ORIGINAL ACRST-2004

OFFICIAL TRANSCRIPT OF PROCEEDINGS

TR04 (ACRS)
RETURN ORIGINAL TO
B.J.WHITE, ACRS-P-315

THANKS! BARBARA JO
#27288

Agency: Nuclear Regulatory Commission
Advisory Committee on Reactor Safeguards

Title: 409th ACRS Meeting

Docket No.

LOCATION: Bethesda, Maryland

DATE: Friday, May 6, 1994 **PAGES:** 358 - 460

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PUBLIC NOTICE BY THE

UNITED STATES NUCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

DATE: May 6, 1994

The contents of this transcript of the proceedings of the United States Nuclear Regulatory Commission's Advisory Committee on Reactor Safeguards, (date) May 6, 1994, as Reported herein, are a record of the discussions recorded at the meeting held on the above date.

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

409th ACRS Meeting

Nuclear Regulatory Commission
7920 Norfolk Avenue
Bethesda, Maryland
Friday, May 6, 1994

The meeting reconvened, pursuant to adjournment, at 8:30 a.m., T. Kress, Chairman of the Committee, presiding.

Members Present:

T. Kress, Chairman.
W. Lindblad, Vice Chairman.
J. Carroll
I. Catton
P. Davis
C. Michelson
R. Seale
W. Shack
C. Wylie

Also Present:

D. Powers

Designated Federal Official:

Sam Duraiswamy

PROCEEDINGS

MR. KRESS: Good morning, ladies and gentlemen. This is the second day of the 409th ACRS meeting. During today's meeting the Committee will discuss and/or hear reports on the following:

1. The potential loss of spent fuel pool cooling - Susquehanna Steam Electric Station.

2. Report of the Planning and Procedures Subcommittee.

3. Future ACRS activities.

4. Something called strategic planning.

5. Reconciliation of ACRS comments and recommendations.

6. Preparation of the ACRS reports.

A portion of today's meeting will be closed to discuss information regarding organizational and personnel matters that relate solely to the internal personnel rules and practices of this Committee and matters the release of which would represent a clearly unwarranted invasion of personal privacy.

This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act. Mr. Sam Duraiswamy is the Designated Federal Official for the initial portion of this meeting.

We have received no written statements or requests for time to make oral statements from members of the public regarding today's session.

A transcript of portions of the meeting is being kept and it is requested that each speaker use one of the microphones, identify himself or herself, and speak with sufficient clarity and volume so that he or she can be readily heard.

Before I start, I would like to introduce to the ACRS members and others Ms. Carol Harris who is from NRC's Office of Personnel and is on rotation to the ACRS Management Staff for three months. For the last two years Ms. Harris has worked as an Acting Deputy Division Director in the Office of Administration. In addition to her management experience, Ms. Harris has an extensive background in employee and labor relations. We welcome you and are glad to have you for at least three months. Maybe we can talk you into staying longer.

MR. DAVIS: Mr. Chairman, you didn't mention anything about our noon meeting. Is that still on?

MR. KRESS: Yes. I mentioned that yesterday. There is a noon meeting in Room P-422 with the Commissioners' technical assistants, a few of them, to discuss one of our recent letters. You are all invited to attend.

MR. DAVIS: Thank you.

MR. CARROLL: Is that at 12:15?

MR. KRESS: Whenever we finish here.

MR. DAVIS: We are prepared to interpret the letter for them?

MR. KRESS: No. That's why I said discuss it.

With that, we will turn to today's agenda. The first item is the potential loss of spent fuel pool cooling at Susquehanna. This will be started off by Marty Virgilio with Staff. I guess I'll just turn it over to you and let you explain what the problem is and what your viewpoint is.

MR. VIRGILIO: Thank you very much, Mr. Chairman. Good morning. For those of you who don't know me, my name is Marty Virgilio. I am currently acting as the Director of the Division of Systems Safety and Analysis.

With me today I have Steve Varga, who is the Director of our Division of Reactor Projects; Joe Shea, who is the Project Manager for the Susquehanna site; and several key members of the staff who have been working on this project, and I will have them introduce themselves as they respond to questions that you might raise.

The purpose of today's brief is to provide you an overview of the concerns raised by two engineers who were working for PP&L, the licensee for Susquehanna. These concerns revolve around events that would cause the boiling of the spent fuel pool and the consequences that spent fuel pool boiling might have on safety systems.

Based on an initial assessment of the concerns that the staff did when we first received the Part 21 report, we concluded that the probability of the initiating event in the sequences that were outlined in the Part 21 were sufficiently low that we had time to study this event further; we didn't need to take a precipitous action.

We did recognize at that time, and we still recognize, that this is a very complex issue and it is warranted and caused us to perform a fairly detailed safety evaluation that is still ongoing.

To guide us in this evaluation, the staff developed a task action plan. This task action plan included both plant-specific deterministic engineering evaluations, a PRA assessment, and a record and docket review. In addition, the task action plan includes generic elements that determine whether this situation has safety implications for any other plant.

The staff has had several interactions with the engineers that raised the concern. We have had interactions with the licensee and the BWR owners group. We have briefed congressional staff and we have briefed the management of the NRC, including the Chairman of the NRC, on this issue.

The engineers have drawn attention to these concerns through their interactions with the staff, the media, state and local officials, and congressional staff as well.

In addition, the Commission has been petitioned via the 2.206 process by an interested third party to take actions in response to these concerns.

