We will proceed with the first, or the next item on the agenda which is the panel put on by the Applicant and before that, we will take a ten-minute recess.

(Short recess.)

Clpw

JUDGE GROSSMAN: The hearing is back in session.

Mr, Knotts, before we proceed, we have received a communication from Fairfield United indicating that they have been removed from the service list. Is there any reason why you can't restore them to the service list until their appeals are decided?

MR. KNOTTS: Mr. Chairman, by way of clarification, we have been serving Fairfield United with all pleadings related to their appeals and stay request before the Commission. What we have not been doing is sending them routine licensing correspondence since they were dismissed, but in response to your question, we will be happy to do so if that is what the Board would like.

JUDGE GROSSMAN: All right, we would like it, and also to submit to them the stuff that has been issued since June 5.

MR. KNOTTS: Fine.

JUDGE GROSSMAN: Thank you.

Before I swear the panel, was it your intention to make an opening statement, Mr. Knotts, or do you intend to have the panelists give a summary? I'm not sure what your procedure is.

MR. KNOTTS: Mr. Chairman, I would be prepared to give an opening statement, but I don't want to consume that time unnecessarily. The panelists are going to present an oral summary and perhaps it would be more meaningful to have the

C2pw

panelists give an oral summary rather than have me outline the whole case.

JUDGE GROSSMAN: That's fine. Would the panelists please rise and raise your right hands?

Whereupon,

SHELTON S. ALEXANDER, PH.D.
ROBIN KEITH MCGUIRE, PH.D.
CHANG CHEN, PH.D.
PRADEEP TALWANI, PH.D.

were called as a panel of witnesses on behalf of the Applicant, and having been first duly sworn, were examined and testified as follows:

JUDGE GROSSMAN: Please be seated. Could you each give your full names and addresses for the court reporter, beginning with the person on my left.

DR. TALWANI: My name is Pradeep Talwani, I am at the University of South Carolina. My home address is 201 North Nottingham Road, Columbia, South Carolina.

JUDGE GROSSMAN: And could you spell that for the reporter please? Your last name.

DR. TALWANI: (Spelling) T-a-l-w-a-n-i.

JUDGE GROSSMAN: I'm sorry, your first name too, please.

DR. TALWANI: (Spelling) P-r-a-d-e-e-p.

JUDGE GROSSMAN: Thank you, Dr. Talwani.

DR. CHEN: My name is Chang (C-h-a-n-g) Chen (C-h-e-n).

C3pw

My home address is 906 Evergreen Drive, Wyomissing (W-y-o-m-i-s-s-i-n-g) Pennsylvania.

DR. MCGUIRE: My name is Robin McGuire, M-c-G-u-i-r-e. I live at 5255 Pine Ridge Road in Golden, Colorado.

DR. ALEXANDER: My name is Shelton S. Alexander, I'm a Professor of Geophysics at Pennsylvania State University, and I reside at 1161 Dorum (D-o-r-u-m) Avenue, State College, Pennsylvania.

JUDGE GROSSMAN: Thank you, gentlemen.

You may proceed.

MR. KNOTTS: Thank you. I may note for the record, gentlemen, that the lead witness on the panel is Dr. Alexander and unless you have a specific matter to address to a member of the panel, Dr. Alexander will either respond or direct the response to a member of the panel.

JUDGE GROSSMAN: I think we ought to establish the ground rules now. We may, or any of the parties may, direct questions to individual members --

MR. KNOTTS: Surely.

JUDGE GROSSMAN: (continuing) -- if anyone on the panel has something in clarification or disagrees with what is stated by another panelist, please make a further statement and clarify the record or we will assume that everyone on the panel agrees with the statement that has been made by the person answering the question. So if you do have some questions about

C4pw

the matters stated, please speak up at that time or we will assume that you agree with the matters stated. Thank you.

MR. KNOTTS: Gentlemen on the panel, let me ask each of you, has each of you prepared a statement of your educational and professional qualifications for use in this proceeding?

DR. ALEXANDER: Yes.

DR. MCGUIRE: Yes, I have.

DR. CHEN: Yes.

DR. TALWANI: Yes.

MR. KNOTTS: I might note for the record, Mr. Chairman, that these statements of qualifications were previously distributed with my memorandum of transmittal dated May 28, 1981, the qualifications of Drs. Alexander, McGuire and Chen were appended to their pre-filed written testimony. The qualifications of Dr. Talwani were filed separately since he did not have pre-filed testimony and is being made available to respond to questions.

Mr. Mahan will now hand each of you a copy of the document and I will ask you to state for the record whether that is a copy of the document you prepared.

Dr. Alexander?

DR. ALEXANDER: Yes, it is.

MR. KNOTTS: Dr. McGuire?

DR. MCGUIRE: Yes, it is.

MR. KNOTTS: Dr. Chen?

C5pw

DR. CHEN: Yes.

MR. KNOTTS: Dr. Talwani?

DR. TALWANI: Yes.

MR. KNOTTS: Now let me ask each of you in turn if there are any corrections or additions to your statement of qualifications which you wish to make. Dr. Alexander?

DR. ALEXANDER: Yes, there are a few of minor nature.

The first page, at the bottom, the second full paragraph up, replace "In 1964" by "From 1963 to 1965" and append at the end of that sentence "while on active duty".

At the top of the second page, third line down, insert between "Geophysics" and "Program", to read "Geophysics Graduate Program". The next line, the parentheses after the word "Coordinator" should read "(1974 to 1977)" and strike "Present", on the next line.

The next paragraph, insert right after "industries", "Teledyne Geotec, Incorporated" and in the very last line of that paragraph, replace "Corporation" by "Research, Incorporated", so that it reads "Weston Geophysical Research, Incorporated."

And on the last page, the sixth line up from the bottom, make that read "National Academy of Sciences" rather than "Science".

MR. KNOTTS: Does that complete your corrections, Dr. Alexander?

DR. ALEXANDER: That completes my corrections.

C6pw

MR. KNOTTS: Dr. McGuire, do you have corrections to your statement of education and professional qualifications?

DR. MCGUIRE: Just several minor corrections.

At the end of the first paragraph, "1980" should read "1981".

And on page two at the beginning of the first full paragraph, "1980" should read "1981".

Other than that, the statement is correct.

MR. KNOTTS: Thank you.

Dr. Chen, do you have corrections to your statement of qualifications?

DR. CHEN: Yes, there is one numerical error on page three.

JUDGE LINENBERGER: Could we go just a little bit slower here please?

DR. CHEN: Certainly.

JUDGE LINENBERGER: Now, where are we?

MR. KNOTTS: With Dr. Chen.

JUDGE LINENBERGER: Dr. Chen, fine.

DR. CHEN: There is a numerical error on page three, in the middle of the second paragraph, "13,000 megawatts" should be "1300 megawatts".

MR. KNOTTS: No further corrections, Dr. Chen?

DR. CHEN: No, that's it.

MR. KNOTTS: Dr. Talwani, are there any corrections to

C7pw

your statement of qualifications?

DR. TALWANI: No.

MR. KNOTTS: In the case of those who have made corrections, is your statement as corrected true and correct?

DR. ALEXANDER: Yes, it is.

MR. KNOTTS: And Dr. Talwani, i yours true and correct as it stands?

DR. TALWANI: Yes.

MR. KNOTTS: Does each of you wish to adopt your statement of qualifications as part of your testimony in this proceeding?

DR. ALEXANDER: Yes.

DR. MCGUIRE: Yes.

DR. CHEN: Yes.

DR. TALWANI: Yes.

MR. KNOTTS: Now let me ask Dr. Alexander, Dr. McGuire and Dr. Chen, whether each of you have prepared written testimony for use in this proceeding.

DR. ALEXANDER: I have.

DR. MCGUIRE: Yes.

DR. CHEN: Yes.

MR. KNOTTS: Is the document which Mr. Mahan is now handing you a copy of the testimony you prepared?

DR. ALEXANDER: Yes it is.

DR. MCGUIRE: Yes.

C8pw

DR. CHEN: Yes it is.

MR. KNOTTS: Now with reference to that document, let me ask each of you in turn whether there are any corrections or additions or updating which you wish to make in your written testimony.

Dr. Alexander?

DR. ALEXANDER: Yes. Again, I have a few corrections.

The first appears on page 3 and it is a misspelling in the statement of Contention A4(a), it should be "activity", a-c-t-i-v-i-t-y.

On page 4, in the middle of the page, the line which ends "in the Charleston area", I wish to replace the statement "other than in" by "including". And in that same paragraph, there should be a parenthesis after "E" on the left hand side, "Appendix E" should have a parenthesis such that everything after "Supplement No. 1," starting with that parenthesis, should close with "Appendix E", so all of that refers back to the SER.

MR. KNOTTS: Thank you.

DR. ALEXANDER: Page 5, first line of the first full paragraph, Piedmont is spelled P-i-e-d-m-o-n-t.

The very last line at the bottom, last two lines, it should read "to the contention of Intervenor Bursey" as opposed to "contention of the intervenor".

MR. KNOTTS: Thank you.

DR. ALEXANDER: Page 12, the paragraph labeled (4),

C9pw

four lines down, there is a typographical error, it should be "surface", s-u-r-f-a-c-e. Two lines below that, propagating should be spelled p-r-o-p-a-g-a-t-i-n-g.

Page 14, the first full paragraph on the page, five lines up, should be spelled "events". The bottom paragraph, second line "occurrences" should be singular, "occurrence", to read "on the occurrence of the 1886 Charleston earthquake."

And those are all my corrections.

MR. KNOTTS: Thank you, Dr. Alexander.

Dr. McGuire, do you have corrections to your pre-filed testimony?

DR. MCGUIRE: I have none.

MR. KNOTTS: Dr. Chen, are there corrections to your pre-filed testimony?

DR. CHEN: No, sir.

MR. KNOTTS: All right. Dr. Alexander, as corrected, is your pre-filed testimony true and correct?

DR. ALEXANDER: Yes, it is.

MR. KNOTTS: And Dr. McGuire and Dr. Chen, is your testimony true and correct?

DR. MCGUIRE: Yes.

DR. CHEN: Yes.

MR. KNOTTS: And does each of you wish to adopt your written testimony as part of your testimony in this proceeding?

DR. ALEXANDER: Yes.

C10pw

DR. MCGUIRE: Yes.

DR. CHEN: Yes.

MR. KNOTTS: Thank you.

Before I ask these gentlemen, Your Honor, to summarize -- provide a brief oral summary of their written testimony, I would now offer the pre-filed testimony and statements of qualifications and ask that it be bound into the transcript at this point as if read.

JUDGE GROSSMAN: Before we rule on that or ask for objections, I think it would be preferable to have them summarize their testimony first and then give the other parties a chance to object or to voir dire the testimony first.

Is there any objection to that, Mr. Knotts?

MR. KNOTTS: I have no objection.

JUDGE GROSSMAN: That way, they can center on --

MR. KNOTTS: I have no objection to voir dire before the testimony is put in.

Gentlemen, would each of you proceed then to give us a brief summary of your pre-filed testimony, beginning with Dr. Alexander.

DR. ALEXANDER: As I indicated, my name is Shelton Alexander. I am employed by the Pennsylvania State University as a Professor of Geophysics in the Geosciences Department. A statement of my personal qualifications and relevant experience is included in my complete testimony.

C11pw

JUDGE GROSSMAN: Excuse me. Let me ask the parties what their preference is on that. They may want to object before the summaries go in.

Mr. Bursey, do you have any preference on that?

MR. BURSEY: Your first suggestion seems to be a reasonable one, hear the summaries and then determine if we want the entire testimony read.

JUDGE GROSSMAN: Mr. Goldberg, what's your preference?

MR. GOLDBERG: I have no preference.

JUDGE GROSSMAN: Okay.

Mr. Bursey, let me point out to you that you then have to move to strike the summary if you find that objectionable, but I'll give you the option of which you prefer. To let them proceed with their summaries and then --

MR. BURSEY: Yes.

JUDGE GROSSMAN: Okay. Proceed.

DR. ALEXANDER: To continue, I have been retained as a consultant to South Carolina Electric & Gas Company since October of 1980, to coordinate and integrate the site studies concerned with the V. C. Summer Nuclear Station and Monticello Reservoir.

The purpose of my testimony is, first, to summarize briefly the results of our investigation and review of the seismic activity in the region in which the V. C. Summer facility is located, and secondly, to explain the grounds for my

C12pw

conclusion that this investigation and review is more than adequate to form a basis for evaluation of the potential seismic hazard at the Summer site and the basis for Dr. Chen's conclusion with regard to the adequacy of the structural and equipment design for such seismic activity.

I will begin by addressing first Contentions A4(a) and A4(b) raised by Mr. Bursey, an intervenor, and then I'll present a brief summary of our findings with regard to the three principal seismic issues: Reservoir induced seismicity; the Charleston earthquake and the Wateree Creek fault.

First I will read the contention and then summarize briefly our response to that.

Contention A4(a) originally is as follows, "The FSAR is inadequate with respect to the description of the seismic activity in the area of the Summer plant site. Then also, Mr. Bursey contends that a near-field magnitude of 5.3 should be used and that the Wateree Creek Fault poses new seismic considerations which must be resolved. The latter added subsequent to the hearing in South Carolina.

I have reviewed the data presented in the FSAR, and also other relevant literature on the subject. My review of seismicity and related geologic and tectonic issues included, but was not limited to, the following documents: The FSAR (Section 2.5); Woodward Clydes" report entitled "Review of Reservoir Induced Seismicity"; all of the technical reports by

C13pw

Dr. Pradeep Talwani on reservoir-induced seismicity at Monticello Reservoir; journal articles and technical reports describing seismicity and interpretations of earthquake activity in the region including the Charleston area; the Safety Evaluation Report for the Summer plant and its Supplement, especially Section 2.5 of that SER; Dr. Murphy's views discussed in Section 2.5.3, pages 2-24 through 2-26 and on page 2-31; LSAS's review in Section 2.5.3 and in Appendix D; and finally the USGS letter by Dr. Devine in Appendix E. The report prepared under my supervision entitled "Supplemental Seismological Investigation - Virgil C. Summer Nuclear Station Unit 1 - December 1980" presents a detailed evaluation of all available seismic information, except for the SER which was issued subsequently. I concluded that the literature search presented in the FSAR was thorough and my subsequent perusal of other available reports and publications revealed no new data that would alter the conclusions reached in the FSAR.

So, contrary to the contention of Intervenor Bursey, the data presented in the FSAR and other referenced documents provide a more than adequate description of the seismic activity in the area of the Summer plant site. The issues concerning a magnitude 5.3 near-field event and the Wateree Creek Fault will be discussed in a moment, but neither proposes (s a seismic safety hazard to the V. C. Summer facility, based on our detailed site specific evaluation.

C14pw

Contention A4(b) is the next and it is stated as follows: "The plans for monitoring site specific seismicity are inadequate, in that they do not consider the seismic effect of filling the reservoir. Site seismicity should be monitored for one year subsequent to filling the reservoir and prior to the granting of the operating license." Later and now, Mr. Bursey contends that monitoring should continue through 1983.

With regard to the monitoring, data from JSC, a permanent seismographic station of the South Carolina seismic network, which is loated 3.5 miles southeast of the plant, provided initial information on the background seismicity prior to the filling of the reservoir. Then South Carolina Electric & Gas installed a four station network which began providing reliable information just prior to the filling of the reservoir. These data were supplemented with those obtained by anywhere from 2 to 5 portable seismograph units deployed in the epicentral area in the early months subsequent to filling. And since July of 1978, additional information has been obtained from six additional stations installed by the U. S. Geological Survey; these additional data confirm that the depths of the seismicity associated with the reservoir are shallow; that is, less than three kilometers in depth and 98% of all of the events that have occurred are less than two kilometers in depth.

The detection threshold with this monitoring -- combined

C15pw

monitoring network, is complete down to a very small magnitude events, M_L events approximately minus .6 are all detected should they occur beneath the plant. So in that sense, the record is quite complete within the immediate vicinity of the reservoir itself.

To date, the seismicity data at Monticello Reservoir have been obtained for 3-1/2 years subsequent to filling, 2-1/2 years longer than originally suggested by Intervenor Bursey. After the initial spurt of activity following the filling of the reservoir, January-February of '78, there has been a marked decrease in the activity level both in the total number of recorded events, M_L greater than minus .6 magnitude, and in the number of the larger amongst the events, microevents, 2 to 2.8 magnitude. These are small events by anyone's standards. And this pattern has continued. We of course are monitoring continuously up to the present and this pattern has continued with the small local episodes of activity, the most recent of which was late March and early April with the largest magnitude of 2.4 approximately. But overall the rate of seismicity continues to decline.

So, in over 3-1/2 years of monitoring the seismicity at Monticello Reservoir, we have seen the pattern of induced microearthquake activity, which is limited spatially to shallow depths in the immediate vicinity of the reservoir; the largest events are in the magnitude range 2.5 to 2.8 M_L, which are

C16pw

small events, and there has been an overall decline in the average activity rate with time following this initial peak of activity. So in my opinion, the microseismicity observed at Monticello Reservoir, although it is very interesting scientifically, does not constitute a safety hazard to the V. C. Summer Nuclear Station.

South Carolina Electric & Gas has committed to continue monitoring the seismic activity at Monticello Reservoir until the end of 1982, at which time an evaluation will be made in conjunction with the NRC staff to determine if it should be continued. So I think that contention is adequately rebutted.

Now I will proceed to discuss the three principal seismic issues in turn, starting with an evaluation of the reservoir induced seismicity.

I have been intimately involved in the evaluation of the reservoir-induced seismicity at Monticello Reservoir, and as I indicated earlier was responsible for the coordination and preparation of the report entitled, "Supplemental Seismologic Investigation - V. C. Summer Nuclear Station Unit 1 - December 1980".

Monticello Reservoir is unusual in that it is probably one of the best documented cases of reservoir induced seismicity in the world. Of approximately 11,000 reservoirs worldwide, only about 45 have confirmed reservoir induced seismicity associated with them and there are about 12 other questionable cases. Of

C17pw

these that are confirmed, 30 are associated with macroseismic; that is, magnitude M_L events greater than 3, and 15 events are associated with microseismicity, M_L less than 3. Monticello is included in this latter microseismicity group, which is characterized by small magnitude events. Now there are 59 reservoirs that have been constructed within the Piedmont Tectonic Province since 1891, and that's the land on which Monticello is situated, 12 have experienced nearby seismic activity, two of which are unequivocably confirmed as reservoir induced seismicity, that's Jocassee and Monticello itself. So with over 2193 reservoir years of data in the Piedmont Tectonic Province, there has been no reservoir that has been associated with a seismic event greater than a Modified Mercalli Intensity VI, which is approximately an M_b of 4.3 magnitude.

JUDGE LINENBERGER: On this point, sir, you've used the term M_L as well as M_b. Would you distinguish between them please sir?

DR. ALEXANDER: Yes. The M_L goes back to the initial definition by Richter of what a magnitude is in the first place and it represents a measurement relatively near to the source and L really stands for local magnitude in that sense, and typically it's measured either by taking the largest amplitude of the signature ground motion and calculating the -- the magnitude scale itself is an arbitrary scale according to the definition, which is logarhythmic in nature. So one takes the

C18pw

logarhythm, base 10, of the ground amplitude maximum and that is the definition of magnitude that is related to a standard distance of measurement and a standard instrument. And with more modern instruments everything is then related back to the equivalent M_L definition.

A second way of determining it, which is calibrated to this definition is the duration of ground motion, which is related again to the size of the event M_L, so there are these ways of measuring local magnitude. The M_b, so called, is the definition made typically from observations at large distances from the event itself. By large distances, we mean 3,000 or more kilometers. And these scales, although they have not been totally matched in every setting, are approximately equivalent to one another.

JUDGE GROSSMAN: I'm sorry, you gave two figures now, one of 6 and one of 4.4, was it? Could you tell me again which magnitudes you were using for those comparable figures?

DR. ALEXANDER: Yes. We should distinguish between intensity and magnitude --

JUDGE GROSSMAN: Oh, you were using intensity, I'm sorry. Okay, thank you. It was an intensity 6 and a magnitude 4.4?

DR. ALEXANDER: Correct. That's the match, the association that we infer between those two such that intensity 6 would correspond approximately to a magnitude of 4.3.

C19pw

JUDGE GROSSMAN: Okay. I assume by the way, when you are discussing magnitudes in general, you're using local magnitude M_L.

DR. ALEXANDER: That's correct because that is what is in fact measured with this local network.

Let's see, let me find my place here. So with over 2193 reservoir years of data in the Piedmont Tectonic Province, no reservoir has been associated with a seismic event greater than intensity 6 or approximately this magnitude, 4.3.

Also, of the reservoir induced seismic events globally, there has been 10 reservoirs that have experienced nearby earthquakes with magnitudes greater than 5.0. And of these 10, 8 are associated with known active faulting and the other two have probable active faulting based on known local geology. There are no known or suspected capable faults near Monticello Reservoir.

We also found that for all reservoir induced events globally with M_L greater than 5.0, the estimated source depth, so-called focal depth, has been at least 5 kilometers or greater, and in most cases it's greater than 10 kilometers. There is no evidence of the effects of the reservoir or residual tectonic stresses in this area to indicate that there are likely to be events of any size beneath this Monticello Reservoir. That is, Monticello does not conform to the situation where magnitude of 5.0 or greater events have occurred.

C20pw

As I stated earlier, Monticello Reservoir is one of the best documented cases of reservoir induced seismicity anywhere in the world and as a result, a significant amount of site specific data have been acquired which provide a good basis for understanding the reservoir induced seismicity at Monticello. And our evaluation indicates that the observed induced seismicity is a result of superficial adjustments to the -- to an altered stress state caused by the reservoir impoundment and there is no evidence to suggest anything more than the microearthquake activity such as we have experienced will occur there in the future. And based on all our data, which includes a variety of lines of geophysical and seismological evidence, we infer that an M_L equal to 4.0 event is the upper bound for any future induced seismicity at this particular site. Also the preponderance of historical data supports our detailed site study in that it's appropriate and suggests that it's appropriate to assign an upper bound with a maximum sized induced event. In particular, near-field reservoir induced events larger than 5.0 should not be considered in this case, as they would imply an induced earthquake larger than the largest natural tectonic event that is known to have occurred in this Province.

M_L equals 4.5, which is the limit stated by the staff, the NRC staff, in the SER, is a very conservative upper bound for reservoir induced seismicity anywhere in the Piedmont Tectonic Province because there is only one reservoir induced event, the

C21pw

Clark Hill event of 1974, that has been as large as M_L equals 4.0, and there is debate as to whether that event was in fact induced.

End of C.

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No reservoir as shallow as Monticello outside of an active seismic zone has RIS as large as M_L euqals 4.0.

Statistical estimates of ground accelerations at the site made by Dr. McGuire, taking into account observed strong motion data from the largest induced earhtquakes at Monticello Reservoir, show that, in order to equal or exceed the design accelerations an M_L equals 4.5 event must be closer than 2 kilometers to the plant in any direction.

M_L equals 5.0 must be closer than three kilometers and M_L equals 5.5 event must be closer than four kilometers. Inas much as all of the reported reservoir induced eventsglobally whose magnitudes are greater than 3.0 have storage depths greater than five kilometers plus site specific data we have indicates that events as large as Monticello would also be deeper than five kilometers, we conclude that an event of the size suggested by Dr. Muprhy, that is an M_L equals as large as 5.3, and later that same figure suggested the University, that size event would not adversely affect the facility.

Moreover, Dr. McGuire's calculated that the mean return period for such an event as an M_L equals 5.3 is approximately five thousand years, which is of the same order as for natural events, ecttonic events in the Piedmont Province.

As I indicated earlier, all induced events five or greater have been associated with capable faults. And there is none known or suspected in the vicinity of the Summer facility.

That summarizes our findings for the reservoir-induced case.

Now, I'll go to the second seismic issue which is the Charleston Earthquake. And I have become familiar with the studies being conducted by the U. S. Geologic Survey on the occurrence in 1886, the Charleston Earthquake.

Available data and literature regarding cause of the earthquake have been thoroughly reviewed and probabilistic analyses based on the three most prominent possible scenarios for explaining the occurrence of that earthquake have been made for comparison to the current design parameters at the Summer facility.

So from the extensive work carried out in recent years by the U. S. Geologic Survey, evaluations of the most prominent hypotheiss concerning the current sutdies and including the probability of future occurrences and of historical records of seismicity in the Charleston area, it's my opinion that there is no observational evidence at this time to indicate that an earthquake comparable to the 1996 event will reoccur at any location other than in the Charleston vicinity. This, I might note, is also the position of the U. S. Geologic Survey, as stated in Appendix E of the SER.

So the final seismic issue concerns the Wateree Creek Fault. And subsequent to the impoundment of the reservoir and the onset of induced activity, the U. S. Geological Survey contracted the services of Dr. Donald T. Secor, Department of Geology,

University of South Carolina, to conduct an intensive geologic investigation of the general area surrounding the reservoir. And this area encompasses a much larger area than was originally part of the detailed site investigation and part of the preliminary safety evaluation report.

During the course of his investigation to date, Dr. Secor mapped some previously-unrecognized fault within the Chapin quadrangle whic he named he Wateree Creek Fault. I reviewed Dr. Secor's findings thus far and have reached the following conclusions.

One, substantial evidence exists indicating the presence of the Wateree Fault inthe Chapin quadrangle as mapped by Dr. Secor. The fault has been traced northward to a point approximatley two kilometers southeast of Peak, South Carolina. The progress of the field work so far has not provided any obervational evidence of the northward continuation of the fault; although significant efforts are being made to determine the limits, the northern limits of this feature.

The theoretical northward projection of the fault apparently coincides or closely aligns with a topographic drainage feature west of Monticello Reservoir, and possible with general areal geophysical linear patterns. Dr. Secor and his consulting geologists in addition, familiar with the site, did not believe that these associations are sufficient evidence of faulting to extend the northern limits of the faulty beyond where it's

d4da

been mapped by Dr. Secor.

But, regardless of whether the Wateree Fault is ultimately found to extend to the vicinity of the reservoir, there is no geologic evidence where it has been mapped to suggest it's a capable fault, nor has there been any seismicity in the region associated with it. And therefore, while we plan to follow the progress of Dr. Secor's investigation closely as it continues, there is no reason to believe based on the findings to date that this feature is of concern to the safety of this facility.

So, to summarize, we have addressed the intervenor's contentions and the three major seismic issues (reservoir induced seismicity, the Charleston earthquake and the Wateree Fault) and find the design basis of the Virgil C. Summer Nuclear Station is adequate so that noen of these issues causes a safety concern for the facility. That concludes my statements.

MR. KNOTTS: Is it appropriate at this time, Mr. Chairman, to renew our offer of Dr. Alexander's testimony and ask it, along with his qualifications, be bound into the transcript as if read?

JUDGE GROSSMAN: Mr. Bursey, do you have any objections or voir dire?

MR. BURSEY: I certainly have some question of Dr. Alexander. I think we need to determine whether I want him to go over verbatim testimony or--

JUDGE GROSSMAN: Well, if it's cross-examination I

think it would be preferable to hold that until all of the panel has given their summaries and that way you can address something to Dr. Alexander or anyone else, unless you have a different preference that you would like made known to the Board now?