I said that this was a complex issue. I think one factor that has complicated the issue and led to some confusion on the part of a number of people is the manner in which the staff performs safety assessments and establishes the design basis for key systems and components. This approach, as you know, has included certain stylized accidents and certain non-mechanistic, very conservative assumptions that are applied for the design of certain structures, systems and components but not others.

As I said earlier, I think this has led to some confusion and made this issue even more complex from that perspective.

We are nearly complete with our plant-specific assessment at this time, and that is the overview that you are going to get today. We intend to continue our actions with the engineers that raised the concerns, issue a Susquehanna-specific safety evaluation report, and then continue on to do our generic assessment to see what implications these issues might have for other facilities. When that is complete, or as needed, we intend to take regulatory action, including responding to the 2.206, which is not a question of whether we will. We are in fact going to respond to that petition.

Steve Jones from the Plant Systems Branch is here to provide the bulk of the presentation. As I said, we have representatives here that are going to be able to assist Steve in responding to questions that you might have in the areas of mechanical engineering and structures, in the areas of probabilistic risk assessment, in dose assessment to the operators.

With that, I would like Steve to start with giving you an overview of the system design, of the spent fuel pool cooling system design, and then go forward and talk about some of the assessments that we did.

MR. CARROLL: What is the timing on completing the SER?

MR. VIRGILIO: We have a fairly good working draft complete at this point. There are areas which we have got to finalize, including the dose assessment area and the PRA area, but I would expect within the next few weeks. I think we've told management within the next two weeks that we would have this completed.

MR. CARROLL: Out of curiosity, who is the 2.206 petitioner?

MR. VIRGILIO: Mr. Paul Blanch.

MR. DAVIS: I had a question, Mr. Chairman. If I recall what you said, Mr. Virgilio, you looked at some sequences that might have resulted from this event and calculated some probabilities and then concluded that there was no immediate concern. Do you have some guideline or some threshold that you use to make that judgment, or is it just purely judgment?

MR. VIRGILIO: When the staff receives a Part 21 notification or an allegation or some other insight from outside the agency, we have a process by which we deal with those issues. That includes a structured assessment by a particular designated branch within NRR that makes an initial determination as to whether we need to take immediate action, and if we do, what that action might be, or if this can be a longer term action and how that would be processed and who would do that effort. This is not a detailed evaluation that is documented. Today we are in a position where we can share with you the numbers that we have assigned to the probabilities associated with that sequence, but that came later as a part of our more detailed assessment.

MR. DAVIS: My question was, what is the criteria for determining whether you need to take immediate action? Is that an engineering judgment thing?

MR. VIRGILIO: Yes. It is pretty much an

engineering judgment. When we get a Part 21 and do our initial assessment or we get an allegation and do our initial assessment, it is based on a structured process that includes management and staff review of the issue and a determination of whether we need to take a prompt action, which in fact may be, let's do a more detailed assessment and calculate this on a high priority basis.

MR. DAVIS: Thank you.

MR. CARROLL: I tried to figure out why I wasn't aware of this before a couple or three weeks ago. I guess the only tipoff that I would have had was the fact that an information notice was published last October. I said I always read those things; why didn't I notice this one. I guess the answer was, because most of ACRS was in Europe at the time and when I got back I had a huge pile of paper and I must have tossed that without reading it or something.

MR. KRESS: That's no excuse.

MR. CARROLL: I am raising this, because I think our staff should have been aware of this a lot sooner than they were.

MR. JONES: As Mr. Virgilio mentioned, my name is Steve Jones. I would like to start the presentation with a quick overview of the systems that cool a spent fuel pool.

[Slides shown.]

MR. JONES: For clarity, only one system is shown with each pool, but in reality both systems are connected.

On the left side we have the RHR system which takes suction from the skimmer surge tank, cools it in the RHR heat exchanger, and then pumps it back to the fuel pool. We also have ESW make-up, two trains for each pool.

Both ESW and RHR are safety grade systems, but RHR is not single failure proof with regard to providing the spent fuel pool cooling function. The normal fuel pool cooling system is non-safety grade. It has three heat exchangers and three pumps and returns the cooled water back to the spent fuel pool.

MR. MICHELSON: I guess you are saying only one train of RHR is on the function of cooling the pool. That's why it's non-redundant.

MR. JONES: The non-redundancy is the fact that there is a series of single valves that need to be opened. Some of them are manual.

MR. MICHELSON: Is there more than one train of RHR on that function?

MR. JONES: It's possible to use either of the two divisions of RHR on each unit to cool the pool, but when the B loop is used it renders the A loop inoperable for any other function.

The Part 21 report included a series of events which led to unacceptable consequences, as postulated in the report.

First, the loss of the normal fuel pool cooling system as a direct consequence of a LOCA or a LOCA and a loss of offsite power.

The mechanisms for that loss included load shed, which was originally thought to be of the fuel pool cooling system, but it's actually the service water system that provides the decay heat removal function for the spent fuel pool.

An environmental failure of the normal fuel pool cooling system.

Hydrodynamic loads as a result of the LOCA causing piping failure of the non-seismic fuel pool cooling system and the service water system.

And last, the loss of offsite power since it's not powered by an onsite power source.

Then, backup cooling of the spent fuel pool would be unavailable. That is referring to inadequate design of the RHR system as postulated in the report, and inability to restore either the normal fuel pool cooling system or the RHR system as a result of postulated radiological doses inside the reactor building following a LOCA.

If cooling is unable to be restored, boiling of the fuel pools is postulated, and the propagation of the steam and resulting high temperatures in the reactor building is postulated to cause failures of safety systems, and the condensate from the boiling pool may cause failures of systems where the condensate collects.

One particular system of notice is standby gas treatment system.

MR. MICHELSON: What you are saying is that the safety systems inside of secondary containment are not environmentally qualified for an atmosphere of the type that would be created by a boiling pool.

MR. JONES: They were not originally analyzed for that condition, no.

MR. MICHELSON: Are they qualified for it? I don't care about the analysis. Were they purchased as qualified equipment for that environment?

MR. JONES: All the safety grade equipment was purchased for qualification to a LOCA environment.

MR. MICHELSON: You don't have a LOCA environment inside of secondary containment. That's true inside of primary containment. We are dealing now with secondary containment, and perhaps there is some other requirement on qualification. That is what I am asking. What is it?

That is important to know first before you worry about boiling pools.

MR. JONES: The equipment inside secondary containment is qualified per 10 CFR 50.49, the equipment qualification rule.

MR. MICHELSON: Wait a minute. I don't think that is true.

MR. CATTON: Wait, Carl. You are not completing the sentence. Qualified for what?

MR. MICHELSON: That's where he ended.

MR. JONES: It's qualified for the calculated temperature and radiological environments post-LOCA based on equipment operation and possible doses outside primary containment.

MR. MICHELSON: A better way of asking the question is, is it a harsh environment qualification or a mild environment qualification?

MR. JONES: Harsh environment.

MR. MICHELSON: How harsh? You've got to know that before you worry about boiling the pool.

MR. JONES: The majority of the equipment is qualified to 148 degrees, but there are several pieces of equipment that are qualified to higher temperatures.

MR. MICHELSON: That's in a steam environment at 148 degrees. It makes a difference whether you are dealing with supersaturated air or you are dealing with just high humidity.

MR. JONES: Just high humidity and temperature, not supersaturated.

MR. MICHELSON: So it's 100 percent humidity at 148 Fahrenheit. Okay.

MR. JONES: As a result of safety system failures that may result from the postulated environment, there would be unacceptable offsite dose consequences due to melting of the fuel in the fuel pool and also melting of the fuel within [illegible]re and possible secondary containment bypass due to loss of standby gas.

MR. CARROLL: Why would you lose standby gas?

MR. JONE[illegible] Condensate accumulation in the duct work.

MR. CARROLL: There was an issue as to what the system was rated and I never could figure out what the conclusion was, whether it st[illegible]ted life at 185 degrees and was derated or wh[illegible]er the rating is still 185 degrees.

MR. JONES: The heaters were designed to reduce the humidity of 180 degree air at 100 percent humidity to 197 degree air at 70 percent humidity for the charcoal filters, but the system was later derated to 125, as you mentioned.

MR. CARROLL: For what reason?

MR. CATTON: It probably didn't work.

MR. JONES: Because it wasn't designed to accommodate a boiling fuel pool.

MR. CARROLL: Okay.

MR. JONES: We have examined the hydrodynamic load failure mechanism for the normal spent fuel pool cooling system deterministically and we determined that it is very unlikely to result in a piping failure of either the service water system or the normal fuel pool cooling system.

We also examined the availability of alternate cooling and make-up. The design of the RHR system and all its support systems were found to be adequate. We are continuing our assessment of radiological access.

The effects of the boiling pool on safety systems were also examined.

The effects of flooding by condensate were found to be acceptable in that only one train of core spray was likely to be affected in the near term following a boiling pool event.

There is adequate isolation of the reactor building environment from the pool provided that standby gas is operating and the recirculation system within the reactor building is turned off.

The standby gas treatment system may be overloaded by condensate within a relative short period of time, depending on the heat load in the pool, the number of pools boiling, and several other events, like the temperature of the outside air.

MR. CATTON: Where is the equipment relative to the pool? Is it close?

MR. JONES: The reactor building is divided into three zones, one zone for the lower levels of each reactor building and then a common refueling floor zone. The safety-related equipment of concern is primarily in the upper levels of the reactor building. There is safety-related switchgear and then in the basement is the RHR and other ECCS equipment. The only communication path is really the floor drains from the refueling floor and then the ventilation systems.

MR. CATTON: What is above the pool?

MR. JONES: A steel superstructure.

MR. CATTON: Is there any equipment or anything that could be damaged above the pool?

MR. JONES: The only equipment that the licensee has identified as being affected by a high temperature environment on the fuel pool level is some pressure differential detectors used to control the standby gas treatment system.

MR. CATTON: Okay.

MR. MICHELSON: Is the refueling floor part of secondary containment that is common to both units?

MR. JONES: There is a logic that is designed to combine the zones in various combinations, depending on the design basis event that occurs.

MR. MICHELSON: In terms of the propagation of potentially harsh environments, can they propagate to both reactor buildings because of the common secondary containment? When I boil the pool in the common secondary containment, is there potential there for it to propagate then backwards into both units?

MR. JONES: For a LOCA in one unit, it would only propagate --

MR. MICHELSON: We are talking about boiling the pool now. That's the event I assume we are concerned about.

MR. CARROLL: No. It's in combination with a LOCA.

MR. MICHELSON: Okay. Then I'll listen some more first and then I'll ask the question. Maybe it goes away.

MR. JONES: Going back to this earlier slide, the Part 21 report postulated a loss of the cooling system following a LOCA or a LOCA/LOOP.

MR. CARROLL: Are you going to talk more about some of these items on that last viewgraph? I'm interested in how you concluded, for example, that LOCA-induced loads aren't going to damage the piping.