MR. BURSEY: I'm not sure if the other afiants are going to get into the same issues that I wanted to question Dr. Alexander on. We'll wait and see. I don't want to waive the reading of Dr. Alexander's testimony.

JUDGE GROSSMAN: Well, the question is really do you have any objections to the offer of the testimony? That does not mean that you can't cross-examine, but is there any objection to the admissibility of the testimony such as may be based on your questioning his qualifications and therefore disputing his expertise?

MR. BURSEY: No, sir, I'm not questioning that. I don't want to let the summary stand as his presentation, oral presentation before the Board. I believe I would want Dr. Alexander to go over his testimony more thoroughly.

JUDGE GROSSMAN: Mr. Knotts?

MR. KNOTTS: Mr. Chairman, I simply don't understand that. The purpose of prefiled testimony is so that the time of the Board and those that come to the hearing is not unnecessaily consumed by reading testimony which could have been read prior to the hearings. It was filed on May 28th.

The purpose of the pretial testimony is to expedite

the proceedings and to make it easier for all parties. If Mr. Bursey is readqy to conduct some questioning about Dr. Alexander's professional qualifications at this time, it's appropriate. Otherwise, it seems to me that the testimony should be admitted and then, if Mr. Bursey had additional questions about his testimony then that would be appropriate.

JUDGE GROSSMAN: Do you have questions, Mr. Bursey, that go to the admissibility of the testimony or do you merely want to cross-examine so as to undermine the testimony, impeach it?

MR. BURSEY: What I want is I want the hearing to a understandable to the public, and myself included. And Mr. Knotts' statement that the parties had the opportunity to read him testimony is very limited. I'm the only party in the room outside of the people who have been paid to be here who has had an opportunity to read this. There are a lot of people in the room, if they want to understand what's going on, if they want to see that the Board is being thorough, they're not going to be able to understand it.

JUDGE GROSSMAN: Again, Mr. Bursey, the question to you is whether you have objection to the admissibility of the testimony or merely want to cross-examine. If you merely want to cross-examine, I think we will hold that until after all the panel has given their summary. If you have questions as to admissibility or want to establish some questions as to admissibility in the

form of a voir dire examination, you may proceed with thatnow.

But it's my understanding from whatyou said that you want to cross-examine on the testimony and I think that would be held for later. Is that basically what you want to do--cross-examine?

MR. BURSEY: Yes.

JUDGE GROSSMAN: Okay. Fine. So let me ask you now whether you have any objections to the admissibility and that would be, for instance, on grounds of the experts not being qualified to offer expert testimony. Do you have any such questions?

MR. BURSEY: No.

JUDGE GROSSMAN: Okay. Well then, we will admit Dr. Alexander's testimony.

MR. KNOTTS: A copy has been provided to the reporter for that purpose, Your Honor.

[Insert]

MAY 28 1981

TESTIMONY OF
SHELTON S. ALEXANDER, PH.D
SOUTH CAROLINA ELECTRIC & GAS COMPAY
BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

My name is Shelton S. Alexander. I am employed by the Pennsylvania State University as a Professor in Geophysics in the Geosciences Department. A statement of my professional qualifications and relevant experience is attached hereto. Previous experience pertinent to the geologic and tectonic setting where the V. C. Summer facility is located includes: (1) Familiarity with the entire region gained from undergraduate studies at the University of North Carolina leading to a B. S. degree in geology; (2) serving from May, 1976, to present as principal seismological consultant to Carolina Power and Light Company with primary responsibility to direct the monitoring and interpretation of seismic activity in the vicinity of the Brunswick nuclear facility near Wilmington, North Carolina, and at the Shearon Harris nuclear plant site now under construction near Raleigh, North Carolina; (3) serving preiodically from July, 1978, to present as consultant to the Tennessee Valley Authority to assist in the evaluation of seismic design criteria for the Sequoyah, Watts Bar and Bellefonte nuclear plants, in particular the "Southern Appalachian Tectonic Study" which characterizes the regional tectonic and geologic setting of a large area

of the southeastern United States extending east of the Appalachians and including part of South Carolina; and (4) serving as seismological consultant for the Virginia Electric Power Company's seismic monitoring of their pumped-storage hydroelectric facility being constructed in Bath County, Virginia. In addition I have for several years been actively involved in seismic monitoring and seismic safety evaluation of particular nuclear power plant sites in the northeastern United States.

I have been retained as a Consultant to South Carolina Electric & Gas Company since October, 1980, to coordinate and integrate the seismic studies concerned with the V. C. Summer Nuclear Station and Monticello Reservoir. In this capacity I have reviewed all of the submittals to the Nuclear Regulatory Commission by South Carolina Electric & Gas regarding seismic issues and have personnally supervised the preparation of the document entitled "Supplemental Seismological Investigation - Virgil C. Summer Nuclear Station Unit 1 - December 1980" as well as subsequent presentations involving the findings of that investigation.

The purpose of my testimony is, first, to summarize briefly the results of our investigation and review of the seismic activity in the region in which the V. C. Summer

facility is located, particularly the reservoir-induced earthquakes that have occurred beneath and in the immediate vicinity of Monticello Reservoir; and, second, to explain briefly the basis for my conclusion that this investigation and review is adequate and indeed comprehensive to describe and provide a basis for evaluation of the potential seismic hazard at the Summer site and the basis for Dr. Chen's conclusion that a hypothetical local magnitude M_L=5.3 near field event will have no adverse effect on the V. C. Summer Nuclear Station's structural and equipment design.

I will begin by addressing contentions A4(a) and A4(b) raised by Mr. Bursey, an intervenor, and then present a brief summary of our findings concerning the three principal seismic issues: Reservoir induced seismicity; the Charleston earthquake, and the Wateree Ceek fault.

Contention A4(a)

The FSAR is inadequate with respect to the description of seismic acitvity in the area of the Summer plant site. Also, Mr. Bursey contends that a near-field magnitude of 5.3 should be used, and that the Water [sic] Creek Fault poses new seismic considerations which must be resolved.

The description of seismic activity that could affect the area of the plant site consists of two parts: (1) The

seismic effects that would be observed at the site caused by earthquakes in the surrounding region, and (2) effects that would be observed as the result of reservoir-induced seismicity in the immediate vicinity of the plant.

I have reviewed the data presented in the FSAR, and also other relevant literature on the subject. My review of seismicity and related geologic and tectonic issues included (but was not limited to) the following documents: FSAR (Section 2.5); Woodward Clydes' "Review of Reservoir Induced Seismicity"; all technical reports by Dr. Pradeep Talwani on reservoir-induced seismicity at Monticello Reservoir; journal articles and technical reports describing seismicity and interpretations of earthquake activity in the region other than in the Charleston area; and the Safety Evaluation Report (SER) for the Summer plant and its Supplement No. 1 (especially Section 2.5); Dr. Murphy's views discussed in Section 2.5.3 (pages 2-24 through 2-26 and 2-31); LASL's review in Section 2.5.3 and Appendix D; and the USGS letter by Dr. Devine in Appendix E. The report prepared under my supervision entitled "Supplemental Seismological Investigation - Virgil C. Summer Nuclear Station Unit 1 December 1980" presents a detailed evaluation of all available seismic information, except for the SER, which was issued subsequently. I

concluded that the literature search presented in the FSAR was thorough and my subsequent perusal of other available reports and publications revealed no new data that would alter the conclusions reached in the FSAR.

The largest earthquake in the Peidmont Tectonic Province was the Union County earthquake of January 1, 1913, located 35 miles (55 km) northwest of the site. For design purposes, this Modified Mercalli Intensity VII earthquake is taken to represent the largest event that could occur at the plant site. The estimated accelerations for such an earthquake are then used to define a safe shutdown earthquake (SSE). The anticipated ground motion at the site because of a repeat of the 1886 Charleston earthquake would cause a lower acceleration than the Union County earthquake, but the duration of shaking would be longer. The estimated accelerations for the Charleston event are used to define the operating basis earthquake (OBE). No other earthquakes in the Piedmont Tectonic Province have been larger than the Union County earthquake.

Thus, I conclude that the data presented in the FSAR and the other referenced documents provide an adequate and complete description of seismic activity in the area of the Summer plant site, contrary to the contention of the intervenor. The issues raised concerning a magnitude 5.3

near-field event and the Wateree Creek fault are addressed later in my testimony. Neither poses a seismic safety hazard to the V. C. Summer facility, based on our detailed site specific evaluation.

Contention A4(b)

The plans for monitoring site seismicity are inadequate, in that they do not consider the seismic effect of filling the reservoir. Site seismicity should be monitored for one year subsequent to filling the reservoir and prior to the granting of the operating license. Mr. Bursey now contends that monitoring should continue through 1983.

Monticello Reservoir is one of the rare early examples where seismic instrumentation was deployed prior to impoundment to observe any seismic activity caused by filling the reservoir. Data from JSC (a permanent seismographic station of the South Carolina seismic network) located 3.5 miles southeast of the plant, provided information on the background seismicity prior to filling. South Carolina Electric & Gas's four station network began providing reliable information just prior to filling the reservoir. The configuration of the South Carolina Electric & Gas network was adequate for obtaining accurate

epicentral locations in the reservoir area and those recordings together with observations from JSC indicated that the induced activity was occurring at shallow depths.

These data were supplemented with those obtained by deploying 2-5 portable seismographs in the epicentral area (in February-March, and July-September, 1978). Since July, 1978, additional information has been obtained from six new stations installed by the U. S. Geological Survey; these additional data confirm that the depths are shallow (<3 km, with 98% of the events <2 km).

Thus, instead of the plans for monitoring the induced seismicity being inadequate, they are more than adequate to characterize the seismic activity associated with the filling of Monticello Reservoir.

To date, seismicity data at Monticello Reservoir have been obtained for 3 1/2 years subsequent to filling, 2 1/2 years longer than originally suggested by intervenor Bursey. After the initial spurt of activity following the filling of the reservoir (January-February, 1978), there has been a marked decrease in the activity level both in total number of recorded events (magnitude $M_L > -0.6$) and in the number of the larger ($2.0 < M_L \leq 2.8$) events. There have been several brief flurries of activity in 1978 and 1979; however, since then there has been a continual

decline in the average activity rate. Also there has been no spatial growth laterally or in depth of the induced seismicity subsequent to the initial period of activity.

Thus, in over 3 1/2 years of monitoring the seismicity at Monticello Reservoir, we have seen a pattern of induced microearthquake activity, which is limited spatially to shallow depths in the immediate vicinity of Monticello Reservoir; the largest events are in the magnitude range $2.5 \leq M_L \leq 2.8$ and there has been an overall decline in activity with time following the initial peak. Thus, in my opinion, the microseismicity at Monticello Reservoir, though very interesting scientifically, does not constitute a safety hazard to the Virgil C. Summer Nuclear Station.

South Carolina Electric & Gas has committed to continue monitoring the seismic activity at Monticello Reservoir until the end of 1982, at which time an evaluation will be made in conjunction with the NRC staff to determine if it should be continued. Such evaluation will be based on the activity up to that time and the potential significance of the data which might be obtained through continued monitoring.

Evaluation - Reservoir Induced Seismicity

I have been intimately involved in the evaluation of the reservoir-induced seismicity at Monticello Reservoir, and was responsible for coordination and preparation of the report entitled, "Supplemental Seismologic Investigation - Virgil C. Summer Nuclear Station Unit 1 - December 1980", prepared for South Carolina Electric & Gas Company.

Reservoir induced seismicity (RIS) is a relatively, recently recognized phenomenon and quantitative evaluations are limited by lack of data in most instances. Monticello Reservoir is unusual in that it is probably one of the best-documented cases in RIS in the world. Of the approximately 11,000 reservoirs worldwide, only 45 have confirmed RIS associated with them; there are 12 other questionable cases. Of those confirmed, 30 are associated with macroseismicity ($M_L \geq 3.0$) and 15 are associated with microseismicity ($M_L < 3.0$); Monticello is included in the latter (microseismicity) group that is characterized by small magnitude events. Of the 59 reservoirs constructed within the Piedmont Tectonic Province since 1891, 12 have experienced nearby seismic activity, two of which are confirmed as RIS (Jocassee and Monticello). With over 2,193 reservoir/years of data in the Piedmont Tectonic Province, no reservoir has been associated with a seismic event greater than Modified Mercalli Intensity (MMI) VI or

approximately M_b = 4.3. Except for the single event of this size, the 1974 Clark Hill earthquake, which in fact may not have been reservoir induced, all other events are less than M_L = 4.0.

Also, of the RIS events worldwide, 10 reservoirs have experienced nearby earthquakes with magnitudes $M_L \geq 5.0$. Of these 10, 8 are associated with known active faulting and the other 2 have probable active faults based on known local geology. There are no known or suspected capable faults near Monticelo Reservoir.

We also found that for all RIS events with $M_L \geq 5.0$, the estimated focal depths have been at a minimum of 5 km, and in most cases greater than 10 km. The microseismicity at Monticello Reservoir has been very shallow (98% of events < 2 km, and all events < 3 km). Over three years of monitoring has shown that the microseismicity is not increasing in depth.

As previously stated, Monticello Reservoir is one of the best-documented cases of RIS in the world, and consequently a significant amount of site-specific data have been acquired which provides a good basis for understanding the RIS at Monticello Reservoir. Our evaluation indicates that the observed RIS is the result of superficial adjustments to the altered stress field caused

by reservoir impoundment, and that there is no evidence that suggests anything more than micro-earthquake activity will occur there in the future. Based on all the observed data, M_L = 4.0 is our estimated upper bound for RIS at Monticello. The most important arguments which support the estimated maximum RIS event of M_L = 4.0 at Monticello Reservoir are:

(1) The seismicity induced by Monticello Resrevoir is shallow (<3 km) and closely associated with the peripheries of shallow plutonic rock bodies of limited size (~ 1-2 km), where there is a highly variable, heterogeneous stress field and heterogeneous rock properties, both of which limit potential seismic source dimensions, hence maximum magnitude.

(2) Because of the spatial scale (dimensions) of lateral and vertical heterogeneities in deviatoric stress and in heterogenous physical properties of the bedrock beneath the reservoir, there are only small pontential seismic source areas (of <1 km^2) for fault movement during any single seismic event.

(3) The overall rate of seismicity is declining, suggesting that the stored elastic strain being relieved through the occurrence of shallow seismicity is not being replenished.

(4) The evaluation has revealed that the effects of the reservoir impoundment are very limited in spatial extent (laterally as well as vertically) with a stress barrier surfce beneath the active seismicity; this barrier will prevent a fault from propogating through it from above or below. This limits the maximum vertical fault dimension (hence magnitude) at shallow depths and prevents a deeper fault from reaching the surface. The occurrence of shallow seismicity under these conditions is highly unlikely to increase the probability of a larger tectonic event (Intensity VII) occurring beneath the site.

The preponderance of historical data supports the findings from our extremely detailed site specific evaluation of RIS at Monticello Reservoir that it is appropriate to assign an upper bound for the maximum RIS event. From these historical data, the conclusions are:

(1) Nearfield RIS events of $M_L \geq 5.0$ should not be considered in the Virgil C. Summer evaluation as this would imply an induced earthquake larger than the maximum tectonic earthquake known to have occurred in the Piedmont Tectonic Province.

(2) $M_L = 4.5$ is a very conservative upper bound for RIS anywhere in the Piedmont Tectonic Province because only one RIS event (Clark Hill - 1974) has been larger than $M_L = 4.0$ and it may not have been an induced event.

(3) No reservoir as shallow as Monticello outside of an active seismic zone has RIS as large as $M_L = 4.0$.

Statistical estimates of ground accelerations at the site made by Dr. McGuire, taking into account observed strong motion data from the largest induced earthquakes at Monticello Reservoir, reveal that, in order to equal or exceed the design accelerations a $M_L = 4.5$ event must be closer than 2 km, a $M_L = 5.0$ must be closer than 3 km, and a $M_L = 5.5$ must be closer than 4 km. Inasmuch as all reported reservoir induced events with $M_L \geq 5.0$ have reported source depths greater than 5 km and site specific data indicates that an event that large at Monticello would

also be deeper than 5 km, our conclusion is that an event of the size suggested by Dr. Murphy (M_L = 5.3) and later by intervenor Bursey would not adversely affect the Summer facility.

Moreover, Dr. McGuire has calculated, under very conservative assumptions, that the mean return period for such an event (M_L = 5.3) (which would be well beneath the plant site as just discussed) is approximately 5,000 years, which is of the same order as that for tectonic events in the Piedmont Tectonic Province. Also, all previous M_L = 5.0 RIS evnts have been associated with capable faults, and none is known or suspected in the vicinity of the Summer facility. In his testimony, Dr. Chen will address the response of the facility to these postulated nearfield events.

Evaluation - Charleston Earthquake (1886)

I have become familiar with the studies being conducted by USGS on the occurrences of the 1886 Charleston earthquake. The likelihood of occurrence of another event such as the 1886 Charleston earthquake was considered, and the question of its possible impact upon the Virgil C. Summer Nuclear Station depends upon the tectonic mechanism(s) that caused the event to occur. Available data and literature

regarding the geologic cause of the earthquake have been thoroughly reviewed and probabilistic analyses based upon the three most prominent possible scenarios that have been proposed to explain the Charleston event were made for comparison to the current design parameters at the Summer facility.

The three major hypotheses which have been reviewed are:

(a) Stress amplification at the margins of mafic or ultramafic plutons;

(b) Reactivation of steep basement faults of diverse orientation and age of development;

(c) Reactivation of a master decollement, either by active thursting or by gravity-induced backslip.

Each has certain weaknesses, but none of these hypotheses can be ruled out, although there is little or no observational evidence in support of widespread reactivation of a master decollement ((c) above). It is concluded that the cause of the Charleston earthquake is still not known.

Probability studies in terms of return period for each of these hypotheses have been performed. From these studies it was determined that the siesmic design basis for tectonic earthquakes is adequate regardless of which of the

three hypotheses is used to explain the distribution of seismic activity in tectonic provinces in the eastern United States.

From: The extensive work done by USGS; evaluations of the most prominent hypotheses; the probabilities of future occurrences; and the historical record of seismicity in the Charleston area; it is my opinion that there is no observational evidence to indicate that an earthquake comparable to the 1886 event will reoccur in any location except for the Charleston vicinity. A reoccurrence of such an event in the Charleston area will not generate ground motions that exceed the Summer design basis.

Evaluation - Wateree Creek Fault

Subsequent to the impoundment of Monticello Reservoir and the ensuing increase in local seismic activity, the United States Geological Survey (USGS) contracted the services of Dr. Donald T. Secor, Jr., Department of Geology, University of South Carolina, to conduct an intensive geologic investigation of the general area surrounding the reservoir. The purpose of the investigation is to provide additional detailed geologic information which, it is hoped, will provide a better understanding of the causes of the observed spatial

variations in the local seismicity at Monticello Reservoir. This geologic investigation encompasses an area considerably beyond the area investigated by the South Carolina Electric & Gas Company during Preliminary Safety Analysis Report studies. The investigation, as presently conceived, consists of the following tasks:

(1) Geologic field mapping of the Jenkinsville, Chapin, Pomaria, and Little Mountain 7 1/2 minute quadrangles.

(2) Extensive study of fracture orientations within the four quadrangles.

(3) Magnetometer survey of diabase dikes within the aforementioned four quadrangles.

The investigation was initiated in March, 1980, and is scheduled to be completed in February, 1982. The first technical report of the progress of the investigation was submitted on September 30, 1980. The report, "Geological Studies in an Area of Induced Seismicity at Monticello Reservoir, South Carolina," by Donald T. Secor, Jr., Principal Investigator, contains a description of the work accomplished, findings, and tentative conclusions. Dr. Secor has emphasized that the conclusions presented in his

report are tentative and subject to revision during progress of the investigation.

During the course of the investigation to date, Dr. Secor has mapped a previously unrecognized fault within the Chapin quadrangle which he has named the Wateree Creek Fault.

I have reviewed the findings by Dr. Secor to date and have reached the following conclusions:

(1) Substantial evidence exists indicating the presence of the Wateree Creek Fault in the Chapin quadrangle as presently mapped by Dr. Secor. The fault has been traced nothward to a point approximately two kilometers southeast of Peak, South Carolina. The progress of the field work to date has not provided any observational evidence of northward continuation of the fault, although intensive efforts to resolve the limits of the fault have been given a high priority by Dr. Secor.

(2) A theoretical northward projection of the fault apparently coincides or closely aligns with a topographic drainage feature west of Monticello Reservoir, and possibly with general areal

geophysical linear patterns. Dr. Secor and consulting geologists familiar with the site geology do not believe these associations to be sufficient evidence of faulting to extend the northern limit of the fault beyond the northernmost control point presently mapped.

(3) The scope of Dr. Secor's present investigation is thorough and comprehensive, and it is highly probable that his intensive efforts to define the northernmost extent of the fault will produce conclusive field evidence on whether the fault continues across the Broad River toward Monticello Reservoir.

(4) Regardless of whether the Wateree Creek fault is ultimately found to extend to the vicinity of Monticello Reservoir, there is no geologic evidence where it has been mapped to suggest that it is a capable fault nor has there been any seismicity associated with it. Therefore, while we plan to follow the progress of Dr. Secor's investigation very closely, there is no reason to believe, based on the findings to date, that this feature is of concern to the safety of the Summer facility.

In summary, then, we have addressed the intervenor's contentions and the three major seismic issues (reservoir induced seismicity, the Charleston earthquake, and the Wateree Creek fault) and find that the design basis of the Virgil C. Summer Nuclear Station is adequate so that none of these issues causes a safety concern for the facility.

Appendix A

MAY 28 1981

PROFESSIONAL QUALIFICATIONS

SHELTON S. ALEXANDER

My name is Shelton S. Alexander. I am employed by the Pennsylvania State University (PSU) as a Professor of Geophysics in the Geosciences Department. I have been employed by PSU since 1965, working as both a professor and coordinator of graduate programs.

I earned my B.S. degree in Geology at the University of North Carolina in 1956; my Letters of Completion (Geophysics) from Sorbonne, University of Paris in 1957; my M.S. degree in Geophysics from the California Institute of Technology in 1959; and my Ph.D. degree in Geophysics from the California Institute of Technology in 1963.

From 1958 to 1961, I was a Research Assistant at the Seismological Laboratories at the California Institute of Technology.

From 1962 to 1963, I was a Research and Consultant Seismologist for United Electrodynamics in California and Virginia. I performed consulting work in the area of seismology.

In 1964, I taught Geophysics as an Associate Professor at the Air Force Institute of Technology in Ohio.

From 1965 to the present, I have been employed by the Pennsylvania State University in the following capacities:

Associate Professor of Geophysics (1965-1972); Director of Seismic Observatory (1968-Present); Professor of Geophysics (1972-Present); Chairman, Geophysics Program (1971-Present); and Graduate Programs Coordinator (1974-Present).

I have served as a consultant in seismology to the following industries: Carolina Power & Light Company; COMSAT; Empire State Electric Energy Research Corporation; Niagra Mohawk Power Company; Tennessee Valley Authority; Virginia Electric Power Company; and Weston Geophysical Corporation.

Since October 1980, I have served as consultant to South Carolina Electric & Gas Company, to coordinate and integrate the seismic studies concerned with the Virgil C. Summer Nuclear Station and Monticello Reservoir.

My professional society memberships include: American Geophysical Union (past Vice-President and President, Seismology Section); Seismological Society of America (past Vice-Chairman and Chairman, Eastern Section); Society of Exploration Geophysics; Royal Astronomical Society; and the American Association for the Advancement of Science.

I have also participated in or been a delegate to the following organizations: National Academy of Sciences, National Research Council Committee on Seismology; National

Academy of Sciences, Committee on International Participation (alternate principal delegate to IUGG/IASPEI, Peru, 1973); Chairman, Committee on Travel Grant Awards for IUGG/IASPEI Meeting 1973; Secretary, 1973 Annual Meeting Committee, General Chairman, 1974 and 1975 Annual Meeting Committee ; Project Ketch Subcommittee, Governor's Advisory Committee on Atomic Energy Development and Radiation Control (PA); Solid Earth Sciences Long Range Planning Committee (PSU); Advisory Panel to President's Science Advisor and NSF on Earthquake Prediction and Hazard Mitigation; Advisory Panel to DOD on Threshold Test-Ban Treaty; Geodynamics Committee, AGU; Earth Dynamics Advisory Subcommittee, NASA (Chairman, Panel on Earth Deformation and Earthquake Prediction); Chairman, IASPEI, Committee on Digital Seismometry; Member, National Academy of Science, Space Science Board (Committee on Earth Science and Committee on Data Management and Computation).

I have been an author or co-author of approximately 60 scientific publications, plus numerous research reports on grants and projects.

MR. KNOTTS: Dr. McGuire, would you proceed to give us a brief summary of your testimony. Excuse me. Mr. Goldberg, did you have any objections or voir dire?

MR. GOLDBERG: No, sir.

MR. KNOTTS: I'm sorry.

JUDGE GROSSMAN: Yes, you may proceed.

DR. MCGUIRE: My name is Robin McGuire. I am employed by the firm of Ertec Rocky Mountain, Incorporated, spelled E-r-t-e-c. I have worked as a consultant to South Carolina Electric & Gas since June of 1980, to conduct investigations associates with Virgil C. Summer Nuclear Station.

These investigations have been in the area of estimation of ground motion characteristics associated with hypothesized reservoir-induced earthquakes and in the area of calculation of probabilities of occurrence of various levels of ground motion at the nuclear station reaulting from both reservoir-induced earthquakes and tectonic-induced earthquakes.

The result of those investigations has been already summarized by Dr. Alexander and are accurately reported in all the submittals to the hearing and in the record associated with the Virgil C. Summer Nuclear Station over the last year.

MR. KNOTTS: Thank you, Dr. McGuire. Mr. Chairman, at this time I would move the admission of Dr. McGuire's testimony which he has already adopted as his testimony and the statements of his qualifications and ask that it be bound into the transcript

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as if read.

JUDGE GROSSMAN: Mr. Bursey?

MR. BURSEY: I have no questions of Dr. McGuire's professional capability but I would like to ask if he's appearing as a consultant and has your firm been registered as a consultant?

DR. MCGUIRE: Yes, it has.

MR. BURSEY: And you were delegated by your firm to appear today, or were you retained personally?

DR. MCGUIRE: I'm not paid directly by South Carolina Electric & Gas; I'm paid through my firm.

MR. BURSEY: And are you paid--is your salary contingent on your appearance here?

DR. MCGUIRE: No.

MR. BURSEY: Okay. That's all.

JUDGE GROSSMAN: Does that conclude your voir dire?

MR. BURSEY: Yes, sir.

JUDGE GROSSMAN: Do you have any objections to the admissibility of his testimony?

MR. BURSEY: No.

JUDGE GROSSMAN: Mr. Goldberg?

MR. GOLDBERG: No.

JUDGE GROSSMAN: The State of South Carolina?

MR. FINKLEA: No.

JUDGE GROSSMAN: Admitted.

[Insert]

TESTIMONY OF

ROBIN KEITH MCGUIRE, PH.D.