MR. JONES: I can refer that question to Arnold Lee. I do have some other slides I can put up to help with his explanation.

MR. CARROLL: This issue results because on this class of BWRs the spent fuel pool piping is not seismically qualified?

MR. JONES: That's correct.

MR. CARROLL: The spent fuel pool cooling piping, I should have said.

MR. JONES: Right.

MR. CARROLL: The make-up water piping is seismically qualified.

MR. JONES: That's correct, as is the RHR system piping.

MR. CARROLL: Then when you move on to Mark III, for some reason a decision was made to seismically qualify the spent fuel pool piping. What was the reason for that?

MR. JONES: I don't know the exact reason. It might be because the Mark III's were designed with more emphasis on meeting the standard review plan requirements or guidance, and that would specify a seismic category I fuel pool cooling system with an exception for seismic make-up and standby gas.

MR. LEE: We don't exactly know why it was not seismically qualified for the service water system in the fuel pool cooling system for hydrodynamic loads other than what Steve just mentioned.

MR. CATTON: You just have up here steam condensation loads. What about the initial clearing?

MR. JONES: I need to have Tony D'Angelo from Containment Systems address that.

MR. D'ANGELO: Good morning, gentleman. I'm Tony D'Angelo with the staff. Dr. Catton, the piping, the spent fuel pool and the service water, which is accepting the heat from the spent fuel pool heat exchanger, both systems were designed in the stress analysis and supported through the use of span tables. So they did not consider in the original design for the plant any hydrodynamics, any seismic. When this issue arose, the question came about, does the piping, either the spent fuel pool piping or the service water which is accepting the heat load, does either system fail following a LOCA from hydrodynamic loads?

Originally, the licensee had taken the position where in their best opinion it did not fail. Both Arnold and I have visited the plant. We reviewed their methodology and their analysis, which was basically opinion. We both concluded that it would be best to do some limited analysis and actually calculate numbers.

MR. CATTON: They actually argue that the pool is uncoupled from the rest of the structure.

MR. D'ANGELO: That's correct, and there is a problem with that.

MR. CATTON: I would think so.

MR. D'ANGELO: Their argument is this is a Mark II and the containment is a reinforced concrete with a liner. Their argument is based on the fact that the foundation mat is not tied to the building structural mat because there is no continuous reinforcement; there is no rebar. However, this plant is founded on bedrock. The base mat for the containment and the base mat for the structure has a cold joint. So there is no isolation joint there. It would be extremely difficult, if not impossible, to show decoupling or so much attenuation through the rock that you don't see the loads in the building.

They essentially went ahead and redid the piping analysis, the stress analysis for the spent fuel pool and service water. They used the same code -- a computer code, I mean. This was done ASME Section 3, Class 3. They used the same computer code as they would have used for their normal class 1 pipe, redid the analysis. The difference is they only considered pressure stress, dead weight, and hydrodynamics. The hydrodynamic response spectra that they used was the same hydrodynamic response spectra contained in the DAR for this Mark II class plant.

MR. CATTON: That was the document produced by GE.

MR. D'ANGELO: Remember, on the Mark I's there was the PUAR and then on the Mark II's there was a DAR document that came to us. It was the plant-unique analysis. They used the same curve, same response spectra. No change. The only difference is they didn't include seismic.

MR. LEE: That's right.

MR. D'ANGELO: No seismic in the load combination. Does that answer your question?

MR. CATTON: I think so.

MR. CARROLL: What was concluded from that?

MR. D'ANGELO: The piping meets section 3 allowables. They had some difficulty where a couple of pipe supports that were overloaded -- these are frame type supports. So they went back, sharpened their pencil, did a frame analysis. Some of these supports may have utilization factors of 95 percent. So real close. They meet the allowables, but no seismic.

MR. CARROLL: How do you figure out what excitation is produced by the suppression pool during blowdown?

MR. D'ANGELO: Within the DAR --

MR. CARROLL: I don't know what that is.

MR. D'ANGELO: When this whole issue came out the staff asked every boiler to do a plant-specific analysis for their plant using the database that came out of the old full scale test facility in San Jose, which is where we ran the full scale test. They did plant-unique analyses using that database and they came up with loads.

MR. CARROLL: This was specifically the

excitation?

MR. D'ANGELO: That's correct.

MR. CATTON: The frequencies associated with the process.

MR. D'ANGELO: That's correct.

MR. CATTON: I guess actually GE or the owners group or something produced the generic document; then each plant made it plant specific, if I remember right.

MR. D'ANGELO: That's correct.

You may remember Susquehanna was one of the few early plants that went off on their own. They actually went to KWU.

MR. CATTON: I remember when they asked GE to leave.

MR. D'ANGELO: They use the T quencher. They don't use the cross quencher. Aside from that it's the standard GE approach for hydrodynamic loads.

MR. CARROLL: So the bottom line is the staff has concluded that this is not a real issue in terms of causing pipe failure.

MR. D'ANGELO: Based on the new analysis that they did when Arnold and I were there, we've concluded that we can say with confidence to our management that we don't believe that piping will fail from hydrodynamics, with the caveat of no seismic.

MR. SHACK: When you say design allowables, what level are you talking about?

MR. D'ANGELO: This would be service level C.

MR. JONES: Based on the deterministic analyses and some other information from Susquehanna, we began a risk assessment.

MR. CATTON: Before you start on that, could we spend a little time on some of the postulates first?

MR. JONES: Sure.

MR. CATTON: In all of the paper that I got, which was a thick stack, there was some discussion of the heat loads. In particular, there were some arguments made that the heat load calculations did not account for the spent fuel pool heat load of 26 million BTUs per hour. Then I saw numbers all over the place. Somewhere else there is a number of 16.23 million BTUs per hour and 33.94. Where is it and what does it mean and what is real and what is not postulated?

MR. JONES: There is a series of numbers, depending on when you look at the spent fuel pool and how close to an outage and how full it is and so many variables. About 12.4 million BTUs is the design capacity for the normal fuel pool cooling system. That corresponds to a full fuel pool with one-third of the core removed about 105 hours after shutdown. There is also the design maximum heat load which the RHR system is designed to accommodate, which is about 33 million BTUs per hour.

MR. CATTON: Is that the number where it says the full core is unloaded and it's the 33.9?

MR. JONES: That would be the full core with a full fuel pool at about 10.5 days after refueling outage.

MR. CATTON: There was also a number in this paper that was 56 million BTUs per hour. Where does that come from?

MR. JONES: That potentially could be the heat load from both pools combined.

MR. CATTON: There is 26 million BTUs that is discussed by the people who wrote that Part 21.

MR. JONES: I don't know where the number came from. I'll have to look that up.

MR. CARROLL: What I got out of that, Ivan, was that there was a contention that there was not sufficient ultimate heat sink to handle the maximum heat rejection load. Is that true or not true?

MR. JONES: We have two separate heat sink-related questions that were raised. One was regarding the RHR system capability to use the ultimate heat sink to cool the pool. That was resolved by another analysis that PP&L did for the ultimate heat sink assuming one unit in a LOCA, the other unit having two trains of RHR performing a normal shutdown, and then they added heat loads from the two fuel pools to the essential service water system based on the limitations of their model and concluded that the ultimate heat sink capacity was adequate for that.

MR. CARROLL: And the ultimate heat sink in this case is what?

MR. JONES: A single spray pond with a 30-day capacity.

MR. CATTON: So the arguments in the allegations that the spray pond was inadequate are not true; is that what you are saying?

MR. JONES: Correct. The heat load doesn't increase significantly just because there is a recent offload from the core when you consider the time that the reactor has been operating. For instance, if you had a full core offload, then there is no heat to be removed from the one reactor vessel.

MR. CATTON: I understand, but somebody has sat down and done a heat balance on the system and concluded the spray pond is adequate; is that correct?

MR. JONES: Yes, sir.

The other question was in regards to if the pool boils, can the systems accommodate the heat that is released into secondary containment? That was addressed by a separate analysis using PP&L's own code called COTAP, a computer code that models all the individual rooms of the reactor building, various heat addition paths and the humidity. They determined that for the case where standby gas treatment system is operating and the recirculation system is secured that there is adequate ventilation to keep the temperatures below the equipment qualification level within the reactor building for at least some period of time. It depends again on the heat load and on the number of pools that are boiling as to how long standby gas will remain operable in that situation.

I do have to put a caveat with that standby gas treatment information. We just received that and it hasn't been incorporated yet in the probabilistic risk assessment.

MR. CARROLL: I guess I want to back up a little bit. We keep getting the pool boiling and worrying about that, but as I read this, there are a lot of things that people can do following a LOCA in some worst case situation in terms of fuel in the pools to establish fuel pool cooling long before there is going to be any really serious radiological concerns in the building. Is that not true?

MR. JONES: That was our conclusion.

MR. DAVIS: That's accounted for in the event trees, I think, that we'll see later.

MR. JONES: That really gets into the risk assessment and how likely it is that they will be able to cool it.

MR. CARROLL: We keep talking about while the pool is boiling. I'm not sure I know how it gets there.

MR. JONES: That's true. I was just trying to address the question on the heat load.

MR. CARROLL: There was also a contention that if it did happen and you had the ventilation set up in the optimum fashion, at least the unit that is having the LOCA would see a lot of humidity and condensation and whatever. What did you conclude would happen to its ESF capability under those conditions?

MR. JONES: As long as the standby gas treatment system is operable and the recirc system is off, the LOCA unit would not see temperatures and humidity levels that are inconsistent with the qualification of the equipment. So all the equipment would remain operable and there would be no adverse consequences. However, at some point standby gas treatment system may fail due to the condensate loading considerations we discussed earlier.

We haven't modeled that aspect. Analyses by PP&L has indicated that if the recirc system is on while the standby gas treatment system is on, or if both systems are off and the pressure that builds in the refueling floor is allowed to propagate steam throughout the building, there would be unacceptable environmental conditions inside that unit as far as the qualification levels.

MR. MICHELSON: That steam is propagating to both fuel pool areas because there is a common open space.

MR. JONES: Right.

MR. MICHELSON: But in the unit that has not experienced a LOCA the lower reaches of that building are being protected by ventilation systems which keep this -- I don't know if you are trying to keep a positive pressure or whether you are just trying to sweep it as it leaks through or just what.

MR. JONES: I should explain the recirculation system a little bit. As I said, the reactor building is divided into three zones. A LOCA signal from high dry well pressure, a low reactor vessel level will cause the recirculation system to align such tnat it mixes the unit that is experiencing the LOCA and the refueling floor to dilute any possible radionuclide leakage from containment. In that situation it would just be the LOCA unit that would be affected by the fuel pool environment. The other unit recirculation system is isolated from the LOCA unit and the refueling floor.

MR. MICHELSON: Such that it does not draw on the refueling floor. Normally it has to draw from all zones.

MR. JONES: Normally the refueling floor is vented out the reactor building vent, as are the other two zones.

It's all separate.