SOUTH CAROLINA ELECTRIC & GAS COMPANY

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

My name is Robin Keith McGuire. I am employed by the firm of Ertec Rocky Mountain, Inc., as a Senior Engineer. A copy of my statement of professional qualifications and affiliations is attached hereto. I have worked as a consultant to South Carolina Electric & Gas Company since June, 1980, with the purpose of conducting seismic investigations for the Virgil C. Summer Nuclear Station and Monticello Reservoir. For these facilities, I have conducted studies in the following areas:

1. Estimation of ground motion characteristics associated with hypothesized reservoir-induced earthquakes.
2. Calculation of probabilities of occurrence associated with various levels of ground shaking at the nuclear station resulting from reservoir-induced earthquakes.
3. Calculation of probabilities of occurrence associated with various levels of ground shaking at the nuclear station resulting from tectonic earthquakes.

All of my work was professionally and accurately performed, and the conclusions I reached have been accurately reflected in the materials filed with the NRC by SCE&G.

PROFESSIONAL QUALIFICATIONS

ROBIN KEITH MCGUIRE

My name is Robin Keith McGuire. I am Director - Decision Analysis for Ertec Rocky Mountain, Inc. I am responsible for the development and application of methods of decision theory to optimize planning, investment, and operations decisions in the energy and mining field. I apply methods of risk analysis for projects in geotechnical and earthquake engineering. I have been employed by Ertec Rocky Mountain, Inc. since 1980.

In 1968, I earned an S.B. Degree in Civil Engineering from Massachusetts Institute of Technology. I received my M.S. Degree in Structural Engineering from the University of California, Berkeley in 1969, and in 1974 received my Ph.D. in Structural Engineering from Massachusetts Institute of Technology.

From 1974 to 1979, I worked for U.S. Geological Survey in Golden, Colcrado, Branch of Earthquake Hazards. I was involved in developing probabilistic methods to determine optimum design of structures for seismic loads, and applying these methods to areas in the United States for the purpose of recommending seismic design requirements for buildings, dams and power plants. Research there included determining which professional and statistical

uncertainties tainties are most important in the context of seismic risk assessment, and determining the relative importance of various earth science technologies (e.g., earthquake prediction and ground motion estimation) for reducing the monetary and life loss during future earthquakes.

From 1979 to 1980, I was employed by Dames & Moore of Denver, Colorado. My position there required the application of seismic risk analysis methods to engineering facilities, including nuclear power plants and commercial facilities, located throughout the country, as well as the development and application of formal decision analysis methodology to evaluate social, economic, and environmental impacts of alternate engineering design of facilities. I also investigated and used geostatistics for making ore reserve estimates and mining development decisions in the mineral exploration field.

I am a member of the following professional associations: Technical Council on Lifeline Earthquake Engineering of American Society of Civil Engineers; Seismic Risk Committee of Earthquake Engineering Research Institute; Seismological Society of America; Chi Epsilon (National Civil Engineering Honorary Fraternity); Tau Beta Pi (National Engineering Honorary Fraternity); and Sigma Xi

(National Scientific Society). I am a Registered Professional Engineer in Colorado and Massachusetts. The Research Award for Foreign Specialists was awarded to me by the Science and Technology Agency of Japan, allowing three months research at Public Works Research Institute in Tokyo in 1977.

MR. KNOTTS: Dr. Chen, would you give us a brief statement of your testimony?

DR. CHEN: My name is Chang Chen. I am the Section Manager of Specialty Structures, Power Division, Gilbert/Commonwealth Companies. I have been a Gilbert/Commonwealth employee since 1969, and participated in the design work of Virgil C. Summers Nuclear Station intermittently since the beginning.

My testimony is related to the effect of reservoir-induced seismicity on the structural and equipment design of Virgil C. Summer Nuclear Station. As discussed in Dr. Shelton Alexander's testimony, the estimated maximum seismic event that might be induced by the Monticello Reservoir is of local magnitude M_L equals 4.0. For an average stress drop of twenty-five bars over the fault plane and source distance of 2.0 kilometers, the Brune model and random vibration theory give a zero period acceleration value of .14g which is less than the safe shutdown earthquake value. Thus, for such an avent, there is no adverse effect on the structural and equipment design.

At the instance of ACRS and the NRC Staff, we were asked to address certaion hypothetical seismic events larger than that which we had demonstrated to be the maximum reservoir-induced seismicity. The effect of the reservoir-induced seismicity with hypothetical local magnitude M_L equals 4.5 to 5.3 on the structural and equipment design was investigated.

The built-in conservatism can be used to demonstrate

adequacy of plant design. After taking into account the more realistic ZPA value in combination with the statistical studies, we can conclude that hypothetical local magnitude M_L equals 5.3 near field event has no adverse effect on the Virgil C. Summer Nuclear Station structural and equipment design.

MR. KNOTTS: Thank you, Dr. Chen. Mr. Chairman, we renew our motion to have Dr. Chen's prefiled testimony along with his statement of educational and professional qualifications received in evidence and bound in the transcript as if read.

JUDGE GROSSMAN: Mr. Bursey, any objections or voir dire?

MR. BURSEY: I don't have any objection to Mr. Chen's professional capabilities. I would like to ask a few more questions though.

VOIR DIRE EXAMINATION

MR. BURSEY: Do you work for Gilbert/Commonwealth?

DR. CHEN: Yes, sir.

MR. BURSEY: And what does Gilbert/Commonwealth do?

DR. CHEN: We are consulting engineers specializing in designing power plants.

MR. BURSEY: Specializing in?

DR. CHEN: In designing power plants.

MR. BURSEY: And you helped prepare the earlier reports and they are about the initial estimates of anticipated seismic activities?

DR. CHEN: You mean the siesmology reports?

MR. BURSEY: Well, the ones that are in the FSAR, the original projections for seismicity?

DR. CHEN: No.

MR. BURSEY: I don't have any questions about his professional capabilities. Again, I don't know if his summary is sufficient for understanding by the public to--

JUDGE GROSSMAN: You can clear that up on cross-examination. Mr. Goldberg?

MR. GOLDBERG: No objection.

JUDGE GROSSMAN: The State of South Carplina?

MR. FINKLEA: No.

JUDGE GROSSMAN: Admitted.

[Insert]

TESTIMONY OF

CHANG CHEN, PH.D.

SOUTH CAROLINA ELECTRIC & GAS COMPANY

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

My name is Chang Chen. I am the Section Manager of Specialty Structures, Power Division, Gilbert/Commonwealth Companies (G/C). A statement of my professional qualifications is attached hereto (Appendix A). I have been a G/C employee since 1969, and participated in the design work of V. C. Summer Nuclear Station intermittently since the beginning. I am knowledgeable of V. C. Summer FSAR Sections 2.5.2.9, 2.5.2.10, 2.5.2.11, 3.6.2.3.1, 3.7, 3.8, 3.9.1.2, and 3.10. I also prepared Appendix X of the Supplemental Seismological Investigation of V. C. Summer Nuclear Station Unit 1, Docket No. 50/395, December 1980.

My testimony is related to the effect of reservoir induced seismicity (RIS) on the structural and equipment design of V. C. Summer Nuclear Station. As discussed in Dr. Shelton Alexander's testimony, the maximum seismic event that might be induced by the Monticello Reservoir is of local magnitude M_L=4.0. For an average stress drop of 25 bars over the fault plane and source distance of 2.0 km, the Brune model and random vibration theory give a zero

period acceleration (ZPA) value of .14g which is less than the safe shutdown earthquake (SSE) value. Thus, for such an event, there is no adverse effect on the structural and equipment design.

At the instance of ACRS and the NRC Staff, we were asked to address certain hypothetical seismic events larger than that which we had demonstrated to be the maximum reservoir induced seismicity. The effect of reservoir induced seismicity with hypothetical local magnitude M_L=4.5 to 5.3 on the structural and equipment design was investigated. The near field earthquake M_L=5.3 has a ZPA value of 0.22g which is higher than the SSE value. However, the built-in conservatism can be used to demonstrate the adequacy of plant design. The plant design used 2% structural damping and the NRC Regulatory Guide 1.61 allows 7% damping. The comparison of 0.22g hypothetical near field response spectrum at 7% damping with the V. C. Summer SSE spectrum at 2% damping indicates that the SSE spectrum is not exceeded in the frequency region of dominant modes of most seismic Category I structures. The SSE spectra would be exceeded in the frequency region higher than about 9 Hz. However, among all the seismic Category I structures, only the Interior Concrete Structure (ICS) of the Reactor Building has

dominant frequency higher than 9 Hz. Thus, the ICS was investigated in detail.

The original ICS design used a single time history, of which the calculated response spectrum envelopes the SSE spectrum, as input. To identify the margin provided by the envelope process, 36 time histories were used in the investigation. The spectrum of each of the 36 time histories matches the 0.22g hypothetical near field spectrum at 7% damping in the mean. The 36 time histories were used as input, one at a time, to the ICS in the dynamic analysis. Thirty-six sets of floor response spectra were calculated and the mean values were obtained. The comparison of the V. C. Summer SSE floor response spectra and the mean value hypothetical near field floor response spectra at the same equipment damping value indicated that the SSE floor response spectra exceeded the hypothetical near field floor response spectra in almost every frequency region, especially by a large margin in the resonance region. The SSE floor response spectra were exceeded only in the 20 to 30 Hz region by a small amount. We assessed the design margin of the relatively rigid essential equipment required for cold shutdown and concluded that it is more than sufficient to cover the small deviation observed. Thus, we can conclude that the

hypothetical local magnitude M_L=5.3 near field event has no adverse effect on the V. C. Summer Nuclear Station structural and equipment design.

PROFESSIONAL QUALIFICATIONS

CHANG CHEN

My name is Chang Chen. I am Section Manager of Specialty Structures, Power Division, Gilbert/Commonwealth Companies (G/C). I have been an employee of G/C since 1969, working in the area of earthquake engineering, structural dynamics, structural design of nuclear and fossil power plants.

I earned my B.S. degree in Civil Engineering at Cheng Kung University in 1962, my M.S. degree in Civil Engineering at Duke University in 1965, and my Ph.D. degree in Engineering Mechanics at The Pennsylvania State University in 1969. I am a Registered Professional Engineer in the Commonwealth of Pennsylvania. I was a committee member of the American Society of Civil Engineers (ASCE) Seismic Task Group in 1976. I am a committee member of the Institute of Electrical and Electronics Engineers, Inc. (IEEE) Working Group 2.5 on the Seismic Qualification of Electric Equipment, and a committee member of the American Society of Mechanical Engineers (ASME) Working Group on Shells.

From 1963 to 1969, I taught Mechanics and performed research work in Structural Mechanics at Duke University and The Pennsylvania State University.

In 1969, I joined G/C Structural Department. From 1969 to 1972, I developed computer programs for seismic analyses of structure and piping systems. I performed seismic resistant designs of nuclear power plants in the United States and Japan. I also performed aircraft resistant design review of prestressed concrete containment structures.

In 1973, I acted as a consultant to the Atomic Power Department of Taiwan Power Company for the seismic resistant design of nuclear power plants. From 1972 to 1974, I performed seismic resistant design of pressurized water reactor (PWR) plants and high temperature gas-cooled reactor (HTGR) plants in the United States, Japan, and Korea. I also designed the low-tuned or flexible turbine pedestal, pipe whip restraints of high energy lines; participated in the seismology study, standard nuclear plant design, and the preparation of equipment seismic qualification specification.

From 1974 to 1978, as supervisor of Structural Mechanics, I supervised the following work: nuclear and fossil plant stress analysis and design, seismic resistant design of PWR and boiling water reactor (BWR) structures and equipment, missile protection design, pipe whip restraint design, compartment pressurization design, jet impingement design, finite element stress analysis and

thermal stress analysis of reinforced concrete structures, and aircraft impact resistant design using soft shell concepts for Babcock-Brown-Boveri Reaktor GmbH (BBR) of Germany. I also worked on the shrinkage and creep of prestressed concrete, effect of coarse aggregates on the crack propagation of concrete structures, behavior of concrete structures under multiaxial stresses. I performed the platform and cold water pipe analysis of the ocean thermal energy conversion system (OTEC) under random wave and current effects.

From 1978 to 1979, as a Supervising Structural Engineer, I was responsible for technical supervision and personnel administration in the area of structural mechanics and computer application. I was also the manager of Kraftwerk Union (KWU) project for the seismic design review of the ~~13,000~~ 1300 MW_e PWR power plants in Iran, and for providing technical support to the KWU Engineering Department. I also supervised the BWR plant MARK III system safety relief valve discharge (SRVD) and loss of coolant accident (LOCA) related hydrodynamic and structural analyses.

From 1979 to present, as the Section Manger of Specialty Structures, I have been responsible for technical supervision and personnel administration of the continuing services of all operating nuclear power plants, computer

applications, applied research and special projects. I am also the manager of the TVA project for design review of Browns Ferry Nuclear Plant MARK I long term torus integrity program. I participated in the study of reservoir induced seismicity, and evaluated its effect on structural and equipment design.

MR. KNOTTS: Dr. Talwani, you have not presented prefiled testimony. Could you briefly tell us what your role has been in connection with this seismic review?

DR. TALWANI: I teach and do research at the University of South Carolina. I've been doing researchin the area of reservoir-induced seismicity and earthquake prediction since about 1974 on contract from the U. S. Geological Survey and National Science Foundation.

Since 1979 I have also got a research grant from SCE&G to monitor the seismicity of Monticello Reservoir. I have served as a consultant to SCE&G in preparation to apply to NRC and to appear in these hearings.

MR. KNOTTS: Thank you, Dr. Talwani. At this time I would renew our motion that Dr. Talwani's statement of educational and professional qualifications be received into evidence and gound into the transcript as if read.

JUDGE GROSSMAN: Mr. Bursey?

MR. BURSEY: If Dr. Talwani's presence here, since we don't have any prefiled testimony for him, is to respond during cross-examination to specific points that might come up, I'm not sure what--

MR. KNOTTS: That's correct.

VOIR DIRE EXAMINATION

MR. BURSEY: Dr. Talwani, you said you received a research grant from SCE&G?

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DR. TALWANI: Yes.

MR. BURSEY: What was that for?

DR. TALWANI: We monitored the seismic activity and submitted quarterly reports indicating where the earthquakes had taken place and attempted to give the location and the nature of seismic activity quarterly.

MR. BURSEY: And when did that begin?

DR. TALWANI: In January 1979.

MR. BURSEY: Is that concluded?

DR. TALWANI: No, it's continuing.

MR. BURSEY: Are you presently a consultant for SCE&G?

DR. TALWANI: This is a contract for the university which we submit these reports but I'm also consultant in the preparation of reports and so on and questions to NRC.

MR. BURSEY: And were you involved in the original estimates of seismic activity of the FSAR?

DR. TALWANI: No, I was not.

JUDGE GROSSMAN: Mr. Goldberg?

MR. GOLDBERG: No objections.

JUDGE GROSSMAN: South Carolina?

MR. FINKLEA: No.

JUDGE GROSSMAN: Admitted.

[Insert]

PROFESSIONAL QUALIFICATIONS

PRADEEP TALWANI

My name is Pradeep Talwani. My business address is Geology Department, University of South Carolina, Columbia, South Carolina 29208. I am employed by the University of South Carolina as an Associate Professor in the Geology Department.

I was graduated (first class first) from the Indian School of Mines, Dhanbad, India, in 1962 with a Master of Science in Applied Geophysics. From 1962 to 1968, I worked for the Oil and Natural Gas Commission, India in Gravity-Magnetic survey parties--being the Party Chief from 1965 to 1968.

I joined Stanford University in 1968 and was graduated from there in 1973 with a Doctor of Philosphy in Geophysics.

From September 1973 until August 1977, I was employed by the University of South Carolina as an Assistant Professor. I was promoted to the rank of Associate Professor in August 1977.

During my stay at the University of South Carolina I have been actively engaged in several research projects.

Since 1974, I have been engaged in obtaining the seismic velocity structure of South Carolina in order to better understand the seismicity of the state.

Another area of research that I have been engaged in (since summer 1974) is reservoir induced seismicity (RIS). I have studied RIS at Clark Hill reservoir, Lakes Keowee and Jocassee, and for the past four years Monticello Reservoir. Besides monitoring the seismicity my effort has been to try and understand it. I have presented my work at national meetings of the American Geophysical Union and Seismological Society of America. At these meetings I have also chaired sessions on RIS and earthquake prediction--another area of research I have been engaged in since 1975.

I have been a consultant to South Carolina Electric & Gas Company since 1978 in the analysis and study of RIS at Monticello Reservoir, and have provided periodic reports on the seismic activity at the Virgil C. Summer Nuclear Station working under a grant provided to the University of South Carolina by South Carolina Electric & Gas Company.

I am a member of the American Geophysical Union, Seismological Society of America, Society of Exploration Geophysicists, American Association for the Advancement of Science, etc. My research work has been published in the Journal of Geophysical Research, Bulletin of Seismological Society of America, Earthquake Notes, Professional paper (on the Charleston earthquake) of the U. S. Geological

Survey, Physics of Earth and Planetary Sciences, Engineering Geology, Tectonophysics, etc. I have reviewed research proposals for NSF, NASA, and U. S. Geological Survey. I have reviewed research papers for several journals.

JUDGE GROSSMAN: At this point Mr. Bursey may proceed with the cross-examination.

MR. KNOTTS: Mr. Chairman, there are some exhibits that are associated with the testimony of these gentlemen and may be helpful from the standpoint of Mr. Bursey's cross-examination and the Board's questions if we proceed with those first, but I have no objection to any manner of proceeding.

JUDGE GROSSMAN: Could you indicate to me again what the parties have done with regard to the exhibits?

MR. KNOTTS: We designated in our memorandum of transmittal submitted May 28, 1981, a number of exhibits beginning at page five; the exhibits are listed.

And the exhibits associated specifically with these--or the FSAR would encompass virtually all of the exhibits. The exhibits associated with these witnesses would be those noted as f, g, h and I on page six in my memordndum of transmittal.

JUDGE GROSSMAN: Have the parties stipulated the admissibility of the exhibits?

MR. KNOTTS: We had an oral agreement over the telephone a little more than a week ago, Mr. Chairman. We have memorialized it in writing. I think Mr. Bursey does not feel that he has had enough time to look at the written version of it. So at least for this morning we are proceeding without benefit of a signed stipulation; although I think we still have an agreement in principle.

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MR. BURSEY: This morning Mr. Knotts handed me the written stipulation and I do need more time to better understand exactly what it is being stipulated to, not as to the authenticity of the documents. I don't have any doubt that they were authentic. But as to the manner in which they are entered into the record, I'm not sure how the stipulation affects that and if you'd like to go into that now, we could do so and clarify that matter, or wait and allow me to consult with other people and what it means to proceed without the stipulation.

MR. KNOTTS: Would it help if I explained the nature of the effect of the stipulation and provided copies to the Board so that if Mr. Bursey has any questions, he can have the comfort at least of knowing that the Board has looked at what we've drafted?

JUDGE GROSSMAN: Mr. Knotts, you made an offer of the exhibits and the Board would like to act on that as quickly as possible. We are close to the lunch hour now and I think it would be advisable if you got together with other counsel and Mr. Bursey and decided where we are or where you are as far as the exhibits go and then we can rule on your offer after lunch, taking into account what Mr.Bursey and the other parties have to say with regard to your offer.

So we will recess until 1:30 at this point and we will resume and discuss as the first order of business the exhibits that you have to offer.

[Lunch recess.]

AFTERNOON SESSION

1:35 p.m.

JUDGE GROSSMAN: The evidentiary hearing is back in session. We had a recess with an offer pending of four exhibits by applicant and the proposed stipulation offered by staff and applicants to Mr. Bursey with regard to these exhibits and all other exhibits to be offered by staff and applicant.

Mr. Bursey, have you perused the stipulation and do you intend to sign that stipulation or agree to?

MR. BURSEY: No, sir, I would prefer not to sign it.

JUDGE GROSSMAN: Okay. I take it then you would like to object or not object to each exhibit as it is offered, is that your position, sir?

MR. BURSEY: Yes.

JUDGE GROSSMAN: Fine, Now, with regard to the four exhibits that have just been offered, have you seen these exhibits before?

MR. BURSEY: Yes.

JUDGE GROSSMAN: When did you receive them, by the way?

MR. BURSEY: I'm not sure. The service date is early March, or May 28th, as Mr. Knotts' pointing out to me. They came recently in a box of materials that I had gotten on the date of the service and they have recently come into my possession,

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but I have seen them.

JUDGE GROSSMAN: Okay. Are you familiar with these documents?

MR. BURSEY: Briefly.

JUDGE GROSSMAN: Well, let me ask you, Mr. Knotts, whether you're offering these documents through any witness here?

MR. KNOTTS: I am prepared to do that. To set the record straight, each of these documents that are before us now which were for preliminary purposes listed as items f, g, h and i in the May 28th memorandum, were provided to Mr. Bursey as issued.

In addition, I understand that each of these documents was provided to Mr. Bursey on or about May 28th or perhaps the next day. So he's got them not once, but twice.

Dr. Alexander, you note in your testimony that a supplemental seismologic investigation was prepared and was submitted to the Nuclear Regulatory Commission in December of 1980. Do you have a copy of that document before you?

DR. ALEXANDER: Yes, I do.

MR. KNOTTS: Is that the document the preparation of which you supervised?

DR. ALEXANDER: Yes, it is.

MR. KNOTTS: And was it prepared and submitted for NRC review?

DR. ALEXANDER: Yes, it was.

MR. KNOTTS: I will note, Mr. Chairman, that the document which I have reference to was previously submitted to the Board and the parties as the document listed as item f in our May 28th designation of exhibits.

We would, for the sake of the order of the numbering, like to have this document marked as Applicent's Exhibit 1, if that wouldn't cause confusion.

JUDGE GROSSMAN: So marked.

[Applicant's Exhibit No. 1 was marked for identification.]

MR. KNOTTS: Three copies of the exhibit have been duly provided to the court reporter, Mr. Chairman, and we now offer it into evidence.

JUDGE GROSSMAN: Mr. Bursey, do you have any objections to the offer of this document?

MR. BURSEY: Document f is being referred to now as?

JUDGE GROSSMAN: Applicant's Exhibit 1.

MR. BURSEY: And, Dr. Alexander, you assisted in the preparation of this entire document?

DR. ALEXANDER: Yes.

MR. BURSEY: And the supplement?

DR. ALEXANDER: We haven't gotten to the supplement yet.

MR. BURSEY: I beg your pardon. I beg your pardon. You did assist in the preparation of this entire book and you can answer questions relevant therein?

DR. ALEXANDER: Yes, I assisted in the preparation of this document and either myself or members of the panel would be prepared to respond to specific contents, but I have in fact-- I did in fact participate in the preparation of the entire document and have reviewed each part of it in the course of its preparation.

MR. BURSEY: And now, your expertise is in the geologic and seismological factors and not in specific construction that deals with seismological problems, is that right?

DR. ALEXANDER: That's correct.

MR. BURSEY: And so in regard to the projections that a certain ground acceleration level is safe for the V. C. Summer plant, that's not--you can only project the anticipated level and not the safety. You wouldn't purport to be doing that in this document?

DR. ALEXANDER: Well, that's--my expertise is to testify as to what we believe to be the ground motion that could be generated by specific seismic events. The section with respect to the actual plant's design and equipment is addressed by Dr. Chen who has expertise in it. He's a member of our panel.

MR. BURSEY: And you have prepared documents like this for other reactors?

DR. ALEXANDER: No, not specifically, but I have

prepared similar integrated studies that are part of the general study of seismic hazards.

MR. BURSEY: And the other gentlemen on the panel, this document is not associated with them but you're the sole representative of this particular document?

DR. ALEXANDER: No, each member of the panel participated intimately in the preparation of at least parts, individual parts of this documnt. So those parts to which they were-- for which their expertise was appropriate are in fact representative in the preparation of this document.

MR. BURSEY: Were you familiar--in the preparation of this document you were famliar with the original, the preliminary safety analysis?

DR. ALEXANDER: Yes. The initial background material of course was the initial stage to put together the document material, the relevant previous submissions for this particular site. So, yes, I became familiar with the prior studies at the time I became associated with the project.

MR. BURSEY: In area of this document where you have revised the figures that we saw inthe preliminary studies, these are your--this is your revision and you're prepared stick to those revisions on ground acceleration and near site magnitude?

DR. ALEXANDER? Yes. What's contained in here we're prepared to defend.

MR. BURSEY: Judge Grossman, I have questions as to

the factual matters contained in here, but I don't doubt that this is an authentic document prepared for Dr. Alexander SCE&G.

JUDGE GROSSMAN: Do I understand, Dr. Alexander, that you and the others on the panel will be able to speak to all of the matters that are contained in this supplemental seismologic investigation, Applicant's Exhibit 1?

DR. ALEXANDER: That's my belief, that either myself or some member of the panel or people generally involved in its preparation can speak to that.

JUDGE GROSSMAN: Do you have any objection to this document being offered?

MR. BURSEY: No, sir.

JUDGE GROSSMAN: Okay. It's admitted. We will state this, though, that if it runs out on investigation that the panelists cannot speak to certain items that are contained in here, we will entertain motions to strike. However, we would certainly afford an opportunity to beingin someone who might be able to speak to that area. However, admitted.

[Applicant's Exhibit No. 1 was received in evidence.]

MR. KNOTTS: Thank you. Dr. Chen, are you familiar with the revised Appendix X dated March 4, 1981 to the Supplemental Seismic Invetigation?

DR. CHEN: Yes, I am.

MR. KNOTTS: Do you have a copy of that before you?

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DR. CHEN: Yes.

MR. KNOTTS: I would like to have that document included as listed as item g in my May 28th memorandum marked as Applicant's Exhibit 2.

JUDGE GROSSMAN: So marked.

[Applicant's Exhibit No. 2 was marked for identification.]

MR. KNOTTS: Dr. Chen, are you familiar with the FSAR change regarding the effect of reservoir-induced seismicity transmitted to the NRC on April 15, 1981?

DR. CHEN: Definitely.

MR. KNOTTS: And do you have a copy of that document before you?

DR. CHEN: Yes.

MR. KNOTTS: Now, this is item h in my May 28, 1981 transmittal and I would like to have it marked as Applicant's Exhibit 3.

JUDGE GROSSMAN: So marked.

[Applicant's Exhibit No. 3 was marked for identification.]

MR. KNOTTS: Dr. Chen, were both these documents prepared for and submitted to the NRC for review?

DR. CHEN: Yes, sir.

MR. KNOTTS: I would now offer Exhibits 2 and 3.

JUDGE GROSSMAN: Mr. Bursey?

MR. BURSEY: Dr. Chen, when did you begin to take part in the seismic review investigation, what date?

DR. CHEN: Since the beginning, 1971.

MR. BURSEY: 1971?

DR. CHEN: 1971, 1972, around that period.

MR. BURSEY: And so have you been working with the reviews, seismic reviews since that time?

DR. CHEN: Intermittent.

MR. BURSEY: Intermittently. And so this document number two or g--and which other did he contribute to, counsel?

MR. KNOTTS: Exhibit 3, which is h.

MR. BURSEY: H.

JUDGE GROSSMAN: No, Exhibit 2 is g, and Exhibit 3 is h.