MR. MICHELSON: They have a separate ventilation system?

MR. JONES: Yes.

MR. MICHELSON: What allows this steam that you are worried about to get down into the lower reaches of the building on the unit that has experienced the LOCA?

MR. JONES: The recirculation system path is open and the standby gas treatment system draws from the recirculation plenum. So it's drawing air from the refueling floor and the reactor building that experienced the accident. If you have the recirculation system fans off and standby gas treatment off, then that is an open flow path.

MR. MICHELSON: You are saying your ventilation valves are all open and it's just a direct conduit.

MR. JONES: Right.

MR. MICHELSON: Have you checked to see if you can continue to cool the RHR pumps which are down in the lower reaches of that building? It's tough to design coolers to cool with air at 148 degrees and 100 percent relative humidity. They'd just be condensers.

MR. JONES: Right.

MR. MICHELSON: So the heat removal capability from the room becomes very limited and yet the motor continues to generate the same amount of heat that it normally would generate, maybe even a little bit more because of the increased atmospherics. Has that been checked to see that you can even cool the motors, which you do have to keep running?

MR. JONES: With the system off and the steam propagating throughout the building there is an eventual failure of RHR. That is one of the limiting components.

MR. MICHELSON: What do you mean by eventual failure? For what reason?

MR. CATTON: How long?

MR. MICHELSON: And therefore how long?

MR. JONES: Based on their environmental qualification and --

MR. MICHELSON: You're saying you'll exceed the 148 degree qualification.

MR. JONES: Right.

MR. MICHELSON: Of course that's not a drop-dead point necessarily.

MR. JONES: Agreed.

MR. MICHELSON: I think before you get there you're going to find room coolers are getting kind of overburdened by condensing out such high amounts of moisture that they may not cool the air effectively.

MR. JONES: That point has not been addressed thoroughly.

MR. MICHELSON: You need to check that, because it's very difficult to design coolers to cool at 100 percent relative humidity in that high a temperature. They just won't cool.

MR. CATTON: Is somebody attempting to calculate time to failure?

MR. JONES: The licensee did what they refer to as a bounding assessment for time to failure if standby gas is off and the recirc system is off, and that was about 30 days, I believe, for RHR.

MR. CATTON: Thirty days?

MR. JONES: Yes. That's using the Arrhenius equation to scale the time to exceed qualification based on the amount the temperature exceeded its qualification level.

MR. CATTON: I'm missing something. So you calculate the temperature and humidity as a function of time in the various areas in the building and then you can use that as the environment for the motor and then you decide when the motor is going to fail based on something. What was the something?

MR. SHACK: Arrhenius acceleration. That is, as the temperature exceeds the qualification temperature, its life goes down exponentially.

MR. MICHELSON: It's a hypothetical, but probably not too bad.

MR. CATTON: I would have thought it just got wet and shorted out and that was it.

MR. CARROLL: Arrhenius was a chemist. You probably don't understand this.

MR. MICHELSON: The problem is that if you're going to speculate filling a building with steam, which is what you are doing here, the conduit system and so forth is not that tight. Steam gets into conduits. It condenses because it's a cooler surface inside, and the water runs down into the junction boxes. They are not qualified for water inside; they are qualified for high humidity outside an appropriate seal on the box. That's probably the extent of it. We know from experience that we just don't have that tight a system, that every bit of that conduit has not been tested or qualified for these kinds of conditions.

I don't think you've got elevated pressure to any extent, because I guess you've got adequate venting to the outside so the building doesn't pump up. If it didn't, then at 148 degrees you've got a fair pressure inside the building, but I'm sure the building is not that tight, so it just vents out all the cracks.

MR. JONES: As you are discussing, the analysis can become quite difficult. The licensee and the staff have both come to the conclusion that we are just taking any situation where the refueling floor cannot be ventilated outside; it's assumed that there is an environmental failure of equipment inside the building.

MR. MICHELSON: Eventually when the staff thinks about reactor water cleanup some day and the effects on present-day plants versus older ones, you've got the same kinds of problems. That is why it is fairly familiar at the moment.

MR. CATTON: By my reckoning, you are going to have about 20,000 pounds per hour of condensate. That's a lot of water. Where is it all going that the machinery can survive for 30 days? If I multiply it by the number of hours, I'm going to have quite a bit of water.

MR. JONES: The 30 days is an environmental calculation based on the room cooler functioning to remove sensible heat and it may not entirely bound any condensate collection down there. We are backing off away from that and saying that it fails. We are not really looking at when as far as our acceptability analysis goes.

MR. CATTON: So PP&L says 30 days.

MR. JONES: Right. Their environmental qualification calculation concluded 30 days, but they basically said it's not an adequate situation to be in.

To answer your question, if the pool boils --

MR. CATTON: You're in trouble.

MR. JONES: For the single pool boiling case, a lot of the condensate collects on the pool being cooled, according to their analysis, and that seems reasonable. Then much of the remainder either condenses on the structure at the refueling floor level and flows down the drains to the sumps in each reactor building, which are flood protected from every ECCS system except one train of core spray in each unit up to 23 feet, and that can accommodate the moisture collection for several weeks, two to four weeks.

MR. MICHELSON: But how do you know that the RHR pump that you need is in a room that doesn't accumulate moisture? I assume you are arguing that the corner rooms are holding it up.

MR. CATTON: You keep using the word "moisture" and we are talking about 20,000 pounds per hour.

MR. MICHELSON: You've got a lot of water. It's running down the walls and conduits, and whatever.

MR. CATTON: That's more moisture.

MR. JONES: Also a considerable amount is being entrained in the standby gas treatment system; some of it is collecting in the recirculation sump and in the bottom of the low portions of the ducting; and some of it is being ventilated out the building.

MR. CATTON: Is anybody making any attempt to determine where all the water is going? The NRC has fancy computer codes like CONTAIN, and so forth, that could be brought to bear on something like this.

MR. JONES: We have been relying on the licensee's COTAP code to date.

MR. CATTON: What is it?

MR. JONES: It's a computer code that they have developed to model compartment temperature and pressure. They do have the arrangement of their building modeled so they can model heat transfer through the concrete; they can model condensation rates.

MR. CATTON: You really need to determine the movement of the steam from room to room, which is another story.

MR. MICHELSON: Doesn't most of it condense in the higher reaches? Gravity works real well, and ultimately it has to end up in the basement unless it vents out of the building.

MR. CATTON: I would guess at these rates it's going to be pretty uniform.

MR. MICHELSON: It's going to be real wet in there.

MR. JONES: I need to clarify our analyses a little bit more, I think.

MR. CATTON: I think so.

MR. JONES: As long as standby gas is operating and the recirculation system is off, the assumption is there will be no water draining or steam propagating through the ventilation system because the standby gas treatment system draws off a greater volume than is being produced in terms of steam.

MR. MICHELSON: Inside the ducts.

MR. JONES: Right.

MR. CATTON: How do you come to that conclusion? Why doesn't some steam go into the ventilation system?

MR. CARROLL: It does.

MR. MICHELSON: It goes everywhere.

MR. JONES: Because the flow should be coming the opposite direction.

MR. CATTON: From the ventilation system to the standby gas treatment?

MR. JONES: Right.

MR. MICHELSON: That is as long as the standby gas treatment is operating.

MR. CATTON: The standby gas treatment system is part of the ventilation system?

MR. CARROLL: Yes, but it's sucking on the two areas.

MR. JONES: It draws on the recirculation plenum.

MR. CATTON: So when you say ventilation, you really just mean the return air.

MR. MICHELSON: What is the air displacement per hour? How many changes an hour does standby gas treatment give you in the building? If your steaming rates are faster than your displacement rates, the steam accumulates anyway.

MR. JONES: The flow rate is designed to be a minimum of 3,000 cubic feet per minute from the reactor building total, up to 10,000.

MR. MICHELSON: That's not much airflow. That's very low.

MR. JONES: It's designed to maintain the pressure in the building at minus a --

MR. MICHELSON: How many air changes an hour do you think that gives you in the reactor building? That begins to give you a feel for how fast you are really venting the thing. I think that will give you a very low number, because it's an enormous volume in that building. I don't think it's going to do much good taking steam out of the building, because it's way too small for that. If you can't talk about seven or eight air changes an hour at least, I don't think you can do much of anything. It's the same problem as with smoke removal. You can't remove smoke unless you've got a great big air system.

MR. DAVIS: What is the problem if the steam stays in the building?

MR. MICHELSON: It condenses and runs to the lower reaches. That's what Ivan was worried about, all that water accumulation.

MR. DAVIS: But you've already had the equipment failure to cause the boiling.

MR. CARROLL: No. We're talking about ECCS equipment.

MR. MICHELSON: That RHR pump is qualified perhaps for 148 at 100 percent relative humidity. That doesn't mean it will stand water dripping on it; that just means that if you control the humidity of the air, it will elevate the temperature, that everything is still okay at 148 Fahrenheit.

MR. JONES: I think I need to get into the risk assessment to help answer these questions.

MR. MICHELSON: You need to understand the hardware if you are going to get into the risk assessment.

MR. CATTON: We may not believe your risk assessment. Where is the standby gas treatment intake relative to the pool?

MR. JONES: I don't have the diagram up here.

MR. CATTON: What do your circulation patterns look like?

MR. CARROLL: I think there is a picture in the stack.

MR. JONES: If you will excuse me a minute, I'll get a diagram.

MR. MICHELSON: You don't want to get too much of that dirty stuff off the pool coming near the operators who stand around it. So they've got some very definite air patterns they would like to maintain. It usually has to be up fairly high or right at the pool edge.

MR. JONES: I'll have to just explain it. The recirculation plenum is directly below the refueling floor and the standby gas treatment duct from the recirculation plenum travels just underneath the refueling floor into a separate building where the fans are actually located.

MR. MICHELSON: Where does it take its air? Where are the intakes to the plenums or the ducts? That's what counts. I think that is what Ivan is trying to find out.

MR. CATTON: That's right.

MR. MICHELSON: Where are you sucking the air from?

MR. JONES: Everything starts and ends at the recirculation plenum.

MR. MICHELSON: That's quite clear.

MR. CATTON: And that's the floor below the pool?

MR. JONES: Right.

MR. MICHELSON: But that is not where the air is coming from.

MR. JONES: Right. There is one duct that draws air from zone 3, the refueling floor, into the recirculation plenum.

MR. MICHELSON: How does it do that? Where is it located in the building, inside that large room which has got about 80 to 100 foot ceilings in it?

MR. JONES: There is one suction, I believe, at the top. I believe for standby gas it's all at the top of the building.

MR. MICHELSON: Usually you try to put it at the top to suck the stuff up as quickly as possible because of occupancy around the pool.

MR. CARROLL: That isn't the detail you are looking for.

MR. MICHELSON: Probably not.