MR. KNOTTS: Oh, 3 is h, I'm sorry.

MR. BURSEY: Dr. Chen, you assisted in the preparation of 2 and 3 or g and h, is that right?

DR. CHEN: Yes.

MR. BURSEY: In that you were intermittently assisting in the development of those records, when did the data come to you that's in here? Was this given to you by SCE&G or did you develop this?

DR. CHEN: I developed both of them myself.

d25da

MR. BURSEY: From the first day, from scratch?

DR. CHEN: I wrote them.

MR. BURSEY: And the figures in here, the magnitude figures, the ground acceleration factors and those figures, those figures are the figures that you determined independently?

DR. CHEN: No, sir. The magnitude was determined by the members of this panel.

MR. BURSEY: Were you involved in the preparation of the PSAR, the original projections of seismic activity for the applicant?

DR. CHEN: I did not prepare them myself; I reviewed them.

JUDGE GROSSMAN: Mr. Bursey?

MR. BURSEY: I am prepared to accept these documents for what they purpose to be.

JUDGE GROSSMAN: You have no objection to their admission? Admitted.

[Applicant's Exhibits Nos. 2 and 3 were admitted into evidence.]

MR. KNOTTS: Dr. McGuire, are you familiar with Appendix XI to the Supplemental Seismic Investigations transmitted to the NRC on May 27, 1981?

DR. MCGUIRE: Yes, I am.

MR. KNOTTS: Do you have a copy of that document

Before you?

DR. MCGUIRE: Yes, I do.

MR. KNOTTS: This was item i in my May 28th transmittal designating exhibits. I would like to have it marked as Applicant's Exhibit 4.

JUDGE GROSSMAN: So marked.

[Applicant's Exhibit 4 was marked for identification.]

MR. KNOTTS: Dr. McGuire, was this document prepared for and submitted to the NRC for its review?

DR. MCGUIRE: That's my understanding, yes.

MR. KNOTTS: Pursuant--strike pursuant.

I would now offer Exhibit 4 in evidence.

JUDGE GROSSMAN: Mr. Bursey?

MR. BURSEY: That's 4/i?

JUDGE GROSSMAN: Exhibit 4 was marked as i previously.

MR. KNOTTS: While Mr. Bursey is reflecting, I've been reminded that there are corrections to be made in an exhibit and, if the court please, I'll hold off on my offer until those corrections can be made. Dr. McGuire--

JUDGE GROSSMAN: Excuse me for one second. I assume Mr. Goldberg and the State of South Carolina have no objections and I'm sorry for not asking you specifically.

MR. GOLDBERG: That's correct.

MR. BURSEY: Which of the panelists assisted in the

development of the estimates of reservoir-induced seismic ground accelerations? Dr. Alexander, do you know?

DR. ALEXANDER: The specific estimates for acceleration?

MR. BURSEY: Yes.

DR. ALEXANDER: The overall background seismicity data was gathered by Dr. Talwani initially. I reviewed it and then the actual estimates of the ground acceleration based on the observations in the site area were done by Dr. McGuire.

MR. BURSEY: And the ground motion model, was that done by Dr. McGuire also?

DR. ALEXANDER: I would prefer for him to answer as to what he did.

MR. BURSEY: Okay.

DR. MCGUIRE: I'm responsible for making the ground motion estimates, that's correct.

MR. BURSEY: Did Dames & Moore have anything to do with this estimate?

DR. MCGUIRE: People in Dames & Moore assisted in those estimates to the extent they helped us determine what the appropriate magnitudes would be. Also, that analysis was developed by an employee of Dames & Moore.

MR. BURSEY: So Dames & Moore determined what the appropriate magnitude would be?

DR. MCGUIRE: People at Dames & Moore assisted in that determination.

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MR. BURSEY: And how did they do that? Were there computerized studies or based on experiential data?

DR. MCGUIRE: No, there were no computerized studies done. There was an examination in conjunction with the people on this panel what would the appropriate magnitdue which could be induced by the reservoir. And that took into account the geologic factors in which geologists at Dames & Moore participated.

MR. BURSEY: And the original magnitude that was projected has since been revised in terms of anticipated magnitude, is that correct?

DR. MCGUIRE: I'm not sure which original magnitude you're referring to.

MR. BURSEY: Well, there's original projections of 2.3 prior to filling the reservoir. Did you assist in the development of that projection?

DR. MCGUIRE: No, I'm not aware of that projection.

MR. BURSEY: And what is the specific projection that you assisted in in terms of near-site anticipated ground acceleration?

DR. MCGUIRE: That's the results of this panel, I think, and are best addressed by Dr. Alexander.

BURSEY: Just a minute. Judge Grossman, I'm not sure that we have all the data necessary to determine ground motion models and acceleration factors are going to be accurately addressed in this document. And the inclusion or acceptance of this document

doesn't preclude or waive the possibility that we have that we don't have the necessary evidence.

JUDGE GROSSMAN: As I indicated before with regard to Applicant's Exhibit 1, to the extent that it appears that the panelists cannot speak to the data included in these exhibits or the positions taken in these exhibits, the Board will entertain motions to strike the exhibits, notwithstanding that they've already been admitted.

We will of cours afford applicants an opportunity to being in the persons who can supply whatever foundation is actually lacking. Right now we're assuming that what the witnesses say is so and that is that they can supply the foundation for the information contained inthe document. Is there any objection to the Board's ruling on that, Mr. Goldberg?

MR. GOLDBERG: No objection.

JUDGE GROSSMAN: Mr. Knotts?

MR. KNOTTS: No objection, Mr. Chairman. Would it be reasonable to assume that such motion to strike would be lodged before the witnesses were excused?

JUDGE GROSSMAN: Certainly. Mr. Bursey, do you have any objection then to Exhibit 4? If you do have a present objection to it--

MR. BURSEY: Jut one further thing for Dr. McGuire. Dr. McGuire, you stated that the conclusion in this particular document that the numbers that the applicant's using in projecting

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anticipated seismic events and the ability of the physical facility to withstand it, you prepared this document and what it purports?

DR. MCGUIRE: I prepared what is called Appendix XI, that's correct.

MR. BURSEY: Thank you.

JUDGE GROSSMAN: Admitted.

[Applicant's Exhibit No. 4 was admitted into evidence.

MR. KNOTTS: Dr. McGuire, did you prepare an errata sheet for Appendix XI, which is now known as Exhibit 4?

DR. MCGUIRE: Yes.

MR. KNOTTS: Do you wish to adopt that errata sheet as corrections to Exhibit 4?

DR. MCGUIRE: Yes, I do.

MR. KNOTTS: Mr. Chairman, I guess we should call that 4a. If there are no objections, perhaps that can be admitted.

JUDGE GROSSMAN: Any objections to the admission of the errata sheet as 4a?

MR. BURSEY: No, sir.

JUDGE GROSSMAN: Admitted.

[Applicant's Exhibit 4a was marked for identification and admitted into evidence.]

JUDGE GROSSMAN: Mr. Knotts, I assumed you had already offered it even though I understand you had reserved it. The

acoustics in this room are terrible as you have observed.

MR. KNOTTS: That's fine. Dr. Alexander, just one or two clarifications that I'd like to ask you about before I turn you over to Mr. Bursey.

You mentioned in your testiony that at the time Exhibit 1 is prepared, the Supplemental Seismic Investigations, you had of course not reviewed the Safety Evaluation Report because the Safety Evaluation Report came out after the Supplemental Seismic Investigation was submitted, is that correct?

DR. ALEXANDER: That's correct, as I stated in my summary earlier, summary of my prefiled testimony.

MR. KNOTTS: And you addressed in your prepared testimony the view of Dr. Andrew Murphy as set forth in the Safety Evaluation Report?

DR. ALEXANDER: Yes, sir.

MR. KNOTTS: Did Dr. Murphy's view as there expressed or elsewhere expressed when they came to your attention cause you to change your conclusions in any way?

DR. ALEXANDER: No, they did not.

MR. KNOTTS: Did Dr. Murphy's views cause you or your colleagues to do anything?

DR. ALEXANDER: Yes. When the issue was raised we did further examination of the question and addressed that in subsequent submissions.

MR. KNOTTS: And did you carefully consider Dr. Murphy's

views?

DR. ALEXANDER: Yes, we have.

MR. KNOTTS: And is your overall conclusion as stated in your prefiled testimony?

DR. ALEXANDER: Yes.

MR. KNOTTS: Mr. Chairman, I have no further questions for the panel at this time and they are available for examination starting, I assume, with Mr. Bursey, and then the staff would be ordinarily the next and any questions the Board may have.

JUDGE GROSSMAN: I think the State of South Carolina would be included.

MR. KNOTTS: I beg your pardon.

JUDGE GROSSMAN: I assume the order will go, and it will be Mr. Bursey, the State of South Carolina, the staff and then Board questions unless there's objection.

MR. WILSON: If we might, Mr. Chairman, have following the staff and just prior to the Board. I think that would be a little more productive. Our primary purpose being monitoring, that would help at that point to know whether or not the matters had been covered.

JUDGE GROSSMAN: Any objections to that from the staff?

MR. GOLDBERG: Not in this order but customarily we would certainly like to have the benefits of everyone else's examination, but in this particular issue, we have no objection.

JUDGE GROSSMAN: We will then adopt that order. Mr.

Bursey, you may proceed with your cross-examination.

MR. BURSEY: Thank you. Before I do that, if I could ask the board to entertain a motion to hear. There've been a number of people that have come up to me and that I've heard saying to other people that didn't know that the limited appearances were going to conclude so quickly.

And I was wondering--there are people in the room fidgeting and wanting to say something and if we could at this point set aside some time in the morning to take the limited appearances, I think that it would be productive.

JUDGE GROSSMAN: For tomorrow morning, is that it, or for this afternoon?

MR. BURSEY: Well, I would think tomorrow morning is--again, I should go ahead and project into next week. If we could just do it again in the morning until the time we start next week, there are many people who are concerned that aren't fully aware of the fact they have this opportunity and that it's happening. And I'm sure that you don't want to preclude someone's even limited involvement if it could be done without delaying the hearing.

JUDGE GROSSMAN: Well, I think whoever is here now and can make a limited appearance statement and desires to can contact Mr. Paul Hamilton in the back of the room. Mr. Hamilton, would you stand? We will entertain limited appearance statements approximately at a quarter till four this afternoon and so we'll

proceed with out business and they may contact Mr. Hamilton and leave their names and we will call them.

MR. BURSEY: Thank you.

JUDGE GROSSMAN: Proceed, Mr. Bursey.

CROSS-EXAMINATION

MR. BURSEY: Dr. Alexander, do you know what the original projection of ground acceleration was for the V. C. Summer plant, the first projection that was made

DR. ALEXANDER: Could you define what you mean by projection?

MR. BURSEY: Preliminary safety analysis had a figure in it. That figure was later revised. I want to know do you know about that first figure?

DR. ALEXANDER: I'm afraid I still don't know which specific figure you're referring to.

MR. BURSEY: The applicant's projection was 6.3, I believe it was, the figure for ground acceleration. There's two figures. One is ground acceleration and one is magnitude. The figures that the applicant projected originally were revised. Are you aware of that?

DR. ALEXANDER: I don't know what you're referring to, magnitude or acceleration or what you're referring to.

MR. BURSEY: Both magnitude and acceleration, the original projections by the applicant were revised. Do you know when they were revised and why they were revised?

JUDGE GROSSMAN: Dr. Alexander, I believe the question was whether you were aware of the original estimates made by the applicants as to the maximum ground acceleration that would be encountered at the Summer site?

DR. ALEXANDER: I did not participate in making that estimate so I can't say the basis on which it was made at that time.

END TAKE D

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MR. BURSEY: Does anyone else on the panel, Dr. Chen, that participated in the original figures?

DR. CHEN: As far as I know, the original figure was 21 G-- .15 SSE.

JUDGE GROSSMAN: What was the second figure you cited?

DR. CHEN: .15.

MR. BURSEY: Now, it is my understanding, Dr. Alexander, that the projections by the Applicant for ground acceleration and the magnitude were exceeded at the reservoir itself, so what we have is induced seismicity if the facility was greater than anticipated, is that correct?

DR. ALEXANDER: I cannot say it was greater than anticipated. There was provision made by virtue of monitoring, as indicated later on, to determine whether there were any effects due to the reservoir loading and those effects were monitored very comprehensibly as I indicated, and the largest event, which has occurred to this time, has been an ML 2.8 event.

MR. BURSEY: I believe you anticipated it would be 2.8 but did not the record reflect that you didn't anticipate anything larger than 2.5?

DR. ALEXANDER: To my knowledge, it did not.

MR. BURSEY: What is the high--what was the upper level projection that you anticipated prior to--

DR. ALEXANDER: I do not recollect the specific number. Perhaps the panel, if they are in existence, perhaps another

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member of the panel can supply that.

DR. CHEN: I think we are talking about different things. We designed for OBE and SSE, before the fading. After the fading of the water based on our exhibit F, based on our investigation, our SSE value was not exceeded.

However, at the request of NRC and ACRS, we did investigate a hypothetical case, that case exceeded our original SSE--

JUDGE GROSSMAN: Excuse me, are we talking about the same item, are we talking about ground accelerations now?

DR. CHEN: Yes, sir.

JUDGE GROSSMAN: The acoustics are terrible here and let me ask you again, did you say that you had originally estimated maximum ground accelerations of .15 G for safe shutdown earthquake?

DR. CHEN: Yes, sir.

JUDGE GROSSMAN: And .10 G for an operating basis earthquake?

DR. CHEN: Yes, sir.

JUDGE GROSSMAN: And you are saying now that that has those anticipated maximum ground accelerations were not exceeded by any event near that reservoir, is that what you are saying now?

DR. CHEN: Based on our investigation, this report was not exceeded.

JUDGE GROSSMAN: I don't understand that qualification,

Dr. Chen; what do you mean based on the report it wasn't exceeded?

DR. CHEN: Based on the extensive investigation of the site characteristics, our conclusion was in the future anticipated event would not exceed the SSE.

JUDGE GROSSMAN: I see. Let me ask you, you are saying now the accelerations were not exceeded at the site, is that it?

DR. CHEN: Yes.

JUDGE GROSSMAN: I see, they were exceeded but not at the site, they were exceeded at some other place?

DR. CHEN: No, that was not--

JUDGE GROSSMAN: There was no ground acceleration from any event near the reservoir greater than .15 G at any frequency or .10 G at any frequency, is that correct?

DR. CHEN: No, that was not my answer.

JUDGE GROSSMAN: Let's get your answer then.

DR. CHEN: My answer was, based on our investigation, the estimated maximum induced event, this met .10 and the corresponding G values would not exceed SSE values.

JUDGE GROSSMAN: The question as I understood it and as I thought I had rephrased it related to ground shaking and ground acceleration values, not magnitude of earthquakes and the sense of the question I thought was very simple and that was whether the ground shaking accelerations exceeding .15 G or .10 G, which were your estimates for SSE and for operating basis earthquake and your answer that no those ground accelerations were

not exceeded?

DR. CHEN: I think our investigation indicated that magnitude 4.0 corresponded to a G factor value of .14 G which is less than .15 G.

JUDGE GROSSMAN: Well, you are computing a value as I understand it from a magnitude of earthquake where I am asking you as to accelerations that actually occurred in the vicinity of the site. Now, it is my understanding from everything that I have read here that there was a 2.8 magnitude earthquake that caused ground shaking at certain locations that exceeded the .15 G and I believe that is what the question was and we seem to be getting a negative answer here.

MR. KNOTTS: Mr. Chairman, if I may interject for a moment. The question of Mr. Bursey was not that at all. Mr. Bursey was making a representation which is not in the record regarding some earlier predictions. He didn't show the witness any piece of paper. He didn't show us where we allegedly made such a prediction and here we are trying to put words in Mr. Bursey's mouth and I don't think it is fair to say that in these circumstances that the witness has not accurately answered the questions as they understood them.

JUDGE GROSSMAN: Well, it is my recollection that Dr. Chen did testify to a certain estimate that had been made

MR. KNOTTS: That is correct.

JUDGE GROSSMAN: And that estimate, to repeat for the

fourth time was .1 g for safe shutdown earthquake and .10 for operating basis earthquake and the question I thought was very direct as to whether those values had been exceeded by any actual event that occurred and I can't seem to get any response. This is not Board questioning, however, I think the witness ought to be responsive to whatever anyone asks and we can't seem to get an answer to whether those accelerations were exceeded by any event. Now isn't there an answer? Dr. Alexander, you seem to want to answer that.

DR. ALEXANDER: Yes, I think given your clarification of the question, I will answer your question. In addition to the seismic stations, there were stromation instruments (sic) for the two sites in the area, one of those recorded 2.8 event that had a distance range of less than, approximately one kilometer. That site was on soil site and the acceleration at the surface on the soil site did in fact exceed .15 g. However, the calculation of what the ground motion would be on the hard rock site below, which is the same as the foundation from which the nuclear plant, the type of rock the nuclear plant was founded did not exceed .15 g. Not to say that the ground amplification because of the soft material there is such that for a very short interval, I believe .05 seconds, the value exceeded .2 I think or .1... point 1.

JUDGE GROSSMAN: The value exceeded .1?

DR. ALEXANDER: At the ground, at the hard rock

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foundation immediately beneath the soil layer on which the instrument was deployed.

JUDGE GROSSMAN: It seems to me that we are going to be here for a very long session.

The question as I understood is was whether there was any place near the site in which the ground acceleration exceeded a certain value. Now we understand from the material that was submitted that there are explanations by the Applicant and possibly the staff as to why the values were exceeded.

I hadn't understood before this there was any question but that the values were exceeded at the location of the accelerometer. Now, is that--were we incorrect in understanding that?

DR. ALEXANDER: The value ..5 was in fact exceeded but the qualification of that is that we anticipated that .15 would be--that an event which would cause a .15 acceleration on the hard rock foundation such as the plant is built upon would--that same acceleration would be larger in a soft material which overlays such a foundation and that in fact was the situation where the observation of a higher acceleration, the data was observed.

JUDGE GROSSMAN: I am not sure, Dr. Alexander, what you are telling me that the accelerometer was placed in an area which you knew would give a faulty reading or whether you are

telling me that--or I understood to be the case to begin with--that there are explanations in retrospect as to why there was a high reading at that area.

Now, which is it?

DR. ALEXANDER: The .15 g basis, prior to any occurrence or observation was also anticipated to be equivalent to .25 g on a soft rock foundation. That was prior to any observation. Now the actual instruments themselves was installed in a site which was, in fact, in a soft material and it wasn't an effort to confuse the issue, and an observation in that particular place exceeded .2 g. The estimate, however of the ground--of the hard rock foundation, that exact same event, was below .15 g.

JUDGE GROSSMAN: I see. Okay, you are now coming up with two values for the safe shutdown earthquake. One was for hard rock, which was .15 g and the other one was for soil which was .25 g; is that basically what you're saying?

DR. ALEXANDER: To my understanding.

JUDGE GROSSMAN: Okay, now, the accelerations that were recorded with regard to that 2.8 magnitude earthquake, exceeded .15 g, is that correct?

DR. ALEXANDER: At the point where they observed, yes, sir.

JUDGE GROSSMAN: Right, but it did not exceed or did it exceed the .25 g acceleration?

DR. ALEXANDER: I believe it did not.

JUDGE GROSSMAN: Dr. Chen, did you have anything to add to that to clarify it?

DR. CHEN: No, sir.

JUDGE GROSSMAN: And you are in agreement with what was said then?

DR. CHEN: Yes, sir.

JUDGE GROSSMAN: Mr. Bursey, you may proceed.

MR. BURSEY: Thank you.

The magnitude we are talking about, ground acceleration factors, Judge Grossman mentioned magnitude, prior to the filling of Lake Monticello, Applicant projected the magnitude, maximum magnitude anticipated was 2.5 and you have 2.8, and now there is a question that has been raised by the ACRS, and by other concerns, equal with the original design based on underestimated magnitudes and ground acceleration factors is going to adversely affect the facility; I want to know what went into this study to conclude that we should not be worried because you were wrong?

MR. KNOTTS: I object to the form of the question because it is incomprehensible.

JUDGE GROSSMAN: The objection is sustained.

Mr. Bursey, go one question at a time.

MR. BURSEY: Okay.

JUDGE GROSSMAN: I don't believe that we have established that there was any estimate with regard to magnitude of earthquake in the first place of the value you mentioned, and I think if

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you want to establish that, you will have to start off and ask questions with regard to that.

MR. BURSEY: Dr. Alexander, do you know what the original projections, maximum expected near-site--- magnitude near-site earthquake was? The first projection?

DR. ALEXANDER: No, I do not.

MR. BURSEY: Does anyone on the panel know?

Do you know, Dr. Alexander, what the present projection for maximum credible--

JUDGE GROSSMAN: I am sorry. Could we get a definitive answer that no one on the panel knows about any original estimate with regard to magnitude earthquake?

DR. MCGUIRE: Just to clarify the question. I don't think any of us is aware of any previous estimate of magnitude of earthquake near any plant and in that case, ours would be the first estimate of magnitude.

MR. BURSEY: Dr. Alexander, is it a fact that there have been seismic events that exceeded earlier projections?

DR. ALEXANDER: I do not understand that questions in light of remarks just made.

MR. BURSEY: Have there been seismic events near the V. C. Summer plant that exceeded your earlier projections, the Applicant's earlier projections?

DR. ALEXANDER: Not to my knowledge.

MR. MCGUIRE: Excuse me, perhaps it would clarify if

you would refer to what applicant's earlier projection you are talking about? We are confused about that point.

JUDGE GROSSMAN: Mr. Bursey, I take it we are still on magnitude of earthquake now and the import of your question is that was there early estimates of magnitude earthquake that have actually be exceeded?

MR. BURSEY: Yes, sir.

JUDGE GROSSMAN: (Continuing) By events. Could anyone on the panel--Dr. Alexander, answer that?

DR. ALEXANDER: To my knowledge, there was not a pre-conceived idea of what the maximum would be there. As a matter of fact, the reason that the network was deployed was to observe the effects of the loading of the reservoir.

JUDGE GROSSMAN: At some point, there was an estimate of maximum magnitude earthquake, was that by the applicant?

DR. ALEXANDER: In this document here, that was one of the objections to this particular study, that defeated what we did.

JUDGE GROSSMAN: When you say this document here, you are pointing to Applicant's exhibit 1?

DR. ALEXANDER: Yes, sir.

JUDGE GROSSMAN: And you are saying that was to your understanding the first estimate made by the applicants with regard to maximum magnitude earthquake?

DR. ALEXANDER: The maximum reservoir earthquake was

estimated the first time to my knowledge in exhibit 1.

MR. BURSEY: What was that estimation?

DR. ALEXANDER: Our estimate is ML 4.0 as I have dictated in the summary of my testimony, prefiled.

JUDGE GROSSMAN: I notice you qualify that with reservoir induced earthquake. Was there any estimate with regard to any kind of earthquake, tectonic or otherwise?

DR. ALEXANDER: Again in the original site study, the standard approach of taking the largest earthquake known to have occurred in a tectonic province was used and it was an intensity 7, not magnitude. The event in Union County mentioned 13 and that was following usual practice in proximity of site and that was in fact the SSE event that was used in arriving at the figures we just mentioned for acceleration and so the answer is yes, the experience in the region was in fact the basis for the initial choice of the SSE and the other event which was considered was the Charleston earthquake which was the basis for the OBE, .1 g and .15 g.

JUDGE GROSSMAN: Okay, I think we have left something out here, Dr. Alexander. That is the link between your intensity scale and your magnitude earthquake. I take it from that event 7 intensity earthquake of 1913 is projected a maximum magnitude earthquake, is that correct, sir?

DR. ALEXANDER: The associated magnitude for intensity 7 would be in the range of 5 to 5.3 approximately, magnitude.

So, it would be significantly larger than what we estimated the maximum, by a large fraction.

JUDGE GROSSMAN: Again, we are asking about original estimates. Now when was that estimate made?

DR. ALEXANDER: That was in the very earliest study, the SAR and FSAR, and those numbers have not been altered and indeed that is what we explored in this extensive study was to determine whether those numbers were in fact appropriate and adequate for the design. Our conclusion is that they are.

JUDGE GROSSMAN: That is design--for a basis maximum magnitude earthquake of 5.0 to 5.3?

DR. ALEXANDER: Maximum at that time, then as originally calculated, that is correct.

JUDGE GROSSMAN: Were there any ground accelerations that were associated with the maximum magnitude tectonic event that you just indicated was estimated at 5.0 to 5.3 magnitude?

DR. ALEXANDER: The intensity 7 event, which as I indicated correlates to an equivalent magnitude event of approximately 5 to 5.3, because--and why it is not precise is because it requires an empirical association--was used as a basis for the safe shutdown acceleration at the particular site, so the 5 and 5.3 at the time of the event was used as the original and the original basis for the SSE acceleration level, and it is included in our study that those numbers are adequate and appropriate still for this particular site in light of the

induced seismic as well as the examination of the Charleston earthquake and all the site conditions that I put into my testimony.

JUDGE GROSSMAN: I am not quite sure I heard any number, and again it may have been the acoustics here but my question related to the ground acceleration that may have been calculated with regard to that basic tectonic event and I don't recall hearing that number.

DR. ALEXANDER: .15 g at the site.

JUDGE GROSSMAN: And that is the same .15 g that you get from a magnitude of four earthquake that is reservoir induced.

DR. ALEXANDER: If it's sufficiently close.

JUDGE GROSSMAN: I see, so that there was some estimate as to the distance between the site and the 5 point here or 5.3 magnitude tectonic event?

DR. ALEXANDER: Let me defer to Dr. McGuire to answer that assumption.

DR. MCGUIRE: I was not involved in the preparation of the SER, but I can answer in generic terms how it is done and that is done by taking, determining what the largest MM intensity in the same tectonic province as the site and using correlations which are obtained from California data torelate that MM intensity to acceleration for intensity 7, you get an acceleration which is on the order of .15 g, so in that specific

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calculation, the event as obtained from data, stro-motion (sic) records in California, so that particular calculation there is no necessity of assumption of magnitude--to make that calculation. That is the standard way that those SSE accelerations are determined.

Now for our study which is reservoir induced, we looked at more details in magnitudes and distances which might be associated with those events.

JUDGE GROSSMAN: I see. So, what I understand you are telling me is that your understanding of what's generally done is that from the intensity of the earthquake, a ground shaking acceleration is determined without going to the intermediate step of determining the magnitude earthquake that would be associated with the certain intensity--ground intensity earthquake, is that correct?

DR. MCGUIRE: That is correct.

JUDGE GROSSMAN: And in this case, there was some calculation made of the magnitude earthquake but that was independent of using it to determine maximum ground acceleration?

DR. MCGUIRE: Where the tectonic event of that magnitude determination, I think was just made off the cuff by Dr. Alexander, to give you some perspective on what that magnitude might be, but that was not--as I understand, that was not used in the FSAR to determine acceleration.

JUDGE GROSSMAN: I see. So you wouldn't find the

magnitude at all in the FSAR, is that correct?

DR. MCGUIRE: I would not expect to, no.

JUDGE GROSSMAN: You would merely find the intensity of the anticipated earthquake and a ground acceleration figure.

DR. MCGUIRE: That is correct.

DR. ALEXANDER: I would like to endorse that your conclusion of that is correct. There was no magnitude to my knowledge, evolved in a direct step from the intensity to acceleration and it was only in our evaluation of it locally that we made a further association with magnitude, local magnitude and acceleration.

JUDGE GROSSMAN: Thank you. Mr. Bursey, you may proceed.

MR. BURSEY: Thank you, sir.

Dr. Alexander, you mentioned, I believe, eleven thousand reservoirs, there had been 45 suspected of inducing seismicity. How many of that 11,000 were monitored?

(Brief pause.)

DR. ALEXANDER: May I refer?

In general, the answer is that very few reservoirs have been extensively monitored. I indicated in my written testimony, this particular reservoir is probably better instrumented than almost any other so far as having a background level and then a subsequent monitoring of the events, so most of the ones for which there is an association were based on

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ability for intensity type estimations as opposed to instrumental recordings as in the case here.

MR. BURSEY: So very few of the 11,000 reservoirs have been monitored?

DR. ALEXANDER: I can't give you any significance of that, you are saying only 45 of them--only--had there been a significant event, you would not have needed an instrument to tell you that. It would have been widely felt and so on, and that I believe was not observed so that--so the fact that none was observed means at least that if there were such events associated with them, it would have to have been exceedingly small. There is no evidence that there were.

After all, the instrumental record doesn't go back too many years. There have been observational--instrumentally observed recordings recently.

MR. BURSEY: One of my contentions was that the seismic activity should be monitored after filling the reservoir. Now, the applicant has said that that is an event. You said on page 7 that you felt that had been met adequately.

My original request was that it be monitored a year after the facility. In that there has been above anticipated seismic events, I have reviewed my statement that I feel monitoring needs to go on at least another two years if the activity continues indefinitely, do you take issue with that?

DR. ALEXANDER: Well, I will say simply that as stated in my testimony, applicant has agreed to continue monitoring through 1982 and at that point, the results to that date will be evaluated and so subsequent monitoring would be decided upon with consultation with NRC and the findings to that point as to whether further monitoring was to be warranted.

MR. BURSEY: What would your advice be if we continue to see above anticipated levels of seismic activity, would you advise the applicant to keep monitoring?

MR. KNOTTS: I object, Your Honor. We have not yet established on the record that we are seeing above anticipated levels of seismic activity.

JUDGE GROSSMAN: Mr. Bursey, could you rephrase that question?

MR. BURSEY: Yes, sir. I am frankly taken aback. It is general knowledge and has been admitted in other proceedings there have been events that have exceeded anticipated levels.

Now I think we are going to have to speak to that. I will have to stop and go get the evidence I know I can produce but--

JUDGE GROSSMAN: I don't think you have established any frame of reference, Mr. Bursey, and if you want to go ahead and establish it, as to what you mean by anticipated levels, you can go ahead and do it. There may be a simpler way--

MR. BURSEY: I tried at one point. I asked if the

gentlemen were familiar with early projections as to what the anticipated levels were and I didn't get anywhere, but let me try another line of questioning.

Dr. Alexander, did the seismicity after filling the reservoir, did it exceed the projections that any of the consultants that you are aware of--yourself or any of the panel--have made for seismic activity in the near area?

DR. ALEXANDER: To my knowledge, no one made a specific projection as to what levels of induced activity could occur at that site and there would be no basis to do that kind of, any experience in that area.

MR. BURSEY: You mention on page 15 of your pre-filed testimony that, "It is concluded that the cuase of the Charleston earthquake is still not known."

Then, on page 16, you say, "it is my opinion that there is no observational evidence to indicate that an earthquake comparable to the 1886 event will reoccur in any location except for the Charleston vicinity". If you don't know what caused it, how can you be so sure it can't happen?

DR. ALEXANDER: As I indicated, we cannot be sure, we have to evaluate the evidence that exists, and the U. S. Geological Survey, as I noted in my testimony, has conducted for a number of years now intensive investigation into that very question and there's the--the question is still not totally resolved. However, if you will refer to Dr. Devine's statement in appendix E of the

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SER, you will find basically the same conclusion as I have reached here, is that there is no basis to move the Charleston event any place other than that area and in some areas to which there has been occurring some activity.

JUDGE LENENBERGER: Excuse me, but I don't think I heard you answer Mr. Bursey's question. I think I heard you say that what you have said here agrees with what Dr. Devine says but it seems to me Mr. Bursey asked a rather logical question; how can you conclude that nothing comparable to the Charleston event will occur in this area on one page when on the following page you have said that the Charleston event is not understood. I didn't really hear you answer that.

DR. ALEXANDER: Okay.

JUDGE LENENBERGER: Let's leave Dr. Devine out of it for a moment.

DR. ALEXANDER: Let me tell you exactly what we did. Because, first of all, the data investigations done by the U. S. Geological Survey were the primary basis for our evaluation on this question and basically there are three leading hypothesis being discussed as to the possible mechanism and origin of an event and we looked at each one of these and did not rule out any one of them as being possible; although we did make the judgment that at least one of those, based on observational facts would be less likely; however, we did consider all three in the statistical analysis of what the acceleration would be at

the site. In other words, we made the calculation assuming that the Charleston event could in fact occur anywhere within the eastern region and calculated a mean return period for various levels of acceleration, so we did not--we did consider the moving of Charleston about in this whole region, of course at each of these three hypothesis, and judgment as to whether it should be kept in Charleston is indeed a judgment but it is based on some observational evidence that there are active faults at depths in that particular area. There are true the geolinic bodies which would concentrate stress there and so there is a set of corditions there which are not present at other sites to our knowledge in the eastern region and these events in fact wouldn't happen in an earthquake in that particular area, and we did not have any basis to--nor is there any evidence of such areas elsewhere, in the proximity of this site or elsewhere on the east coast.

JUDGE LENENBERGER: Thank you.

JUDGE GROSSMAN: Mr. Bursey.

MR. BURSEY: Dr. Alexander, have you or any of your panel examined the Wateree fault or its implications?

DR. ALEXANDER: I believe none of the present panel members did that, although the members I think before who helped prepare this document did in fact look at the field evidence and go into the field with Dr. Secor in that connection.

MR. BURSEY: And you stated in your earlier testimony that significant efforts to locate the fault as it proceeds towards the plant are being undertaken. Who is undertaking those significant efforts and what all do they entail?

DR. ALEXANDER: It is all spelled out in my testimony if you refer to that, and Dr. Donald Secor specifically if you in fact look at the whole section on Wateree Creek, page 16 through 19; that spells out exactly what is known about that particular feature.

MR. BURSEY: And Dr. Secor is undertaking this investigation for who?

DR. ALEXANDER: The U. S. Geological Survey.

MR. BURSEY: And have there been arrangements made between the applicant and the USGS that Dr. Secor's work, is he going to be incorporated into your seismic considerations?

DR. ALEXANDER: It already has been, yes, and will continue to be.

MR. BURSEY: I am still a little uncomfortable feeling that over here on the one hand is a professor at the university who is doing some work and you on the other hand saying that I shouldn't worry, the plant--the applicant is going to be fully appraised of all developments, what is the link, what is the establishment, rapport, between you and Dr. Secor?

DR. ALEXANDER: Number one, he is required to submit

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reports periodically. I don't know whether it is quarterly, semi, or annually, but on one of those basis, he reports to the U. S. Geological Survey his findings and we have received copies of all those and members of the Dames & Moore corporation have been participating in the project, have gone into the field with him on several occasions and there is frequent contact with Dr. Secor as to the course of his investigation, so there is a cooperative basis on which we have learned in a very timely way what he has found in that particular study.

MR. BURSEY: Are there any formal contracts or agreements?

DR. ALEXANDER: I am not the person to answer that. To my knowledge there is not but I am not the right person to ask that question. To my knowledge, he works only under contract with the U. S. Geological Survey on this question.

MR. BURSEY: Can you venture a projection that on page 18 in your statement, "The fault has been traced northward to a point approximately two kilometers southeast of Peak", and if you are familiar with where that is, that is not very many kilometers from the plant, not very many at all. I would say less than three miles, a mile and a half.

DR. ALEXANDER: I believe it is eight kilometers.

MR. BURSEY: If the continuing field work shows that the fault does indeed proceed directly towards the plant, can you project what changes this can necessitate?

DR. ALEXANDER: Yes, as a matter of fact I addressed that question, item number 4, page 19 of my written testimony here, and even if the fault were found to project into this area, there is no evidence anywhere where it has been mapped and identified that it is a capable fault. There is no evidence of any geologically recent movement on that feature and so even if it were to be present at the site, it would not have a safety implication.

JUDGE GROSSMAN: Excuse me. Mr. Knotts, could you tell me whether Dr. Secor is available for this hearing?

MR. KNOTTS: Dr. Secor is not under our control but we have a gentleman available from Dames & Moore who are intimately familiar with Dr. Secor's work.

JUDGE GROSSMAN: I notice what seems to be very unusual in this testimony on page 18 that Dr. Alexander has reviewed the findings of Dr. Secor and has reached certain conclusions and, you know there is no way of telling what the basis for those conclusions are, whether Dr. Secor also holds with those conclusions and, of course, we have some leeway as far as hearsay goes, but I don't know how critical the testimony is in the first instance but we would like to know whether we would have an opportunity to talk to Dr. Secor.

MR. KNOTTS: If the Board wishes to call Dr. Secor as their witness, I assume the Board can do that but we have available a gentleman from Dames & Moore who are under contract to us.

JUDGE GROSSMAN: Could they do any better than Dr. Alexander than just saying that they believe that Dr. Secor believes something or they believe from what they have seen of Dr. Secor's work--in other words, I don't know, is that anymore helpful than having a statement made by Dr. Alexander as to what his conclusions are of Dr. Secor's work.

MR. KNOTTS: I don't know what the source of the Board's concern may be. It is pretty standard practice for somebody doing field work to report their conclusions to somebody for analysis, but I will be happy to put the gentleman from Dames & Moore who have actually accompanied Dr. Secor in the field on the stand.

JUDGE GROSSMAN: Well, maybe it would be preferable if we had the same work before us that Dr. Alexander looked at in order to arrive at his conclusions. What type of materials did you look at?

DR. ALEXANDER: His written reports to the Geological Survey.

JUDGE GROSSMAN: Had the staff intended to offer those reports, Mr. Goldberg?

MR. GOLDBERG: No.

JUDGE GROSSMAN: Isn't the USGS working along with the staff in this case?

MR. GOLDBERG: The U. S. G. S. Letter Report is on the--the USGS studies of the Charleston earthquake, which comprise

Appendix E to the SER--we don't have any other documentary testimony we would offer on behalf of the USGS.

JUDGE GROSSMAN: In other words, you are restricting their role to the Charleston earthquake and not to the Wateree Creek--

MR. GOLDBERG: Right.

JUDGE LENENBERGER: Mr. Knotts, you said in response to discussion with the Chairman that you didn't understand what--quite what the Board's concern is here.

MR. KNOTTS: That's right.

JUDGE LENENBERGER: Quite simply stated, it is this, we have testimony that says that there is a gentleman out there trying to see how far the Wateree Creek fault goes and what it looks like and he has done some work but his work isn't complete and the person on the panel that is relaying this to us says he is pretty sure that things aren't so bad but he isn't Dr. Secor and he hasn't seen, nor has anybody seen the final results of Dr. Secor's work, so I think it is very easy to see how the Board could have a concern here. That is an area of ignorance, if you will, and perhaps on further questioning, Dr. Alexander can dispel some of this ignorance--I don't want to get into Board questions right now, but this leaves,and I will say this for Mr. Goldberg's benefit, also, this leaves the Board with a feeling of a large area of uncertainty. Dr. Alexander has expressed the opinion, for example, that even at the Wateree Creek

fault, getting close to the site, there is nothing to indicate that it is capable.

Well, now, the Board is not at all certain that Part 100 criteria with respect to capability of faults are completely applicable in the region where there is a large reservoir just been filled. Capable faults refer to tectonic things that generally aren't mixed up with reservoirs in Part 100, so I think you gentlemen can see sort of the nature of the Board's concerns here.

MR. KNOTTS: Judge Lenenberger, I can see what you are saying. I will point out to Judge Lenenberger that we filed are designation of witnesses and our pre-filed testimony on May 28th. Had we known in advance that the Board desired physically to interrogate Dr. Secor we might have been able to make some arrangements to get Dr. Secor here. I am afraid the best I can do at the moment is offer the gentleman from Dames & Moore and we will make inquiries as to the whereabouts of Dr. Secor.

MR. GOLDBERG: We will have a geologist on the panel who will answer your questions on the Wateree Creek fault.

JUDGE LENENBERGER: Okay.

MR. BURSEY: Judge Grossman and Judge Lenenberger, I am not sure the difficult in calling Dr. Secor. He lives in my neighborhood. He works at the university and he has been unwilling to talk to me about Wateree fault, he has stated his

unwillingness to talk to me about it. One of his graduate students who was with him when they uncovered the fault and worked with him on it expressed to me a sense of alarm. I don't see why the applicant is unwilling to make a phone call to someone locally if they are relying on this man's judgment and unwilling to present him.

JUDGE GROSSMAN: I am surprised. The NRC staff has expressed concern on page 2-39 of it SER, with regard to the Wateree Creek fault, and has indicated that it considers it prudent for the applicant to continue to monitor the ongoing mapping of the Wateree Creek fault, but nevertheless is not concerned enough to review the investigatory materials of Dr. Secor or to present him as a witness, Mr. Goldberg.

MR. GOLDBERG: We are reviewing his materials. We also conclude that we do not believe that that fault represents a hazard to the site and will have a staff geologist to substantiate that position. I am advised we are receiving correspondence from Dr. Secor and will continue to review it in the spirit, when we made that comment.

JUDGE GROSSMAN: Have you investigated to see if Dr. Secor is also available?

MR. GOLDBERG: I have not.

JUDGE GROSSMAN: Could you do that, Mr. Goldberg?

Well, let me ask you what the nature is of the testimony that will be presented by your witness with regard

to Dr. Secor's work; will the witness for one thing have all the investigatory materials available that Dr. Secor has presented to the USGS?

MR. GOLDBERG: May I confer with the witness?

JUDGE GROSSMAN: Certainly.

(Brief pause.)

JUDGE GROSSMAN: Why don't we take a ten-minute recess?

(Short recess.)

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JUDGE GROSSMAN: Mr. Goldberg?

MR. GOLDBERG: It's my understanding that Mr. Knotts has something to report about Dr. Secor's availability.

MR. KNOTTS: It's my understanding, Mr. Chairman, that Dr. Secor, as of about ten minutes ago, thought he could be over here in about twenty minutes, so I assume that means he will be here in about ten minutes from now.

JUDGE GROSSMAN: And he will come now if we request it? He's on his way anyway?

MR. KNOTTS: That's correct.

JUDGE GROSSMAN: Fine.

Mr. Bursey, are you prepared to examine him when he comes? I would hope so.

MR. BURSEY: You bet.

JUDGE GROSSMAN: You may proceed with this panel.

MR. BURSEY: Dr. Alexander, you mentioned in your testimony that there had been an event that at a location at an accelerometer exceeded at the surface the .15 figure that the -- the .10 figure that was a safe shutdown. Can you be more specific as to where that accelerometer was and how far the epicenter of that event was from the facility?

DR. ALEXANDER: Which of those do you want me to answer first?

MR. BURSEY: Both.

DR. ALEXANDER: Will you restate it?

F2pw

MR. BURSEY: Where was the epicenter of that event?

DR. ALEXANDER: It was approximately one kilometer from the dam site itself, Monticello Reservoir dam.

MR. BURSEY: And you're saying that -- what was the magnitude of that event?

DR. ALEXANDER: The estimate was M_L 2.8.

JUDGE GROSSMAN: Excuse me. Mr. Bursey, I just want to clarify this for the record. I believe the witness answered and accepted everything that you had prefaced your question with as to the values, and I believe the record would indicate that those were not the correct values. He merely answered as to where the location was, the epicenter of the event, but he did not, as I understand it, accept your G values as postulated. Is that correct, sir?

DR. ALEXANDER: That's correct.

MR. BURSEY: Would you state the G values then, as you accept them, that are in place compared to the event?

DR. ALEXANDER: The safe shutdown earthquake acceleration for this site are .15 G on hard rock and .25 G on soil type foundations.

MR. BURSEY: And so this event that was a 2.8 magnitude, what was the ground acceleration value for that?

DR. ALEXANDER: On the soil site, which is where the instrument is situated, it was approximately .2, approaching .23 to .25 G.

F3pw

MR. BURSEY: So it was very --

DR. ALEXANDER: Excuse me, and that was for an extremely short duration of time that it reached that kind of a value, .06 seconds.

MR. BURSEY: But it was close to the Applicant's projected safe shutdown ground acceleration factor?

DR. ALEXANDER: For a soil location, that's correct.

MR. BURSEY: In preparation of your pre-filed testimony, other than Dr. Secor, what other material did you draw from others that you did not yourself prepare?

DR. ALEXANDER: With regard to which question?

MR. BURSEY: The pre-filed testimony that is -- (Pause) it's the pre-filed testimony.

DR. ALEXANDER: But what part of my testimony are you querying with regard to whom I consulted?

MR. BURSEY: Well all of it. We can start at the beginning, but I've determined that with Dr. Secor it has been fairly second hand and now I'd like to go back to the beginning of it and determine what else has been performed by you or by others.

DR. ALEXANDER: As I indicated, this report, Exhibit 1, was prepared under my general supervision. The members of this panel and members of the Dames & Moore Corporation assisted in preparing this and indeed did intensive work on individual parts of it. So I was a participant in each part of the whole study as

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presented here, but others assisted in individual parts and I believe the principal individuals who did participate are either members of this panel or are here in the audience, with the exception of Dr. Secor himself, whose reports we have relied upon.

MR. BURSEY: So then you're saying that other than Dr. Secor, there is nothing contained in your pre-filed testimony that was drawn from an outside source, it was either prepared by the panel or by other consultants for the Applicant.

DR. ALEXANDER: We looked at all available literature, and that would include, for example, the U. S. Geological Survey's work in Charleston, so we have included as part of our synthesis and evaluation here, the available published record in each of the issues to the extent that we have available information. So in that sense, we have used sources that exist in the literature. So far as preparation of the written document itself, members of this panel and myself plus people from Dames & Moore prepared the entire document as you see it here.

MR. BURSEY: Can you or anyone else on the panel speak to the seismic design of the dam at Lake Monticello that you -- was the dam at Lake Monticello the one that you just referred to as being one kilometer from the epicenter of the 2.8 magnitude event?

DR. ALEXANDER: Yes.

MR. BURSEY: Would you speak to the seismic design factors of the dam itself?

F5pw

DR. ALEXANDER: I am not myself qualified to speak to that question.

MR. KNOTTS: Mr. Chairman, I have a question regarding the relevance of the inquiry into the seismic design of the dam. The dam is not before us for licensing.

MR. BURSEY: Lake Monticello is referred to by the Applicant as the ultimate heat sink for the facility and I feel that if there has been an event out there, as Dr. Alexander has stated, that did indeed reach what is considered the safe shutdown factor for the plant, our concerns can't be limited or erased by the fact that that is a soil movement a kilometer away from the facility. I'm concerned and I think it's relevant.

MR. KNOTTS: The application will show, Mr. Chairman, and the record for the agency, that the Applicant has provided a surface water pond, which is the emergency source of cooling water and which of course is designed to the seismic standards and we have a gentleman in the audience who can address that issue.

JUDGE GROSSMAN: I believe, Mr. Bursey, in an attempt to connect up his concerns, I will allow that now. No harm done if he can't later on. You may proceed on that line, Mr. Bursey.

MR. BURSEY: Is there anyone on the panel that can speak to the impact of the event that we previously mentioned or anything exceeding that on the Monticello Dam or any other impoundment?

DR. ALEXANDER: As I indicated, I cannot speak to that, as

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an authority on the design of dams. I can only remark that to my knowledge no earthquake in the Tectonic Zones has caused the failure of a dam, including, for example, the 1971 San Fernando earthquake, which was much larger than anything we've been discussin here, it was a six and a quarter event right beneath the dam and it was an earthen dam, whose design characteristics I'm not aware of, but this was built more recently by the Corps of Engineers, to my understanding. Beyond that, I have no basis to answer your question.

MR. BURSEY: Did the Applicant conclude, was it your conclusion, Dr. Alexander, that the, I believe it's the rebound of the filling of the reservoir and that you anticipate that period has passed?

DR. ALEXANDER: The effects of the reservoir filling, according to the observations available to us over the past three years suggest that that indeed is the case, that apart from the response initially to the filling, which the induced activity began to occur and continued to occur until it reached its present limits both laterally and with depth, that took place over the first few months. Since that time there has been no further expansion of the region and the overall level of activity on the average has steadily declined and continues to do so.

MR. KNOTTS: Mr. Chairman, when we get to an appropriate place, Dr. Secor I am told is now in the room. He has an appointment at 4 o'clock and if the Board has questions for him or

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Mr. Bursey does, perhaps he could be brought up now.

JUDGE GROSSMAN: Yes, I think that would be appropriate. Dr. Secor, would you come forward?

Dr. Talwani, since you're the last one there, will you please relinquish your seat?

Dr. Secor, please remain standing and raise your right hand.

Whereupon,

DONALD TERRY SECOR, JR.

was called as a witness by and on behalf of the Applicant, and having been first duly sworn, was examined and testified as follows:

JUDGE GROSSMAN: Could you state your full name and address, sir?

THE WITNESS: Donald Terry Secor, Jr., Route 1, Box 251, Newberry, South Carolina.

JUDGE GROSSMAN: Mr. Bursey, do you want to proceed with Dr. Secor?

MR. BURSEY: Yes, thank you.

CROSS EXAMINATION

BY MR. BURSEY:

Q Dr. Secor, did you examine the documents that South Carolina Electric & Gas is attempting to put into evidence here that cites you and your studies of the Wateree Creek Fault?

A I just examined it briefly prior to coming to this

F8pw

meeting.

Q. Have you been previously in communication with SCE&G?

A. Yes.

Q. And they worked with you in preparation of this document?

MR. KNOTTS: What document is being referred to, Mr. --

MR. BURSEY: I'm referring to the document that is Dr. Alexander's pre-filed testimony on page 16 where it begins "Evaluation - Wateree Creek Fault".

A. No, they did not work with me in preparing this statement. I hadn't seen it until I came here.

BY MR. BURSEY:

Q. There are some conclusions that they have drawn, I'll quote Dr. Alexander: "I have reviewed the findings by Dr. Secor to date and have reached the following conclusions:

"(1) Substantial evidence exists indicating the presence of the Wateree Creek Fault in the Chapin quadrangle as presently mapped by Dr. Secor. The fault has been traced northward to a point approximately two kilometers southeast of Peak, South Carolina." Is that so far correct?

A. Yes.

Q. "Progress of the field work to date has not provided any observational evidence of northward continuation of the fault...."

MR. KNOTTS: Excuse me, gentlemen. As a courtesy to

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the witness, I will provide him with a copy of what is being read from.

(Mr. Knotts hands a document to the witness.)

A. Everything you've said so far is correct.

BY MR. BURSEY:

Q. And is the field work -- where does the field work stand now?

A. Right now we've basically completed mapping the Chapin and Little Mountain quadrangles and this summer we're working on Monticello and Pomaria.

Q. You have begun on the east Broad?

A. Yes.

Q. Do you have any findings that you think would be of concern to the Board?

A. I don't believe so. We have not found any evidence of the Wateree Creek Fault nor the location right southeast of Peak that you referred to, so we have no evidence that it extends north into the Monticello quadrangle at present, and we've covered a good bit of that ground already and it doesn't seem to be there.

Q. Dr. Alexander theoretically projects that if the Fault were to continue on towards the plant, that there is no evidence that it would have any negative seismic impact on the facility. Are you prepared to conclude that now?

A. That's outside my area of expertise really.

Q. Can you make any observations as to the potential

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capability of this Fault?

A We have recently determined that a diabased dike, probably of Jurassic Age, intrudes across the fault in the southern part of the Chapin quadrangle, completely across the fault zone, and to me that means that the fault hasn't moved since that time, which is roughly 100 million years. So it looks like the fault has been dead for a long time.

Q Have you made any arrangements with SCE&G to procure the data that you develop as your investigation continues into the fault?

A I am more or less obligated to file reports with the U. S. Geological Survey periodically and these reports can be obtained by anyone through the U. S. Geological Survey. I have in the past provided the Electric Company with one copy of these reports, as I file them with the U. S. Geological Survey.

Q But there have been in the past no arrangements between you and them and there are none for the future?

A That's correct.

MR. BURSEY: Mr. Grossman, that's all I have right now for Dr. Secor.

JUDGE GROSSMAN: Does anyone have any further questions? Mr. Knotts?

MR. KNOTTS: Dr. Secor, would you mind telling us for the record a little bit about your educational background? Where did you attend college?

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THE WITNESS: Yes, I have a degree in civil engineering from Cornell, under-graduate degree, a Masters Degree in geology from Cornell and a Ph.D. in geology from Stanford.

MR. KNOTTS: And does your work experience normally take you into the area of mapping faults or possible faults?

THE WITNESS: Yes.

MR. KNOTTS: Thank you. No further questions.

JUDGE GROSSMAN: Mr. Goldberg?

MR. GOLDBERG: No questions.

JUDGE GROSSMAN: Mr. Wilson?

MR. WILSON: Just briefly, Mr. Chairman, maybe I missed something, I was out just a moment on the phone.

Dr. Secor, on the conclusions that Mr. Bursey asked you about on page 18 of Dr. Alexander's pre-filed testimony, based on your investigation and having reviewed these conclusions, did you concur or dispute any of those individually or collectively?

THE WITNESS: No, what he states here seems to have been derived from my first technical report to the U. S. Geological Survey and I still feel that that's accurate.

MR. WILSON: So they are correct derivations?

THE WITNESS: That's right, yes, they are.

MR. WILSON: Thank you, that's all I had, Mr. Chairman. Thank you.

JUDGE LINENBERGER: Dr. Secor, do we understand correctly

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that your field of expertise and your involvement in these present studies have to do with the geology of the area and not to do with the seismological implications of that -- of those geological findings? Is that correct or not?

THE WITNESS: That's basically correct, yes.

JUDGE LINENBERGER: All right, sir. Now you then have not, yourself, made any -- drawn any conclusions about, or have you, about the capability of the Wateree Creek Fault. I know you spoke about the diabase dike intrusion that was observed and indicated no movement something of the order of a million years or greater. Do you have any further conclusions about capability or lack of capability of this fault other than the observation?

THE WITNESS: There are some places where capability and geology come together and one of them is an issue that looks like it's an old fault, as I stated previously. Also, if a fault is going to be reactivated, it should have an orientation that's -- a certain orientation with respect to the stress field in the rock, if it's going to be reactivated. And I have looked at the stresses that have been derived from geophysical information and it doesn't look like the attitude of the Wateree Creek Fault is particularly favorable for reactivation.

JUDGE LINENBERGER: In terms of stress orientation?

THE WITNESS: That's correct.

JUDGE LINENBERGER: All right, sir. Let's stick with this dike intrusion for just a moment. I'm not quite sure how to

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ask this, but somewhat naively let me ask how does the extent of the dike intrusion into the fault compare with the, let's say, the overall length of the fault? Is the dike intrusion something that could permit the fault to break up and behave subsequently perhaps as two segments of fault?

THE WITNESS: The dike itself is a relatively thin sheet of rock, only a few tens of feet thick. It's strength is miniscule, so it doesn't act as a pin which prevents the fault from slipping at all. The only significance of the dike is that it hasn't been misplaced by the fault and therefore it tells you that the fault is older than the age of the dike.

JUDGE LINENBERGER: All right. Perhaps another way to ask my question, does the dike extend -- is the extent of the dike comparable to the extent of the fault?

THE WITNESS: Their lengths are of the same order, yes.

JUDGE LINENBERGER: Same order.

THE WITNESS: Roughly ten kilometers.

JUDGE LINENBERGER: All right, sir. And the stress pattern orientation that you were referring to that you said is not consistent with reactivation of this fault, has that stress pattern been observed along the whole length of the fault?

THE WITNESS: No, the stress data that I'm familiar with comes from around Monticello Reservoir and the fault is south of the reservoir, so they're in different places really.

JUDGE LINENBERGER: So it's in the area of the reservoir

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that the stress orientation is, if you will, in a direction that would not be consistent with fault activation?

THE WITNESS: Yes.

JUDGE LINENBERGER: Will you say a little bit more, sir, about what is left to be done in your study? I gather it is still going on, and what constitutes -- where were your objectives and what will constitute completion of it and what's left to be done? That's three questions there.

THE WITNESS: Basically I'm interested in the geology of the Piedmont Province in South Carolina and so I'll probably be doing geology here for the rest of my life. But as far as this project goes, I am in the second year of funding from the U. S. Geological Survey and the objectives this year are to finish the mapping of the Monticello and Pomaria quadrangles and to complete fracture studies and some geophysical measurements that we're making in these areas.

I have a proposal that has been submitted to the U. S. Geological Survey for a third year of work to study the northern extension and the southern extension of the Wateree Creek Fault. In particular, if we can trace the Wateree Creek Fault south to the vicinity of Lake Murray where there are some coastal plain deposits, we would have still another geological way of pinning down it's age. So I have requested a third year of funding, but I haven't heard officially whether that's going to be awarded or not.

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JUDGE LINENBERGER: Well finally then, as to the portion of your ongoing program that is left to be done, assuming you get the money you asked for, will the work that is yet to be done have a very direct bearing on the question of specifying the geological nature of the proposed Summer plant site, per se, or is it getting away from the site now?

THE WITNESS: We're getting away from the site basically. We're doing the geology in the critical place right now and as time goes on we'll be working farther and farther away from the site.

JUDGE LINENBERGER: So, so far as efforts that you are doing or have to do that impact the site itself, when will those be available for USGS?

THE WITNESS: The results of this summer's work will be written up and submitted to the USGS in the fall, October-November.

JUDGE LINENBERGER: I'm going to ask you for a professional opinion here. From what you have done to date and the kinds of things you anticipate doing that could have an impact on the site because of the proximity of your efforts, are there any areas of unknowns that cause you personally to have reservations about the Wateree Creek Fault upsetting the conclusions of the USGS and the NRC staff so far about this site?

THE WITNESS: No. I have personal reservations about whether facilities of this sort should be built, but I don't feel like geology is the limiting factor.

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JUDGE LINENBERGER: All right, sir. I think we hear you and I thank you very much for your candor. That's all I have.

JUDGE GROSSMAN: Dr. Secor, the stress orientation that you mentioned, was that based on observations from the two boreholes that the USGS has made in that area?

THE WITNESS: Yes, that's mainly it, plus the first motion data from the seismic studies that Dr. Talwani has made.

JUDGE GROSSMAN: How far is the nearest borehole to the fault that you have so far mapped, to the extent that you have mapped it?

THE WITNESS: The nearest point on the fault is I guess about two kilometers southeast of Peak and I don't recall exactly the distance from Peak up to where the boreholes were, several kilometers but I don't know exactly.

JUDGE GROSSMAN: It seems to me from some of the things that I've read that there have been suggestions made that from the nature of the materials in the boreholes, one could only learn the local stress conditions, that is for a very confined area. Is that your understanding too?

THE WITNESS: Yes, the stresses that have been measured are applicable to the vicinity of the reservoir since the fault is not present there, at least we haven't found it, we don't know what the stresses are like around the fault down in the Chapin area where it has been mapped.

JUDGE GROSSMAN: So you really can't project the stress

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conditions from the bore holes to the fault itself, is that so?

THE WITNESS: That's true.

JUDGE GROSSMAN: Now even though this isn't your area, you must be aware of the fact that there has been reservoir induced seismicity as a result of the Monticello Reservoir.

THE WITNESS: Yes.

JUDGE GROSSMAN: Have you any opinion as to whether that seismicity is related at all to the Wateree Creek Fault?

THE WITNESS: I don't think it is, because the Wateree Creek Fault doesn't seem to occur in the place where the seismic activity is.

JUDGE GROSSMAN: I have no further questions.

JUDGE HOOPER: Professor Secor, can I ask you just two questions, and both of them come from a little bit of information, perhaps not enough. One concerns this matter of lineations that continue on from the fault, I believe north. I believe there's some sort of creek bed lineation, is that correct, sir? The basis for speculating that the fault goes on farther north.

THE WITNESS: I've heard those speculations, yes.

JUDGE HOOPER: They're not yours then?

THE WITNESS: No.

JUDGE HOOPER: Then you have, as far as what you can say right now is that you're not convinced that these lineations have any relation to the continuation of the fault?

THE WITNESS: I'm not convinced. I've walked the creek

F18pw

in question and I have not found any evidence of faulting in it.

JUDGE HOOPER: Concerning the Chairman's last question, and I realize that you're not an expert in this area, but I would appreciate your general opinion, is there any possibility of an interaction between a non-capable fault in the geological sense and reservoir induced seismicity, is there any possibility of this interaction for an old fault and reservoir induced seismicity, not necessarily, but is it possible for there to be some amplification along a fault line?

THE WITNESS: If you regard a capable fault as being -- a fault that's not capable as one that's been inactive for a certain period of time --

JUDGE HOOPER: That's what I'm saying, that's correct.

THE WITNESS: Then I would say that a fault that wasn't capable, in other words, hadn't moved for certain periods of time, still might be reactivated by a reservoir if it happened to be in an orientation with respect to the stresses that were favorable.

JUDGE HOOPER: I understand that some of the largest magnitude earthquakes that are reservoir induced have been along old fault lines and that is the reason I'm just asking this question. So I guess to paraphrase your answer, it would be possible, not necessarily probable, but possible that the Wateree Creek Fault could in some way amplify, not necessarily amplify, but could transmit some of the shaking from a reservoir induced

F19pw

quake.

THE WITNESS: I guess that's possible, yes.

JUDGE HOOPER: Thank you.

JUDGE GROSSMAN: Any further questions?

MR. KNOTTS: I have some recross if I may.

JUDGE GROSSMAN: Yes, certainly.

MR. KNOTTS: Dr. Secor, in response to Dr. Hooper's last question you indicated it was possible that there might be some reactivation of the old fault as a result of reservoir induced seismicity. I thought I heard you indicate earlier that the stress field in the vicinity of the reservoir was not conducive to that. Could you explain or confirm?

THE WITNESS: All right. I believe that the stress measurements that have been made in the vicinity of the reservoir indicate that the greatest principal stress is horizontal and the least stress is vertical. These are the conditions that lead to thrust faulting. And thrust faults have inclinations that are generally about 30 degrees, they are moderately inclined. Wateree Creed Fault is practically vertical, so its dip is wrong for it to be reactivated as a thrust fault.

MR. KNOTTS: Thanks very much.

JUDGE GROSSMAN: But does it appear to be a dip slip fault or a reverse dip fault?

THE WITNESS: Its dip is about 80 degrees on the average and the net slip would be such that it would be a reverse

F20pw

fault.

JUDGE GROSSMAN: I see, but nevertheless it does exhibit vertical --

THE WITNESS: Nearly vertical, yes.

JUDGE GROSSMAN: Thank you, we have no further questins. Thank you ver, much for joining us, Dr. Secor.

(Witness excused.)

JUDGE GROSSMAN: I think at this time we promised the limited appearance presenters that they could offer their statements and we would like it if the panel would relinquish their seats for just awhile and hear these statements, though we are definitely not excusing you.

(Panel steps down.)

JUDGE GROSSMAN: We do have nine names. I just thought I would let the parties know what to expect.

MR. KNOTTS: I'm sorry?

JUDGE GROSSMAN: Nine.

MR. BURSEY: Judge Grossman, are we going to go back to the seismic considerations this afternoon?

JUDGE GROSSMAN: Yes, as soon as this is concluded. I don't know how much time, I believe we'll have some time left.

Could the first four speakers, Barbara Bullard, Michael Goodling, Wes White and Elizabeth Level please have a seat at the witness table?

If you have not heard from this morning's session, we

F21pw

would prefer that you limit your time to five minutes apiece.

The first speaker will be Barbara Bullard, and could you first give your full name and your address please?

STATEMENT OF BARBARA BULLARD

MS. BULLARD: My name is Barbara Jean Bullard, I live at 1204 Whitney Street, Columbia.

JUDGE GROSSMAN: Could you speak slower and louder please and please repeat it. The court reporter here is attempting to take it down so that it will be printed in the transcript.

MS. BULLARD: My name is Barbara Jean Bullard. I live at 1204 Whitney Street in Columbia.

All I would like to say is that I don't want a nuclear power plant here because there's too much room for error, human error. The same thing that happened at Three Mile Island could very easily happen here and it won't just hurt us, it will hurt generations past us and there's nothing you can do to reverse the action and I don't see how anybody could want one.

JUDGE GROSSMAN: Thank you, Ms. Bullard.

The next speaker is Michael Gooding.

STATEMENT OF MICHAEL GOODING

MR. GOODING: My name is Michael Gooding, I live at 1204 Whitney Street in Columbia, South Carolina.

As a resident of Columbia and a resident of Columbia and a user of SCE&G power, I definitely stand unequivocably opposed to the licensing of the V. C. Summer Plant or any other

F22pw

power plant in the area, and I could list a multitude of reasons why, but we only have five minutes here.

One reason is, this technology is something we don't even need to begin with. We waste 50% of the energy we use in this country, so why do we need to build power plants in order to supply maybe 3 or 4% at the most, that is this dangerous. It doesn't make sense. We need to look at who is going to win, who comes out ahead with these power plants. Do the customers come out ahead? No, we pay higher rates and higher rates and higher rates. This is an expensive technology, it's not cheap. Some of these people may tell you it's cheap, but it's not. We see how much it will cost to clean up the Three Mile Island plant, a lot of bucks. It is by no means cheap and it's dangerous, it's dirty.

Second of all, another reason why I'm opposed to it is we're making decisions here now that are going to affect future generations that don't even have the chance to be represented. I mean we supposedly live in a democracy here, but these people aren't getting a chance to be represented with these decisions. What are we going to do 20, 50, 60 years up the line when our grand children, children, our great grandchildren come to us and say, listen, great grandad, why didn't you decide no nuclear power. You're killing us now and we can't do anything about it. But SCE&G is going to come out ahead on this because they're going to make big bucks off of it, a lot of money, it's capital intensive.

F23pw

Another point is, there are so many parts of nuclear technology that we still don't know how to deal with. Hopefully, sometime during these hearings, someone from SCE&G will respond to, what are they going to do with this reactor 30 years from now when they have to decommission it. They don't know how to decommission it, no one knows how to decommission one of these things. Is it going to sit out there like a little baby nuke, SCE&G's test reactor is, growing over with weeds waiting for some terrorist or someone to come along and blow it up or something or some earthquake to come along? What's going to happen to it? It's just going to sit and sit and sit and be hot as hell.

And that's all I've got to say.

JUDGE GROSSMAN: Thank you, Mr. Gooding.

Wes White.

STATEMENT OF WES WHITE

MR. WHITE: My name is Wes White and I live at 18 Bluff Road, Columbia.

I want to examine what will come out of this reactor based on our experience with past reactors. First off, there will be, based on past experience, from time to time what is called "routine emissions of radiation", as at TMI. And these routine emissions of radiation will, not going into the exact mechanism which will take too much time, cause a certain number of cancers in the surrounding population from runaway cell multiplication, which is a cancer.

F24pw

Also, the reactor itself is a danger to the water table in that the reactor, as you all have heard, very conceivably can melt down. There have been some projections about how many melt downs we can expect where the core melts to the floor of the reactor, hits the water table and thus produces a radioactive cloud of steam. It hasn't been all that long since there were no human beings living in the Congaree River valley, say about 1730, and though it may be hard for the rest of us to concede here now, that can happen again.

And also, as has been pointed out in Canadian Geographic, several months ago, there probably used to be quite a bit of plutonium here on the planet. The planet is possibly five billion years old. I don't think anybody knows but supposedly that's how old it is. Now the plutonium that used to be here has decayed into lead. It's heavier than lead and anything heavier than lead will eventually decay into lead, if I can believe Canadian Geographic. And all the plutonium that used to be here has now been gone for three or four billion years, more like four billion years or more. Now in order to produce steam to make electricity, and incidently to keep a few people rich with electricity that we don't need, what some people are proposing that we do is build this reactor and it's basically a multi-million pound kitchen pressure cooker. I mean if you don't have three doctorates and an MD, that's about the only way you can conceive of it and understand what the thing is.

F25pw

And this stuff, this reactor, this pressure cooker, will produce, to quote the lady who did the Masters' thesis on the history of the Savannah River installation, it will produce "a hideous amount of waste" indirectly in that the waste that is produced by the V.C. Summer reactor will have to be sent somewhere eventually and when it is sent there, well, here, I want to quote for the record one sentence, one sentence only out of the current issue of Newsweek, June 22, 1981, on page 33, this one sentence states, yes, here it is, under headline, "How to build a bomb". All right, this one sentence states, "But with a little atomic alchemy and a lot of undercover tinkering almost any nuclear reactor can be used to make a bomb."

Now my question is, is it worth it for this electricity and another thing is the waste that will be produced by this V. C. Summer reactor will, the plutonium in it, which will have to be sent somewhere, I suppose to Barnwell, that's a very dangerous idea. We've had experience with that before. In 1958, between Sevierlux (ph.) and Cherubinx (ph.) some improperly stored plutonium extract blew sky high and wiped out 100,000 square kilometers. I think that's 38,600 square miles, 30 villages of up to 2,000 people apiece disappeared off the -- well they disappeared off the map, the villages aren't there now, no one lives there now.

And I'm saying that the waste produced by the V. C. Summer reactor will lead to a situation like this sooner or later.

F26pw

It has happened once before, it's going to happen again, sooner or later.

Now when it comes to nuclear energy, my proposal would be to wait until we have perfected some sort of fusion technology. I have never heard anyone say anything bad about fusion. There may be all kinds of things bad about it, but we don't know that yet, and that's possibly only 30 years off. There are counter proposals about how to get the energy that we can get from nuclear. I mean other ways to get it. And finally, I think that the nuclear waste that will be produced by the V. C. Summer reactor is a threat to civil liberties. The various versions of the recodification of the criminal code, the great grandson of S-1 that's knocking around Congress now, there is occasional mention of nuclear energy in this recondification of the criminal code and I think that the waste that is produced is so dangerous and so -- well let's just say flat out evil, that it will necessitate a -- something more like a police state than what we have now and a lessening of civil liberties.

That's all.

JUDGE GROSSMAN: Thank you, Mr. White.

Elizabeth Lever.

STATEMENT OF ELIZABETH LEVER

I am Elizabeth Lever, I live at 5420 Knoll Road, Columbia 29203. I'm a licensed practical nurse in a local hospital.

I am against the current licensing of the V. C. Summer

F27pw

nuclear plant. I think that the contracts have been enforced poorly, the contractors' employees are aware that work has not been up to specifications and these employees are as capable of reading specifications as the inspectors. Some whistle-blowers in the area have been -- who have worked at the plant are currently blackballed.

I also feel that I am representing approximately 1,000 people if -- that cannot be here because they are working, who sympathize with this on the basis that our senators recognize that my letter to him represents the voice of 1,000 people.

I am aware that contracts with the hospitals only currently cover the employees of South Carolina Electric & Gas in the event of a nuclear accident. The hospital that I work at has broad, non-specific plans for care of radiation victims and emergencies calling for evacuation. For the close proximity of this plant and others dealing with agents creating radiation problems, we have almost no knowledge of treatment and care of radiation burns and sickness being taught in our medical schools and nursing schools. These hospitals are within 30 miles of the V. C. Summer nuclear plant: RMH, Richland Memorial Hospital; Baptist Hospital; Providence Hospital; Lexington Hospital; Moncrief Hospital and the Veterans Administration Hospital. There are several smaller hospitals in closer proximity than these.

Wind drift - today with the winds from the west of up to 12 miles an hour with gusts to 19 miles an hour, would affect

F28pw

all of Lake Wateree, which is within 30 miles of the V. C. nuclear plant. If the winds from the north, most of the Lake Murray communities would be affected by any accident that spilled into the air. If the winds were from the southwest, Great Falls would be affected. If the winds were from the south, the Chester and Sumter National Forests would be affected. And if the winders were from the east, Newberry would be affected. I'm not a meteorologist, but these are just facts.

My other question is what effects would be temperature inversion if the phenomena occurred simultaneously with an accident at V. C. Summer nuclear plant with a spill into the air.

Thank you.

JUDGE GROSSMAN: Ms. Lever, why are these workers being blackballed?

MS. LEVER: Because they have been aware of faulty joints in pipes and they are the people that reported that the initial laying of the concrete was not up to standard, that this concrete subblayer had to be pulled and relaid.

JUDGE GROSSMAN: Was that done?

MS. LEVER: I understand that it was relaid.

JUDGE GROSSMAN: Thank you, Ms. Lever.

The next speakers are Pam Hudson, Merll Truesdale, Renee Bursey and Jean Fundstein. Would you all please come up here to the witness table?

F29pw

(Mr. Truesdale confers with Judge Grossman at the bench.)

JUDGE GROSSMAN: Have a seat and we'll handle further speakers. There were four that I read. Pam Hudson, you may proceed.

(No response.)

JUDGE GROSSMAN: She's not here. Okay. Merll Truesdale.

STATEMENT OF MERLL TRUESDALE

MR. TRUESDALE: My name is Merll Truesdale and I reside at 1613 Wynnewood Road here in Columbia, South Carolina. For most of my life I have lived here in the State of South Carolina and in Richland County.

There are some things that kind of bother me about this plant, the V. C. Summer nuclear power station that is coming up. One is the plant is very close to our water supply, the Broad River. If anything was to happen, such as happened at Three Mile Island or even worse, the water in our area probably would be contaminated from that. I'm just a regular human being who works and everything else, but I know one thing about radiation, that it has half lives and it lasts for a long time. You don't have to be a great mathematician or scientist to realize that. I am concerned about this because my family has been in this state for a little over 200 years. I would like to raise my family here but if this continues I will be forced to move somewhere else.

I think this Commission, the Nuclear Regulatory

F30pw

Commission, has the obligation to hear the facts and concerns of the citizens of this area concerning this plant and realize that whatever decision you're going to make, which I believe you already have made your decisions somewhat, that we must all really think towards the future because if we don't that's all we have to go on. Our lives might not be worth anything to the South Carolina Electric & Gas as far as dollars, but it means a lot to me. And I cannot accept the risk, nor can I tolerate the risk by having a Three Mile Island or having some boondoggle, even if it doesn't happen, that in 30 years I'm going to have to pay for it when I'm 50. I will not accept that responsibility. And at this point I cannot see any reason why this plant should be licensed. SCE&G makes a fairly good profit off the electricity they have and what they generate.

I realize technology has to grow but explore other ends, do not manipulate and exploit the land that you work on, you live on, because in return if you do it will come back to you and it will hit you hard. And maybe that is what is needed.

But another thing that bothers me about the plant in itself is within the 10 mile radius if a meltdown does happen, the people in that 10 mile area is already written off. What is going to be in effect is, the people's death warrants are going to be signed very fast and very quick. So I feel like that is very unjust and it's up to you gentlemen to decide about licenses and I hope that you will decide in some prudent manner.

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End of F.

JUDGE GROSSMAN: Thank you, Mr. Truesdale.

Renee Bursey?

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STATEMENT OF RENE BURSEY

MS. BURSEY: Rene Bursey, Route 1, Box 95, Blue Mountain, South Carolina 29705. I'm a registered dental hygienist and I've been practicing in the dental field since 1972. I became concerned about radiation not because of nuclear power but through x-rays when I read several reports that low-level radiation could very well damage the genetic structure of children in some way. They weren't sure. The report wasn't positive, but however it was possible.

And also that the use of fluoride--fluouride is a topical substance that's been put on children's teeth in to help them keep down the caivities--that the use of fluorides and the ways it bonds with minerals that it might catch some of these substances that would also cause cancer.

And I never really did put that together until I started hearing about the problems with nuclear power plants and things like that. And I got to thinking that if children could be more susceptible to cancer and genetic damage, then low-level emissions that occur during x-rays, then what would happen in the event of a nuclear accident.

And I haven't seen a whole lot of research on this and I'm not going to be very comfortable until I do. You're talking about little kids dying of a very horrible disease. If it's possible, it chould be researched before this plant gets licensed.

JUDGE GROSSMAN: Thank you, Ms. Bursey. Jean Pfundstein?

STATEMENT OF JEAN PFUNDSTEIN

My name is Jean Pfundstein, 2520 River Drive, Columbia 29204. I'm a recent person that's moved to South Carolina in the past few years. I grew up in New York State and had Indian Point in my backyard and I really wasn't aware of the nuclear problem until I did come to South Carolina.

I have seriously considered not getting up and bothering to say anything today, but I'm looking on this as an opportunity to get up and express, you know, voice my position on nuclear power, and it's subsequent waste coming into South Carolina.

I have no statistics or anything else to lay on you. I'll leave that to the scientists and everybody else here in the hearing. Myself personally, I'll never say that nuclear accident cannot happen, but I see a real threat behind nuclear power and this is in the individual and it's twofold. One is ignorance and the other is apathy and I'm afraid I've been guilty of ignorance for most of my life but I'm not apathetic right now.

Ignorance describes someone who knows nothing about nuclear power which is kind of inconceivable after Three Mile Island, but not impossible. And apathetic describes someone who does have some kind of awareness and chooses not to act on it. I believe that most people are willing to get involved about nuclear power and alternate energiesfor the sake of our

nation and I've made my choide and I've chosen to turn my own ignorance and other people's ignorance into knowledge and apathy and inaction into action. And I challenge the private citizens of this state--I don't care who you are, whether you're a housewife, a lawyer, doctor, a student--to take an active effort and say no to nuclear power in South Carolina.

And for myself and for a grwoing number of many other people, enough doubt has been shed not only on the V. C. Summer plant but on nuclear power in general to question the continued commercial use of nuclear power. And for those that choose not to speak out and make any decisions about nuclear power, don't worry because big business, the utility companies and government will make them for you.

I don't know about you, but I will not give up my right to speak out stridently. I will not stand aside to take down my roadblocks. South Carolina right now is my state. The United States is our nation and, more importantly, it's our money going out to fund these nuclear power plants. So we really need to decide on the quality of life that we want to have for ourselves now, for our families and for future generations. And I hope that possibly this will be kept in mind.

JUDGE GROSSMAN: Thank you, Ms. Pfundstein. Ms. Bursey?

MS. BURSEY: Can I have a minute? I forgot to say something that's real important.

JUDGE GROSSMAN: Yes, certainly.

MS. BURSEY: I forgot to say one thing that I think is really important, and that is that you don't have to have a nuclear accident to have low-level emissions. That happens all the time. So my question relates to the way we operate our nuclear power plants.

JUDGE GROSSMAN: Thank you. Thank you. The next speaker is Anthony Martin and I understand there are two others who would like to speak. Would they come forward, please, and have a seat at the table?

STATEMENT OF ANTHONY MARTIN

My name is Anthony Martin. I reside here in the city. I don't know a whole lot about nuclear power. I don't know its dangers or the safety measures that are being taken, but I do know some things that I think ought to be pointed out to the taxpayers.

In the Summer of 1978 I worked for the Bunson Service Company who made the heating and air conditioning units out there at Jenkinsville. I was the accountant keeping the books for the equipment. And while working there, I became aware of a black market operation going on inside the Jenkinsville plant involving the main warehouse people.

It was common knowledge that you could get anything that you wanted. Four hundred dollar drills were being sold for thirty bucks. It was a matter of three or four days before whatever you order was delivered to you. I was just handed

some figures a few months ago from some friends who told me that the original estimate for the construction of the Jenkinsville plant was approximately a hundred and ninety million dollars. That figure has been revised to five million dollars. I think the taxpayers ought to be given some kind of accounting of why this gross underestimate was made to begin with.

I think one of the reasons is because all the construction workers there and all the companies involved in that project knew that this was kind of a pork-barrel situation. That money was being thrown about by the shovelfuls. Everyone there was aware of it and they were taking advantage of it every day I was there.

JUDGE GROSSMAN: Thank you, Mr. Martin. Will the person that's sitting next to you please speak and give your full name and address, sir?

STATEMENT OF ABRAHAM SHINGLETON

Reverend Abraham Shingleton, Columbia, South Carolina. I'd like to speak against licensing the facility. There are some men who haven't been opened up to the public concern in the nuclear facilities. There is a certain group of people who have been against our people, against our country. One of their divisions is a land division.

Some years ago, it concerned the TVA. They had membership on the TVA. At this time they have membership in the environment and power. Saul Hill is one. There's a man named Russell

Train. These people are members of an organization called the Council on Foreign Relations. In South Vietnam they had people placed to shave points against us whereby they carried out the premeditated murder of our men there.

On defense against the Russians, they have certain point-shaving tactics in which they--we don't nave missiles to knock down the ICBM missiles out of the sky during an attack against us. These particular plants came insurreptiously, just thrust in surreptitiously without much publicknowledge or discussion On examination it was found that Daniel Construction up here in Greenville, a construction company and builder, Mr. Daniel was a member of this particular organization.

There are any number of other people who are--could very easily be using these nuclear power plants as potential targets to be used by terrorists. If somebody like Carter would get in again, Carter being a member of a group called the Tri-lateral Commission, who sided with the Communists to overthrow Central American governments. Now, if we aren't careful to get these people before they continue and one of them gets in again and they could bery easily use these facilities as cataclysmic targets our people, either for destruction or for the ensickening potentialities.

It's not our norm to allow such facilities to open up with so many dangerous factors that are not ironed out. The one brochure I read--I work and do a lot of construction myself.

g5da

I understand a lot of them are crackerbox construction. They used a very frivolous brochure to try to get it across to the public, trying to make a yard look like a mile. But such is not the case.

The people, the particular CFR people who have--the particular agencies concerning this and other facets of our governments and our lives, they're the same people that gave the A-bomb secret to Russia after World War II. They carried out the premeditated murder of the fifty thousand, sixty thousand American men in South Vietnam and also the premeditated murder of thirty-five thousand American men in South Korea. Also the South Vietnamese and South Korean are members also.

Now, it's expected to be responsible for the FBI and AT&F entrapment procedures against American citizens. They're responsible the crime rate, the attempted mental derangement and degeneration of the people. They're responsible for the smut and pornography. They're responsible for divorce mills. Certain forces behind this, for instance, a Jew named Rothman who is a heavy Seagram's distributor, he's a heavy financial backer of Carter. He's also a heavy pronographic supporter. He is a heavy financial contributor to this particular group of people.

They're responsible for putting Communist Castro into Cuba, enslaving the Cuban people. They're responsible for removing prayer from the public schools. Their apparatus, these very

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same people that are trying to push these dangerous nuclear devices against the people. They're responsible for trying to pervert the women to female/masculine types or sodomites of the women. Forgive the subject matter; it's shameful.

They're responsible for perverting girls in public school in drill teams and trying to truncate them into masculine occupations. They're attempting to pervert young girls with Saturday morning t.v. cartoons. They're a vicious and vile people who are trying to put this across to the public and trying to assuage the public. Trying to get in and then assuage the people. Even now they have power plants going to other countries wo should--going to undeveloped nations. And they'll give them the bombs. It's a very dangerous thing, very, very dangerous thing.

JUDGE GROSSMAN: Thank you. The next spaker--

MR. SHINGLETON: One more thing, please, sir. I have much information here. However, it is my sincere wish and I think it's the wish to hold the construction implementation of the nuclear power plant until this particular apparatus is brought to justice because it's not being done on the level with the people. And until the people find out the particulars about this skulduggery and the scurrilousness being perpetrated against them, there will not be satisfaction or safety regarding a nuclear power plant.

JUDGE GROSSMAN: Thank you. The next speaker?

STATEMENT OF RICHARD LANE

My name is Richard Lane. I live at 600 Haywood Street. I got here a little bit late to these hearings so I don't know if anybody brought up my point or not. But I was just wondering if this whole plant is necessary from the standpoint of needing the enrgy that it's going to provide.

I think anybody here, whethere they're pro- or anti-nculear or in between would agree that there's been an enormous amount of money spent on this plant. It's taken an interminably long time to get it going. We still don't have one little kilowatt of power from it yet and I'm just wondering if this plant is necessary or do we have an alternative to it chat we could use rather than--what we've got now is possibly dangerous.

I myself am worried about the radioactivity possibly getting in our drinking water. I'm worried about--well, I'm worried about the waste because obviously nobody knows what to do with it yet. and I'm not talking about an alternative like fission which is in the future or solar energy which is--I don't think we know how far away that is right now.

What I'm talking about--and I don't know if anybody's brought this up yet or not, but the subject I want to speak on his conservation of energy. And I'm not just going to say something pie-in-the-sky like if we all went out and insulated our houses and built solar collectors and all, we could lick

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the problem and not need the nuclear plant. What I will say is I can give you an example of what's already been done and it was done in Oregon a few years ago.

I was surprised by these hearings so I don't have every fact with me that I need right now. But my information comes from the Reader's Digest from a couple of months ago and it was an article on conservation and how if we started right now to retrofit our buildings, insulate and start building our new buildings in a way that they would save energy, the amount of energy we would save would more than offset the amount of energy this plant would need to produce.

In other words, in Oregon a few years ago there was-- I believe it was Oregon Power & Light; I'm not sure about that-- but Oregon Power & Light was proposing to build a new nuclear plant for an outrageous cost just like V. C. Summer. And instead they had a referendum and they didn't want to spend all that money if they didn't have to. They had a referendum and most of their customers opted to be given low-interest loans to insulate and, in cases where this was feasible, to retrofit their homes. Retrofitting means establishing solar water heaters, thing like that, where they would be feasible, like if your roof was in the right direction to get enough sunlight during the day.

Those people that were served by Oregon Power & light went ahead and got low-interest loans. The loans did not need

to be paid back until the homeowner sold his home. The loans only went out to people who owned their own homes. And it turned out that for a fraction--I'm not sure how muchof a fraction; I think maybe fifty percent, maybe seventy-five percent--of the cost, projected cost of the nuclear plant, the people who were served by Oregon Power & Light retrofitted their homes, insulated and consequently drove down their demand for the electricity to a point where the nuclear plant was no longer needed. The plant was originally designed to offset a future demand that had been estimated by some study group, but for a fraction of the cost, by conservation, they managed to not need the plant at all and did away with the need for hearings and cost overruns and things of that nature.

And I'm just wondering, has SCE&G done a study about what they could do for conservation rather than--now, I know they had some nice little ads in the magazines and on billboards about conservation but I don't know that they've done much more than pay lip service to that idea.

JUDGE GROSSMAN: Thank you, Mr. Lane, and the last speaker?

STATEMENT OF GARY LANE

My name is Gary Lane. I live at 301 Palmetto Street, no relation to Richard. I think what aggravates me the most, not this nuclear plant; it's not even needed right now. What is needed for public transportation. And all this money going

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for a nuclear power plant and there's not a dime going for public transportation adequate for all our people, wheelchairs and all that.

I went out the SCE&G and asked them couldn't we have wheelchairs put on buses where handicapped people could ride on buses. This is the statement they gave us and they expect us to sit back and watch this piece of junk power plant going up. I worked on construction in the Shore Nuclear Plant on Long Island. It was one of the shittiest operations going. Every once in a while a guy looks around and pays someone to turn the other way while he rewrites the specs that were originally designed there.

I've seen it. I walked off that plant. I came back with the people that protested on that plant. I don't want it anywhere. I want it out of here.

MR. MARTIN: Could I say something more, please? When I quite working at the V. C. Summer plant, I went back to school at USC. I called the office of this Campaign for Riley because I thought somebody should know what's going on there. And I was informed by the campaign manager that they were all aware of what was going on, that it was a matter of course that these things were going on and there wasn't anything anybody could do.

I don't agree. I think it's precisely that kind of attitude that allows these types of things to go on all the

time and I think it's time for the public to go out and be counted. Thank you.

JUDGE GROSSMAN: Thank you, Mr. Martin. Thank you, ladies and gentlemen. We'll take a five-minute recess and then the seismology panel will come back.

[Brief recess.]

JUDGE GROSSMAN: Mr. Knotts?

MR. KNOTTS: We have an administrative matter to report, Mr. Chairman. The administrative matter is that the documents which were not delivered to Fairfield during the interval between June 5th and today have now been delivered.

JUDGE GROSSMAN: Thank you. We've had another request for another limited appearnce statement. I really don't think we can handle it in drips and drabs that way and organize the hearing effectively. We will entertain some more limited appearance statements on Thursday morning so that anyone who does want to speak can come on Thursday morning, and to the extent that we can accommodate them, we will. But we don't represent that we will hear every one.

Okay. I think then we're ready to proceed with the panel. And the Thursday session, by the way, will be at the Carolina Inn rather than here. Do you recall that we're here for two days and then at the Carolina Inn for the remainder of the hearing?

MR. KNOTTS: Yes, sir. I took an implication that

simply was not there. We are going to be at the Carolina Inn starting Wednesday, is that not correct?

JUDGE GROSSMAN: Yes, that's correct. Mr. Bursey, you may proceed.

CROSS-EXAMINATION (Continued)

MR. BURSEY: Dr. Chen, you have in your prefiled testimony statements about hypothetical seismic events and built-in conservatism to demonstrate adequacy of plant design. Can you tell me what estimates were used and how you determined your design that you're relying on?

DR. CHEN: The estimate was requested by ACRS and ARC staff was at 4.5 to 5.3 magnitude.

MR. BURSEY: And how did you determine those estimates?

DR. CHEN: How did I determine? That was requested by ARC and ACRS, we didn't determine.

MR. BURSEY: You were given those figures by the Nuclear Regulatory Commission?

DR. CHEN: That's what they requested us to evaluate, the effect of magnitude 4.5 to 5.3 events on the plant design.

MR. BURSEY: And who determined what the safe shutdown factor for ground acceleration should be?

DR. CHEN: That was indicated in FSAR.

MR. BURSEY: So, when you say it was indicated in the FSAR, you're saying that that's a Nuclear Regulatory Commission figure that you're working with?

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DR. CHEN: No, that's the report prepared by South Carolina. That's the final safety analysis report.

MR. BURSEY: And who prepared that report that concluded that that was the figure for the safe shutdown?

DR. CHEN: You're asking what was the number used for safe shutdown?

MR. BURSEY: No, sir. I'm asking who prepared it and how that determination was reached?

DR. CHEN: Oh. The safe shutdown was determined by the consultant to South Carolina; it's by Dames & Moore.

MR. BURSEY: And do you know how they reached the determinatio that .10 ground acceleration factor was the safe level in which the plant could--

DR. CHEN: It was not .10.

MR. BURSEY: What is it?

DR. CHEN: It was .15 and .25.

MR. BURSEY: And how was that figure reached?

DR. CHEN: That was based on the seismologist at the site--the seismology of the site.

MR. BURSEY: Obviously there's some interface between the seismological condition of the site and the actual physical apparatus of the facility. Someone must have done some research to determine how you set up your facility to be able to establih .15 ground acceleration factor to safely shut the plant down?

Who did that work? What were your models based on?

DR. CHEN: Okay. We designed the plant based on the .15g earthquake. Based on that we designed the whole plant and the equipment.

MR. BURSEY: So you're saying that the plant was designed around that number?

DR. CHEN: In combination with the responsive spectrum specified by NRC also.

MR. BURSEY: And that .15 figure came from the consulant Dames & Moore?

DR. CHEN: Yes, sir.

MR. BURSEY: And can you tell me how they derived that figure?

DR. CHEN: Yes, I just indicated it was based on the site seismology investigation.

DR. ALEXANDER. I think I'd like to suggest that we ask the people--Dames & Moore are present--to see what they did because they're present here in the audience and would be prepared, I believe, to respond to that question specifically.

JUDGE GROSSMAN: Are you suggesting now they take the stand and testify?

MR. KNOTTS: That would be agreeable to me if the Board feels it's relevant.

MR. BURSEY: That's fine. How many are there?

MR. KNOTTS: We have two witness, Mr. McWhorter and

Mr. Smith.

JUDGE GROSSMAN: Will the two witnesses come forward, please? Stand and raise your right hand.

Whereupon,

JAMES G. MCWHOTER,
WILLIAM G. SMITH,

were called as witnesses for and on behalf of the applicant and, having been duly sworn, testified as follows:

DIRECT EXAMINATION

JUDGE GROSSMAN: Could you give your full manes, sir?

MR. MCWHORTER: Yes, my name is James G. McWhorter, M-c-W-h-o-r-t-e-r. I reside at 153 Hillcrest Avenue in Cranford, New Jersey. And I work for the firm of Dames & Moore, consultants to South Carolina Electric & Gas.

JUDGE GROSSMAN: The other gentleman, sir?

MR. SMITH: My name is William G. Smith. I reside at 504 Kenridge Circle, Stone Mountain, Georgia, and I am employed by Dames & Moore, consultants to Souther Carolina Electric & Gas Company.

JUDGE GROSSMAN: I take it you gentlemen have heard the question that has been posed by Mr. Bursey?

MR. MCWHORTER: Yes.

JUDGE GROSSMAN: Would one of you proceed and answer that?

MR. MCWHORTER: Certainly. It's been an object of

some discussion. Mr. Bursey, Dames & Moore did FSAR prep tions in the area of Section 2.51 and 2.52. This Section 2.52, laboratory and ground motion followed regulatory guidelines in standards proposed by the NRC, specifically Guideline 1.70. That specifically requires that the applicant prepare a reasonable estimate of earthquake activity that could affect the plant, and specifically it begins at the regional level looking at the tectonic provinces surrounding the plant for two hundred miles, if any earthquakes have occurred in those provinces, and then either associating those earthquakes with specific tectonic structures, seismographic structures for the specific tectonic provinces.

And then those earthquakes are evaluated by various evaluation laws, and the largest earthquake that has the largest effect at the plant site is determined, and then that earthquake becomes safe shutdown earthquake.

MR. BURSEY: And what was the date of the conclusion of your first study?

MR. MCWHORTER: I believe the PSAR investigation was carried out between January 1971 and whenever the PSAR was filed.

MR. BURSEY: And did you at that time postulate any anticipated site events for either magnitude or ground acceleration factors?

MR. MCWHORTER: At the time of the PSAR preparation it was before Appendix A of the 10CFR was promulgated, but to the best of my recollection, I did not prepare that. I was

a geologist working on site. But to the best of my recollection they used similar concepts in arriving at the safe shutdown earthquake. At that time it was called the design basis earthquake. That particular earthquake has remained the same, the 1913 Union County, intensity 7, and that became the design basis earthquake at the time.

And during the regulatory process I'm sure most everybody was familiar with the processes. That particular earthquake was discussed quite a bit and I believe the original estimates of ground motion were something less than .15g for design basis earthquake and a .1g acceleration for the operating basis earthquake.

But during the regulatory process and conservatisms add on to those by the ARC and ACRS for licensing boards, the final numbers that were arrived at during the construction stage were .10, the operating basis, or .15 for the SSE, design basis.

MR. BURSEY: And those figures that you just cited are the ones that the plant was constructed to meet?

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

MR. BURSEY: And yet the recent activity that has resulted in magnitude of 2.8, you feel that's not giving you any concern in that it was--

MR. MCWHORTER: I think it's very intersting, as Dr. Alexander pointed out earlier, from an academic standpoint, a scientific standpoint. But, no, it didn't give me any concern. The design of the structures to resist earthquakes is not my

expertise, but my understanding is you have to be concerned with sustained acceleration, that the plant is designed to withstand a not very short duration, .05 seconds of ground motion in excess of .1g.

MR. BURSEY: What about short duration, high-frequency of 10HZ?

MR. MCWHORTER: I couldn't comment on that, sir. Perhaps Dr. Chen could.

MR. BURSEY: Who could?

MR. MCWHORTER: Dr. Chen.

DR. CHEN: Would you repeat your question again?

MR. BURESY: In ground motion of a short duration and high frequency which might exceed the safe shutdown earthquake above 10HZ, this question had been raised in the final Safety Evaluation Report and is of concern. And I'd like for you to address the impact of the shutdown capability of short-duration, high frequency event above 10HZ?

DR. CHEN: As Mr. McWhorter mentioned, for that kind of earthquakes, it's interesting from a scientific standpoint, but from an engineering point of view, it's of no sigificant because of energy content of such a .06 second impulse is minimal as far as the energy input to the structural design is concerned.

JUDGE GROSSMAN: Excuse me. Could I interrupt for a second. I've heard you, Dr. Chen, and also Mr. McWhorter refer to the .15g figure and then, almost as an afterthought,

mention that .25g figure on soil. Was that an add-on in the FASR or was that part of the original environment.

DR. CHEN: That was a part of FSAR..

JUDGE GROSSMAN: Okay. So that figure was in there from the beginning, both figures, the .25 and the .15g?

DR. CHEN: Yes, sir.

JUDGE GROSSMAN: Thank you.

MR. BURSEY: Can either of you gentlemen comment on the Brune model? I don't know if I'm saying it right. I understand that that was what you used to determine some relationship between magnitude and maximum intensity and peak acceleration. Who is Mr. Brune?

MR. MCWHORTER: I'm responsible for that sections, those estimates of peak acceleration. Mr. Brune is a professor at San Diego, University of California San Diego.

MR. BURSEY: Can you rely on Mr. Brune's application? Explain a little bit about it is, the Brune model, and why you relied on it?

MR. MCWHORTER: It's a conceptual mathematical model of the earthquake rupture. It takes the earthquake rupture as an indicator of the location of a fault surface. It's an appropriate model of the earthquake process for the purpose of determining ground acceleration, strong ground motion at a point that's far afield from that rupture.

JUDGE GROSSMAN: Excuse me. Could I ask the reporter

to repeat that? I couldn't catch the first half of that.

[Whereupon, the court reporter read back the last answer.]

JUDGE GROSSMAN: Would the witness repeat the answer?

MR. MCWHORTER: The Brune model is a mathematical representation of the earthquake source and it treats the earthquake source at its peak rupture point. It allows--and we use it for the purpose of calculating strong ground motion because it's appropriate for that purpose. It allows you to estimate various characteristics of the strong ground motion far afield.

MR. BURSEY: And did the use of the Brune model factor in the reservoir predict the potential of induced seismicity?

MR. MCWHORTER: It's an appropriate model for estimating strong ground motion during an earthquake which is caused either by tectonic or by reservoir proceeses.

MR. BURSEY: There's also been some mention of formulas from McGuire & Hanks. Does anybody wnat to speak to who McGuire & Hanks are and what those formulas are?

MR. MCGUIRE: I can speak to that.

MR. BURSEY: Do.

MR. MCGUIRE: What's the question, please?

MR. BURSEY: Well, there's a reference to formulas from McGuire & Hanks. What formulas were used and what are they?

MR. MCGUIRE: Are you quoting from my testimony?

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MR. BURSEY: Actually I don't know whether it's from your or Dr. Alexander's. It was something that I came across in the prefiled testimony. It made note that you were using McGuire & Hanks, and I'm not sure what it was, and if you don't know, I'll stop and find it.

MR. MCGUIRE: I know what formulas were used. I just wanted to make sure I was putting my answer in the context of the question which is still not clear. But I think to summarize, the formulas there are formulas which tell how to use the Brune model, to calculate various characteristics of ground, motion, strong ground motion on the site, including peak acceleration.

MR. BURSEY: And could any one of you--Dr. Alexander, perhaps you could take the point on this. There's numerous references in all of the applicant's filing about built-in conservatism and the estimates that are going to accommodate for the fact that there has been a suggestion on the part of at least one of the NRC staff that the magnitude potential for that be increased and thatthe near-field incident, if we were to have one that reached the same shutdown level for the soil service.

And the applicant's response is, well, there's built-in conservatism. Can you speak to that issue of built-in conservatism?

DR. ALEXANDER: Can you be more specific about the context?

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MR. BURSEY: For instance, there could be a criticism that though something changes, you don't need to change your studies. You just--the numbers that have been used previously to indicate what levels of safety that we're seeking, that the applicant is arguing, it doesn't matter if factors change; it doesn't matter if we have a greater near-site event that we've anticipated because of built-in conservatism or design.

MR. KNOTTS: I'm constrained to object to the form of the question, Mr. Chairman. The witness seems to be having trouble with the context of the question.

JUDGE GROSSMAN: I believe the witness really asked you which reference to conservatism or where there was a reference to conservatism that he could respond to.

MR. BURSEY: There are numerous references. There's one on page two of Dr. Chen's testimony. "However, the built-in conservatism can be used to demonstrate the adequacy of plant design." And that term, built-in conservatism, is one that I see in a lot of the applicant's figures. And I'm just wondering if you can give me some assurance that I can rest easier. Explain that to me.

DR. ALEXAN:DER: Dr. Chen can explain that particular one because the conservatism shows up in different aspects of the study--siesmological, or in this case that you just referred to, to the plant design itself and what it is capable of tolerating and he specifically can answer that question about the

conservatism with regard to the plant itself.

DR. CHEN: The specific built-in conservatism which you just mentioned, which is one page two of my testimony, was further explained at the bottom of page two in the same testimony and also continued on page three.

MR. BURSEY: I can read it, Dr. Chen, but I'd appreciate it if you could explain it to me.

DR. CHEN: Okay. I'll be glad to. At the bottom of page two, the conservatism there was about a damping value we used inthe dynamic analysis. After taking into account a more realistic damping value, we quantified the original built-in conservatism.

And on page three the built-in conservatism displayed here is using the enveloping process of generating the time history. Here, we quantified built-in conservatism by comparison of the original enveloping process with a statistical study. That's the only two built-in conservatism which we have quantified so far.

MR. BURSEY: Thank you, sir. Judge Grossman, I had a question that I needed to refer to the supplement of the Safety Evaluation Report, 3.71, and I'm unable to find that in any of the supplements, the supplement additions, the two supplement additions that I have. Skip that number and that cite 3.71 raises the question that I had raised earlier about safety shutdown earthquake about 10HZ. A discussion of the effects of these

short duration, high-frequency ground motion on the plant structures is contained in Section 3.7.1 of the supplement to the Safety Evaluation Report. And I've looked for it. I'm sorry. I haven't been able to find it. It's not in either Supplement 1 or 2.

JUDGE GROSSMAN: I'm sorry. Whereis the reference?

MR. BURSEY What I just read is on page 2-32 of the SER. It's Part 4 under conclusions, midway through the page.

MR. GOLDBERG: Judge Grossman, that's in Section 3.72 of Supplement 1, dated April 1981.

MR. BURSEY: That answers my question about the events above 10HZ. I had not been able to find that. It was apparently recited incorrectly in the first SER so I don't have any other specific questions right now. I assume now that the staff or the Board has questions for the panel.

MR. KNOTS: Mr. Chairman, is this the appropriate time to enter the qualifications and Mr. Smith into the record? We have those available. They've been distributed now.

JUDGE GROSSMAN: Yes, that's fine.

[Insert.]

PROFESSIONAL QUALIFICATIONS

WILLIAM G. SMITH

I am a Senior Geologist with the consulting engineering firm of Dames & Moore as well as Technical Manager of their Atlanta office which has a staff of 55 persons.

I am a graduate of Emory University in Atlanta, Georgia, with a degree in geology and physics. I have also completed over one year of graduate studies.

During my association with Dames & Moore and with various part-time projects, I have performed, or been directly responsible for, numerous investigations which have included studies in the geologic, engineering geologic, foundation engineering, and marine geologic and geophysical disciplines. I have completed assignments as Project Manager of multi-disciplinary projects which have addressed the environmental and socioeconomic disciplines.

I have participated on PSAR and FSAR studies for the Farley Nuclear Plant (Dothan, Alabama), the Duane Arnold Nuclear Plant (Palo, Iowa), Turkey Point Nuclear Plant (Turkey Point, Florida), the proposed South Dade County Nuclear Park (South Dade County, Florida), and the Susquehanna Nuclear Plant (Berwick, Pennsylvania) as well as the Virgil C. Summer Nuclear Facility. My responsibilities on these projects have ranged from Field Geologist to Project Manager for Chapter 2 of the PSAR and FSAR documents. I was also responsible for investigation of subsurface cavities, sinkholes, faults, groundwater regimes and solutioning.

I am registered as a Professional Geologist in the States of Maine and Georgia. I am a member of the Association of Engineering Geologists, the Marine Technology Society, and Sigma Gamma Epsilon.

PROFESSIONAL QUALIFICATIONS

JAMES G. MCWHORTER

I am a Senior Geologist with the consulting engineering firm of Dames & Moore. In this position I participated in studies to identify causal mechanisms of induced seismic activity at the Virgil C. Summer Nuclear Station's Lake Monticello. Analyses included use of in situ stress data, focal mechanism solutions of recorded seismic events, and other geologic observational data. As a member of the project team, I helped prepare the report on Supplemental Seismologic Investigation dated December 1980.

I received a Bachelor of Science Degree in Geology from Clemson University, South Carolina, in 1967. In 1974, I received my Master of Science Degree in Geology from Rutgers University, New Jersey.

From September 1967 through September 1968, I was an Assistant Hydrologist with the United States Geological Survey-WRD Columbia, South Carolina. I participated in the evaluation of ground water resources in various parts of South Carolina, including a comprehensive plan to alleviate salt water encroachment in coastal aquifers and potential sites for underground storage of liquid radwaste at the Savannah River Plant.

From September 1968 through December 1970, I was a Field Geologist for a private consulting geologist, Dr. Bennet L. Smith of Highland Park, New Jersey, while in

graduate school. My responsibilities included: analyzing potential quarry sites by picket line survey; performing field and quantitative laboratory analyses of potential magnetita ore bodies; supervising drilling and geologic investigations for various industrial facilities; participation in a five-year geotechnical maintenance inspection program of all dams and dikes for Jersey Central Power and Light's Yards Creek Pumped Storage facility in northwestern New Jersey.

Representative projects with Dames & Moore between January 1971 and April 1972 included ground water hydrologic and seismic studies; in situ pressure testing of boreholes, permeability measurements; well inventories; analysis of potential radioactive spills on the ground water environment; analysis of geologic subsurface conditions; preparation of PSARs. These projects included work on the Nine Mile Point No. 2 Nuclear Power Plant for the Niagara-Mohawk Company; North Anna Nuclear Power Station Units 3 and 4 of the Virginia Electric and Power Company; The Newbold Island Nuclear Plant for the Public Service Electric and Gas Company of New Jersey; also mapping, rock classification and potential borrow area exploration for the Virgil C. Summer Nuclear Power Plant.

From April 1972 until June 1972, I was Project Seismologist and Ground Water Geologist for PSAR Investigation, Douglas Point Site, Potomac Electric and Power Company. In this position I was responsible for preparation of Sections

2.4.13 (Ground Water) and 2.5.2 (Vibratory Ground Motion) of the PSAR. Analysis included documentation of regional and local ground water conditions, well inventories, analysis of aquifer characteristics, effects of potential radioactive spills on ground water environment for Section 2.4.13 of the PSAR. Responsibilities for Section 2.5.2 (Vibratory Ground Motion) included analysis of local and regional tectonic structures for their potential in localizing earthquakes; documenting historical seismicity; selection of safe shutdown and operating basis earthquakes; preparing final report for inclusion in PSAR.

From June 1972 until August 1972, I was Project Seismologist for PSAR investigation, Atlantic Generating Station, Public Service Electric & Gas. My responsibilities included analysis of local and regional tectonic structures for their potential in localizing earthquakes; documenting historical seismicity; selection of safe shutdown and operating basis earthquakes; preparing final report for inclusion in PSAR.

From August 1972 until October 1972, I was Project Seismologist for PSAR investigation, Summit Site Delmarva Power & Light Company. I was responsible for analysis of local and regional tectonic structures for their potential for localizing earthquakes; selection of safe shutdown and operating basis earthquakes. I wrote the final report on vibratory ground motion.

From October 1972 until March 1973, I was Project Manager and Project Seismologist for Seismic Risk Evaluation, Veterans Hospitals, Veterans Administration. In this

position I was responsible for scoping out and implementing investigation of seismic risk analysis for nine existing Veterans Hospitals in New York State, Vermont, and Massachusetts. I wrote 75% of the final report and supervised two Dames & Moore personnel.

In June 1974, I was Senior Geologist on a site inspection and review of geologic analysis for proposed Nuclear Power Plant Site, Asturias, Spain, for Hydroelectrica del Cantabrico. I was responsible for performing a technical review of the client's independent geologic analysis of proposed site, according to existing U.S. NRC criteria.

From October 1974 until March 1975, I was Project Manager and Senior Geologist for investigation of five proposed sites for Nuclear Power Plants, Oslofjord Region, Norway, for Norwegian Water Resources and Electricity Board. I was responsible for coordinating seismotectonic investigation between Dames & Moore geologists and three participating Norwegian consultants: Norsar, Seismological Observatory at Bergen, and the Norwegian Geotechnical Institute. I wrote (40%) of the final Dames & Moore report, as well as scoped out original program of investigation.

From November 1975 until February 1976, I was Principal Investigator-Seismotectonics for a Nuclear Power Plant Siting Investigation for Comision Federal de Electricidad, Mexico. This investigation required analysis of seismicity and tectonic information for large area of central Mexico for input into computer data management system. I participated in Delphi session with over twenty top Mexican experts

in various disciplines to identify critical importance factors for disciplines involved in the siting study. I also supervised preparation of final seismotectonic maps for the region studied.

From February 1976 through March 1976, I was Principal Investigator-Seismotectonics for Surface Faulting Investigation at ESCOM's Koeberg Nuclear Station, Capetown, Republic of South Africa. I wrote scope of work and was responsible for implementing the program. I wrote 90% of the final report documenting regional seismicity, tectonics, and establishment of Design Earthquakes for the site.

In April 1976, I was Technical Reviewer-Seismotectonics report for Swedish State Power Board's Forsmark-3 Station, Forsmark, Sweden. I was responsible for internal technical review of Dames & Moore report on seismotectonics and vibratory ground motion for PSAR on Forsmark Station.

From July 1975 through April 1977, I was a member of the Technical Advisory Panel, Geologic Investigations, Ramapo Fault System, Indian Point Generating Station, Buchanan, New York, for Consolidated Edison of New York. I was responsible with others for maintaining internal (D&M) quality of investigation of the Ramapo Fault System in satisfying conditions required for operating license by NRC.

From May 1973 until August 1977, I was involved in the Supplemental Geologic and Seismologic Investigation, North Anna Power Station, Louisa County, Virginia, for Virginia Electric and Power Company. This was a detailed fault

investigation for documenting age of last movement of faults discovered beneath reactor containment excavations. As Project Manager, I was responsible for coordinating with client the daily operation of the project, involving up to eight geologists. With the Principal-in-Charge, formulated scope of work for entire investigation. Since 1974, I have been responsible for ongoing micro-earthquake monitoring program (17-station array) at the site. I participated as an expert witness in public hearings. I wrote 50% of final report for geologic investigation and subsequent answers to questions by NRC staff.

From September 1977 through September 1978, I was Manager of geologic and seismologic studies for the Safety Analysis Report of the Esfahan site for Atomic Energy Organization of Iran. This program included detailed faulting investigation, Seismic Hazard Analysis, Selection of Design Basis Earthquakes, geophysics and paleomagnetic analysis of soils samples.

From September 1978 until May 1979, I was Project Manager for a site selection study for a nuclear power plant in Central Chile. In this position I was responsible for supervision of a multidisciplinary team of investigators. The program included Seismic Hazard Analysis, selection of design basis earthquakes, characterization of seismotectonic setting of Central Chile.

In January 1978, I was promoted to my present position.

I am a Certified Geologist in the States of Maine and Georgia. I am a member of the Seismological Society of America and the Association of Engineering Geologists.

Subsequent to the award of my degree, I continued in school for over a year off and on.

JUDGE GROSSMAN: At this point we''ll recess. I'm sorry. We didn't rule on that. That's admitted and we'll recess. I just want to make sure that everyone is available tomorrow morning including Mr. McWhorter and Mr. Smith and the entire panel.

MR. KNOTTS: The entire six-member panel will be here tomorrow.

JUDGE GROSSMAN: Okay. Nine-thirty tomorrow.

[Whereupon, the above-entitled proceedings was concluded at 5:5 o'clock, p.m., to reconvene at 9:30 o'clock, a.m. in the same place.]

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then?

MR. MCWHORTER: Yes, sir.

MR. SMITH: Yes, sir.

MR. KNOTTS: Do you wish to adopt them as part of your testimony in this proceeding?

MR. MCWHORTER: Yes, sir.

MR. SMITH: Yes, sir.

MR. KNOTTS: Mr. Chairman, we would offer the statement of qualifications of these gentlemen in evidence and ask that they be bound into the transcript as if read.

JUDGE GROSSMAN: Mr. Bursey, any objection?

MR. BURSEY: I have a question for Mr. Smith, if I may?

JUDGE GROSSMAN: Proceed.

VOIR DIRE EXAMINATION

MR. BURSEY: Mr. Smith, your degree is a Bachelor of Science in Geology?

MR. SMITH: I majored in geology and physics, double major.

MR. BURSEY: And that's a Bachelor of Science?

MR. SMITH: Yes, B.S.

MR. BURSEY: Adn you're presently taking graduate studies? It says you've complete one year of graduate studies. Are chey ongoing now?

MR. SMITH: No, I'm not undergoing studies now.

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JUDGE GROSSMAN: I think it's about time to adjourn for the day. We'll do that and I think we'll start then in the morning with Mr. Goldberg's cross-examination and then the State of South Carolina and then we'll on to the Board questions. Is that agreeable to you, Mr. Goldberg? Isn't that the order that we agreed to?

MR. GOLDBERG: Yes, at this point we anticipate no questions.

JUDGE GROSSMAN: Well, why don't you enter that into that record?

MR. KNOTTS: Very well, Mr. Chairman. Mr. McWhorter and Mr. Smith, did each of you prepare statement of educational and professioanl qualifications for possible use in this proceeding?

MR. MCWHORTER: Yes, I did.

MR. SMTIH Yes,I did.

MR. KNOTTS: And do you have a copy of the statement that you prepared before you?

Q MR. MCWHORTER: Yes, sir.

MR. SMITH: Yes, sir.

MR. KNOTTS: Are there any additions that you wish to make at this time, asking you first, Mr. McWhorter?

MR. MCWHORTER: No, I don't.

MR. KNOTTS: Any revisions in your statement?

MR. SMITH: No, I have none.

MR. KNOTTS: Are they true and correct as they stand

TESTIMONY
before the
Advisory Committee on Reactor Safeguards
related to
Virgil C. Summer Nuclear Station
February 26, 1981 and February 27th
at
Capital Inn, 1901 Assembly St., Columbia, S. C.

Introduction:

My name is Ruth Thomas. My address is 1339 Sinkler Road, Columbia, S.C., 29206.

I'm glad to have the opportunity to attend this meeting. I have an interest in the Virgil Summer Nuclear Plant as a customer of South Carolina Electric and Gas Company (SCE&G) and as a resident of a city within 26 miles of the power plant.

I have studied the Summer Plant as well as such related subjects as reprocessing, transportation of nuclear materials and the handling of radioactive wastes. For the past ten years, I have continued to seek out factual information. I have worked with state and national organizations and am presently a member of the South Carolina Environmental Quality Control (EQC) Advisory Committee.

Questions Related to Instrumentation and Plant Controls:

1. What studies are being and have been done of design basis accidents and how to avoid them, since Three Mile Island (TMI)?
2. What design changes have been incorporated into the Summer Nuclear Plant as a result of TMI? As a result of accidents and near accidents at other nuclear power plants?
3. Why wasn't more work done on design basis accidents and how to avoid them prior to TMI?
4. Did the NRC"s decision not to follow the recommendations of NRC safety engineer, Demetrios Basdekas, have anything to do with his not being direct enough in his 1976 reports on safety issues? *
5. Was the NRC's principal reason for not following Mr. Basdekas' advice based on the belief that "only a small reduction in risk could result from improvements in plant controls"* or because the NRC thought that nuclear industry was going to voluntarily research design improvements to reduce accident risks?
6. What improvements in instrumentation have been implemented since TMI which assist operators? Will they or have they been carried out at the Summer Plant?
7. Why was one of the instruments critical to the operators at TMI plant located behind him?
8. Who has the final say in such matters as- what alarms are used, limiting the number of alarms, coordinating the arrangement of instruments for easy and effective use?
9. Does an operating group have the last word on the acceptance of design plans?
10. Reports and information regarding the operation and design of nuclear plants contain very little about the role of operators, supervisors, production people to decision-making related to design, control room operation, emergency planning and other important considerations. What changes have been made since TMI in the way of involving such people? At the Summer plant?

* Report to Congress, NRC, NUREG-0438, April 12, 1978

11. At TMI, why wasn't instrumentation provideo to show stem trovel on remotely operateo critical valves rather than instruments which only recoro a signal from a solanoio?
12. Why weren't TMI owners ano operators alerteo to this proolem oy the NRC? By the ACRS?, By other utilities? By manufacturers?
13. An annonymous letter to the NRC alerteo the agency to stress corrosion cracks in Westinghouse turoines. How can the reluctance of company officals to aomit to equipment failures ano tecnnical proolems relateo to the nuclear inoustry oe overcome?
14. What central communication system is there for notifying nuclear power plant operators immeoiately of proolems which could affect them? Which could leao to accioents?
15. What oackup equipment does Summer plant have to ensure correct air flow across ouilding?
16. Does the Summer plant have instrumentation to measure the liquio in the reactor vessel?
17. Are on-site NRC inspectors experienceo production people? If not, what group of production ano operating personnel oo these inspectors consult with?
18. Has a team of nuclear power plant operators ano production personnel looKeo into failures which could occur ano combinations of happenings (equipment failures, human errors, oesign miscalculations, etc.) in terms of the possible outcomes ano in terms of how to prevent a ouiloup of proolems?
19. How are operators, supervisors ano nuclear power plant employees oeing traineo to hanole emergency situations? At Virgil Summer?
20. How long is the training perioo?
21. Keeping clean areas in a nuclear plant free of contamination has not been successfully oone at a number of facilities.
22. Are operating personnel involveo in the oevelopment of such proceoures?
23. In the case of cracKeo turoines, such as those of Turkey Point Nuclear Plant, how oio the contamination reach the steam generators?
24. How oio the clean secondary system at Turkey Point oecome contaminateo?
25. What other nuclear power plants have experienceo turoine cracking in aooition to Zion Station Unit 1 ano Yankee-Rowe?
26. Has there been contamination of turoines at these Zion ano Yankee-Rowe plants?

Questions Relateo to Monitoring, Emergency Planning ano the Hanoling of Raoioactive By-Products

27. At TMI, a helicopter was flown over the stack for the purpose of measuring raoiation ano contamination levels, ouring the accioent. Why was it necessary to ootain oata in this way? Would such a metho of monitoring oe necessary in the event of an accioent at the Summer Nuclear Plant?
28. Is there a system of continous monitoring of the off-gases at the Summer Plant Is this in the stack?
29. At how many locations is continuous monitoring ano continuous printouting of of raoiation ano contamination measurements planneo? At the fence? ½ mile oeyono? 1 mile oeyono? In how many oirections?
30. How often will the recoros of the Summer monitoring system oe reao? Daily?
31. Will these recoros oe available to the puolic?
32. Will ooth alpha ano beta oe measureo continously at the Summer plant?

33. Why has so little progress in emergency planning taken place when such planning started more than ten years ago?
34. How many nuclear plants have written sabotage and air raid procedures?
35. Will the Summer plant be required to have these prior to startup?
36. What separation system has been or is being developed to ensure that no long-lived radioactive materials are mixed in with wastes which are buried at such sites as Chem-Nuclear in Barnwell, S.C.?
37. What plans are there for alternatives to burial of nuclear wastes in the event that land burial operations are closed down? Summer plant plans?
38. What alternatives to transportation of nuclear waste by-products is being studied and considered? By NRC? By utilities? By Summer plant?
39. Explain how the research findings of John Stephen, Jr. and Robert Pohl (Trace Elements in Reactor Steels: Implications for Decommissioning , Materials Science Center of Cornell University, August 1977) has changed the plans for decommissioninf nuclear power plants? the Summer plant?
40. How would it be possible for instructions to be given on evacuation if there is not continuous monitoring of radiation, contamination and meterological conditions?

Ruth Thomas

Ruth Thomas

Submitted by.
Ruth Thomas

MEDLOCK & GERGEL
ATTORNEYS AT LAW
1320 RICHLAND STREET
COLUMBIA, SOUTH CAROLINA 29201

T. TRAVIS MEDLOCK
RICHARD MARK GERGEL

GLORIA Y. LEEVY
OF COUNSEL

TELEPHONE 779-9[illegible]
AREA CODE 80[illegible]

May 12, 1981

Mr. Jack D. Richardson
Chairman
Regional Advisory Committee
Region IV
Federal Emergency Management Agency
1375 Peachtree Street, N.E.
Atlanta, GA 30309

Re: Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants, NUREG-0654, FEMA-REP-1, REV1

Dear Mr. Richardson:

Like most Americans, I appreciate the effort on the part of government and private organizations to promote optimum safety to public health in the event of accidents at fixed commercial nuclear power reactors. The regulations referred to above seem a substantial step in that direction, and I urge continued close monitoring and enforcement thereof. I agree that good faith cooperation by industry and active community involvement are essential to implementation of your protective guidelines.

I submit for your consideration the following specific proposals that have been provided me by a concerned citizen who is actively involved, as is your agency, in promoting the public's interest on these issues. I am not knowledgeable in the field and claim no expertise on the subject. Therefore, I must rely upon appropriate government agencies, such as yours, and interested citizens for guidance in the matter.

Please advise me as to whether or not your agency considers the enclosed proposals reasonable and responsible. To me they appear to be so. They appear consonant with the letter and spirit of your guidelines and regulations.

I recommend that you carefully review the proposals with a view toward appropriate implementation. If you disagree with the proposals, please advise me of the basis therefor so that I might be enlightened and have a better understanding on this important public issue.

I copy this to Congressman Holland, in whose District the V.C. Summer Nuclear Station is located, and to Congressman Spence, who represents the District of my residence, which borders Fairfield County. I appreciate the effort and concern on the part of our National Congress relative to public health and safety implications of our developing nuclear energy industry.

Thanking you for your attention to the matters expressed herein, I am

Sincerely yours,

T. Travis Medlock

TTM/mt
Encl.

cc: Honorable Floyd D. Spence
Honorable Ken Holland

RECOMMENDATIONS
Related to
RADIOLOGICAL EMERGENCY RESPONSE PLANS
for the
V. C. Summer Nuclear Station

The nuclear accident at Three Mile Island and the May 1, 1981 radiological emergency exercise related to the V.C. Summer Nuclear Station demonstrated the need for identifying procedures which would improve:

1. Accident Assessment
2. Notification Methods
3. Public Education
4. Public Participation

Based on the need for improvement in these four aspects of emergency planning, the following proposals are made:

(1) That a radiation contamination monitoring system be installed (capable of immediately and continuously measuring and reporting on radiation contamination levels) at numerous stations surrounding the V. C. Summer Nuclear Plant at varying distances from the facility. Quicker and more accurate response to a nuclear accident would be possible if radiological emergency decisions were based directly on data collecting equipment rather than depending on calculated estimates.

(2) That the radiation contamination data together with meteorological data from the V. C. Summer Plant site and the National Weather Bureau be reported into one central office for use in making emergency response decisions. The data serves as a check or what is being reported from the radiation contamination system. The two systems compliment each other.

(3) That frequent bulletins on both radiation contamination level and meteorological conditions be issued to enable people to follow the progress of the drill, simulated accident or an accident in the event of its occurrence.

(4) That the proposed siren system for the V. C. Summer Plant be expanded so that persons in a wider area would hear the warning, including those who would not have telephones, TV and radio available to them, such as persons farming, working outdoors, fishing, hunting, etc. on highways.

(5) That notification regarding emergency instructions for use on radio, television, telephone etc. be prepared and presented by emergency planning experts who are experienced in knowing what to stress, what to repeat, etc.

(6) That a computer dialing system be used which would make it possible to automically dial a majority of the people living in the affected area. This warning system would be more reliable than radio and television.

(7) That a sufficient number of information centers be available.

(8) That simulated accidents include Columbia, and other high density population areas.

(9) That the personnel of state, county and city offices, colleges, public schools, hospitals, businesses and civic organizations receive training which would help them to answer questions and direct members of the public to the proper authorities.

(10) That residents of Fairfield County and surrounding counties be provided an opportunity, if they so desire, to participate in emergency preparedness exercises and drills and receive training in the following:

(a) All aspects of evacuation -- knowing the possible routes, how to prepare for evacuation, possible shelters

(b) Care of animals and livestock

(c) How to close up buildings to keep out radiation contamination

(d) Ensuring heat, lighting, cooking sources are available in case of power failures

(e) Have on hand food and water in sealed containers

(11) That instructions be provided people outside the immediate area affected by the simulated accident so that they would be ready if the situation changed.

(12) That members of the public be represented at exercises and drills and that these observors be chosen on the basis of their knowledge of nuclear subjects from the viewpoint of the general public and on the basis of their demonstrated commitment to the interests of the public. They should not be financially involved with the industry.

(13) That all evaluation and critique sessions of radiological emergency drills and exercises include persons who have been selected as observors on behalf of the general public. (See number 12)

(14) That the meeting at which a preliminary critique of an emergency drill or exercise is presented include statements by observors for the general public, and that public imput from those in the audience be transcribed and made part of the final evaluation.

June 22, 1981

An Expression of Concern

We the women of Cedar Creek would like to express our reluctance to accept the risks involved in living near the V. C. Summer Nuclear Generating Plant.

The plant is in sight of us, and spent waste is to be stored at the site. We feel that the plant should not be allowed to go on line until answers are found concerning the eventual storage of this deadly radioactive material for the thousands of years needed for it to break down.

We do not relish the idea that we, our children, and grandchildren are living next to a man-made Pandora's Box. Under certain conditions it could create the catastrophe which would make our leaders decide there has to be a safer way to produce energy.

We are normally quite easy-going in our outlook on life. None of us protested Vietnam or the draft. We watch the ERA question with outiide interest. But this nuclear plant poses problems which we do not want to pass on to our children -- neither through our genes nor through the deadly wastes for which there is no true means of disposal.

Therefore, we request the Nuclear Regulatory Commission to withhold the operating license for the V. C. Summer Plant contingent on (1) no storage of any radioactive waste at the plant and (2) an irrevocable guarantee that absolutely no radiation will ever be emitted from the plant.

Patricia S. Bianchi
Margaret E. Gaskins
Sandra D. Jones
Frances T. Riley
Verna L. Seaber
[illegible]
Charlotte Fridy

Madeline S. Lewis
Lois L. Roof
Irene O'Neill
Patricia O'Neill
Peggy O'L. Wilson
Linda B Lewis
Mary Roof Shugart
Mrs. Earl Campbell
Alta B. Seaber

An Expression of Concern

about the V. C. Summer Nuclear Plant

Ruth Blume
Flora Thorne
Carolyn Rawl
Mary A. Harrell
Tatiana G. DuBard
Eug H. Riley
Winifred L. DuBard
Charlene R. Meetze
Sandra L. Bloodworth
Edgefield F. Suten
Nancy Sayle
Kitty mae Lever
Deryl B. Gross
Mary Ann Hollis
Dudley H. Graham
Judy C. Hall
Mother Jean Lodovici
Rebecca D. Thompson
Judy Habel
Margaret C. DuBard

An Expression of Concern

We the residents of upper Richland County would like to express our reluctance to accept the risks involved in living near the V. C. Summer Nuclear Generating Station.

The plant is within fifteen miles of us, and spent waste is to be stored at the site. We feel that the plant should not be allowed to go on line until answers are found concerning the eventual storage of this deadly radioactive material for the thousands of years needed for it to break down.

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Don A. Pruitt

Charles Burton

Fred E. Rawes

Douglas M. Tygrett

Carol L. Tygrett

Nell L. Jones

Bill Jackson

Lavern H. Hamm

Laverne Byrd

Jewell Byrd

[illegible] + Johnston

Susan Flemings

John J. Epperson

Jim H. Allred

Wayne D. Wall U.S.A Ret.

John D. Jodrey

[illegible]

Mike Evans

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Glenn E. Campbell
Charles D. Mintz
Donald J. Wilson
James H. Fuller
Ashley C. Taylor
Robert N. Lott
James F. Stephens
William L. DuBard

John A. Sabo Jr
Barney F. Greeway Jr.
A. N. B. Jr

Travis J. Bianchi

An Expression of Concern

We the women of The FAIRLAWN EXTENSION CLUB would like to express our reluctance to accept the risks involved in living near the V. C. Summer Nuclear Generating Plant.

The plant is in sight of us, and spent waste is to be stored at the site. We feel that the plant should not be allowed to go on line until answers are found concerning the eventual storage of this deadly radioactive material for the thousands of years needed for it to break down.

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Esther L. Biggs
Helen V. Thomas
Louise P. Smith
Virginia L. Parry
Margie Branham
Barbara Stroud
Faye Farmer
Baron Farmer
Charles Smith
Howard Parry

Youtha Burrell
Julia Burrell
Stacey Rose
Keri Rose
Verna Rose
Verna Lee Walter
Mildred Burrell
Barbara Burrell
Stan. Burrell
Ethel Burrell
Fred Burrell
Jessie Myers
Frances Myers

Satra L. Collins	Rt. 5, Bay 14	Columbia 29203
Carrie Graas	Rt 2, Bay 157	Blythewood 29016
Violet Riewaldt	Rt. 5, Bay 96	Columbia 29203
Nannie Hollis	Rt. 2. Bay 156	Blythewood 29016
Myrtle Lever	Rt. 5, Bay 344	Columbia 29203
Beaufort Cooper	8444 Parklane	Columbia 29204
Edna Gilmore	Rt. 5, Bay 80	Columbia 29203
Katheryn W. Price	Rt 2, Bay 158-A	Blythewood 29016
Caroline L. Hawkins	Rt. 5, Bay 345	Columbia 29203
Mattie Lee Jones	R#1. Box 588,	Cola, S.C. 29203
Mrs. William Swindler	512 Sunset Dr.	Columbia S.C. 29203
Mrs. R.D. Lambert Jr.	Rt. 5, Bx 270,	Columbia S.C. 29203
Ella Cooper	8244 Parklane Rd	Cola S.C. 29204
Beaufort Cooper	8444 Parklane Rd	Cola S.C. 29204

An Expression of Concern

We the women of Eastover Home Makers Club would like to express our reluctance to accept the risks involved in living near the V. C. Summer Nuclear Generating Plant.

The plant is in sight of us, and spent waste is to be stored at the site. We feel that the plant should not be allowed to go on line until answers are found concerning the eventual storage of this deadly radioactive material for the thousands of years needed for it to break down.

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We are normally quite easy-going in our outlook on life. None of us protested Vietnam or the draft. We watch the ERA question with outside interest. But this nuclear plant poses problems which we do not want to pass on to our children - - neither through our genes nor through the deadly wastes for which there is no true means of disposal.

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Annie E. Hinton
Catherine D Jefferson
Mary Higgins
Shirley Wider
Barbara Hawkins
Dodie Guess
Eulela Sanders
Gloria Deveaux

An Expression of Concern

We the women of Kelinwood Club would like to express our reluctance to accept the risks involved in living near the V. C. Summer Nuclear Generating Plant.

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Robinwood Club
Extension Homemakers

Lillian Smith
Susan Blackmon
Mildred McClain
Emily Broach
Alberta Sargent
Marie Brown
Anne Weeks
Ollie Harper
Lizzie Bonner
Ellen Rainey
Grace Jones
Thelma McNinch
Julia Bonner

An Expression of Concern

We the residents of the Denny Terrace area would like to express our reluctance to accept the risks involved in living near the V. C. Summer Nuclear Generating Station.

The plant is within twenty miles of us, and spent waste is to be stored at the site. We feel that the plant should not be allowed to go on line until answers are found concerning the eventual storage of this deadly radioactive material for the thousands of years needed for it to break down.

We do not relish the idea that we, our children, and grandchildren are living next to a man-made Pandora's Box. Under certain conditions, it could create <u>the</u> catastrophe which would make our leaders decide there has to be a safer way to produce energy.

We are normally quite easy-going in our outlook on life. None of us protested Vietnam or the draft. But this nuclear plant poses problems which we do not want to pass on to our children -- neither through our genes nor through the deadly wastes for which there is no true means of disposal.

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Country Gardens Garden Club

Mrs. J. H. Alderman
Mrs. Ford Dickson
Bertha Vinson
Mrs Henry R. Williams
Mrs I. H. Sheth
Martha S. Lawrence
Mrs. George Deirich
Steve Emery
Mr H G [illegible]

over

Miss B. M Webb

Mrs E. A. Schichler

Ernest Schichler

Mr R M Webb Sr

Gilbert Webb

An Expression of Concern

We the residents of areas surrounding the V. C. Summer Nuclear Generating Station would like to express our reluctance to accept the risks involved in living near the nuclear plant.

The V. C. Summer Plant is within thirty miles of us, and spent waste is to be stored at the site. We feel that the plant should not be allowed to go on line until answers are found concerning the eventual storage of this deadly radioactive material for the thousands of years needed for it to break down.

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Ethel T. Abney
Nancy R. Reese
Pamela Jimison
Anita Bolick
Eleanor Avant

Sara Ward
Ann Anders
Thelma Fisher
Betty Cain Simril
Mitchell Taylor
Shirley K. Faulks

Marjorie Lee
Nanci Hubbard
Archie C. Suber

Annette Ferguson
William C. Sutton
Carleen R. Sutton
Leland G. Ferguson
[illegible]
William H. Jackson
[illegible]

Norma Bedard-Carrillo
[illegible]
[illegible]
[illegible]
[illegible]
[illegible] cont
Deborah M. [illegible]
Pamela S. Gladden
Margaret Cameron
[illegible]
[illegible]
Emily [illegible]

Ron Koenig
[illegible]
Laura Dennis
Jennie Clayton
Audrey Andrieski
Rose Chai
Sally D. Atwater

An Expression of Concern

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1. Karen Delgado
2. Chas Winchester
3. J. M. [illegible]
4. Nancy Gropp
5. Alex McLeod
6. Keith Walters
7. Cynthia Young
8. Lou Abide
9. Becky Reed
10. Sally Varner
11. Robert [illegible] Watkins
12. [illegible]
13. Alan H. Lurie
14. Ed Bloom
15. Robert Hopkins
16. Mr & Mrs James E. Stone
17. Woody Dimmo
18. Mona Watkins
19. Melinda Radcliffe
20. Herbert E Buhler
21. Judy M. Buhler
22. Irene Lonaghy
23. Tom Poats
24. Kym Breedy Jo Dawes
25. [illegible] Hardwicke
26. Linda [illegible]
27. Deborah Wright
28. [illegible] Freeman
29. Judy Conrad Rutledge
30. Cathy Raccit

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1. Ellen Snyder
2. Teresa Tallevast
3. Basil Harper
4. Rick Batty
5. Laura Rich
6. Frank Lee
7. Art Shaw
8. Susan Cain
9. Amy Logan
10. Susan Thompson
11. Elizabeth Hale
12. Judy C. Melton
13. Bobby Fore
14. Robin Gwin
15. John A. Brown
16. Pam Brown
17. Paula Manley
18. Allen Glick
19. Mary Schuessler
20. Karen H. Dacey
21. Gayle Davis
22.
23.
24. Sandra Stanton
25. Kathy Williams
26. John D. Hull
27. Thomas B. Smith
28. Sara L. Rodriguez
29.
30. Linda S.
31.
32. Robert L. Hopkins
33. Martha Lile

This is to certify that the attached proceedings before the

NUCLEAR REGULATORY COMMISSION

in the matter of: South Carolina Electric & Gas Co., Summer Unit 1

Date of Proceeding: June 22, 1981

Docket Number: 50-395-OL

Place of Proceeding: Columbia, South Carolina

were held as herein appears, and that this is the original transcript thereof for the file of the Commission.

Peggy J. Warren

Official Reporter (Typed)

Peggy J. Warren

Official Reporter (Signature)