MR. JONES: For zones 1 and 2, the reactor buildings, there are recirculation supply fans that draw on the recirculation plenum and deliver the air to all the various spaces, and then there are separate suction plenums that collect the air, pass it through a return fan and back into the recirculation plenum.

MR. MICHELSON: It's truly a shared system between the units, isn't it?

MR. CARROLL: Yes.

MR. JONES: Yes.

MR. MICHELSON: I wonder if anybody ever looked at that one very close.

MR. JONES: I think the important point to note is if the standby gas treatment system isn't ventilating the steam out the reactor building, we are assuming for our analysis purposes that the safety systems that are qualified fail due to the environment.

MR. CARROLL: One other hardware question before you get to your probabilistic stuff. There is a great debate going on as to whether people can get into the building to open the seismically qualified make-up valves to the pool. Questions include, you'd have to go in lots of times to throttle this valve just right. Two issues. One is, why the hell don't they just install some level instrumentation outside of the building? There certainly must be a pump or a valve you can throttle outside of the building so you only have to go in once and open those valves. Why is that such a big deal?

MR. JONES: To answer your first question, PP&L has evaluated and has begun the process to install instrumentation to monitor fuel pool level and temperature in the control room.

MR. CARROLL: Is that common practice on boiling water reactors?

MR. JONES: To have the instrumentation in the control room?

MR. CARROLL: Yes.

MR. JONES: It's variable. I'd be only guessing, but I'd say probably 50 percent have instrumentation.

MR. CARROLL: Thank you.

MR. JONES: The second question, regarding ESQ make-up. Since it is a safety system and it's supplying a lot of other cooling loads, they will not have the capacity to throttle from outside the building, because it would affect other components besides the fuel pool.

MR. CARROLL: Then there is another simple answer, and that's to put in a motor operated valve.

MR. JONES: I can't answer for the utility, but to my knowledge they haven't considered that.

MR. MICHELSON: In this case, why can't you use fire water or something? It's a one-shot proposition. You're in pretty bad shape already with a LOCA and boiling pool. Some river water isn't going to be the worst thing in the world to keep the pool from boiling. You can do that with a pipe with all valves outside of the secondary containment.

MR. CARROLL: That's another alternative.

MR. MICHELSON: Which some people have talked about. The last ditch argument always is, I'm going to bring my fire hose in and squirt it. Of course, in this case this is slightly more sophisticated. That's an alternative too, to have a last ditch fire water addition.

MR. JONES: I have up our simplified event tree for the LOCA event in particular that was raised in the Part 21 report. We have the LOCA initiating frequency. Then a probability that the normal fuel pool cooling system will be returned to service. If it's not returned to service, then we have another probability that they are able to align RHR to cool the pool. If RHR is also unavailable on that unit, the other mitigating actions include using an offsite powered crane to remove gates between the pool and use the other unit's cooling systems and natural circulation between the pools to cool the unit.

MR. CATTON: How do they remove those gates? I guess there was some question about that, as to whether or not they would be able to. Have you addressed that?

MR. JONES: The Part 21 postulates that there is a radiological airborne concern that would prevent access.

MR. CATTON: That's right.

MR. JONES: Other than that, the only real limitation is availability of offsite power to power the cranes and the time it takes for the operators to deflate the seals and remove the gates. PP&L is evaluating another modification to permanently remove the gates and leave the pools in a crosstie configuration. I will be discussing that a little bit later.

From the point of a boiling fuel pool, this shows in simplified form how environmental failures were modeled. As I've been mentioning, the standby gas treatment system is operating and the recirculation system is off. Then we get an okay condition, at least for a period of time. The PRA has not yet modeled early failures of standby gas treatment or late recoveries of cooling systems either, for that matter.

If the recirc system is on and it is circulating the steam throughout the reactor building -- the people at Pacific Northwest Labs did a very approximate heat-up calculation that is intended to be bounding. If the FSAR temperature was exceeded before the system completed its safety function, then it was assumed to fail.

MR. MICHELSON: This is again an example of a PRA model that was only modeling one phenomenon involved in the event, namely, elevation of temperature. Also involved is condensation and water running down, getting into conduits and into components that weren't qualified for water. The environmental qualification doesn't necessarily assure that it will handle water; it will only handle high humidity at high temperature. It's a different test that you do in an autoclave then.

MR. JONES: Our deterministic analyses are what fed into this. From those we are concluding that as long as these two systems are in these alignments there won't be any vapor being transferred to the reactor building and the only water will be the water that is going down the drain system to the basement, and that would be confined to affect only the core spray.

MR. MICHELSON: You are not condensing on the walls in this model? Where are your heat sinks?

MR. JONES: The heat sink is the refueling elevation superstructure. If a fuel pool is being cooled, that would be another heat sink, the concrete structure of the building itself.

MR. MICHELSON: Where is that condensate going?

MR. KELLY: Glenn Kelly with the staff. In the PRA model we were looking primarily at the effects of temperature rather than water.

MR. MICHELSON: The conclusion will be valid only from the viewpoint of temperature rise.

MR. KELLY: There is no way effectively to model what conduit might be affected by the water.

MR. MICHELSON: A real PRA would include all phenomena that can be instrumental to the downcomer.

MR. KELLY: We haven't ever done a real PRA. What we did do with the temperature is to not take credit for losses to concrete. We wanted to see what would be the time if we ignored that for the room temperatures to reach a point where they would be exceeding the FSAR temperatures. We factored that in as to how quickly we are going to get potentially failing equipment. It tends to be a faster number that you would get if you took into account all the different heat sinks for the steam.

MR. KRESS: Mr. Jones, I'm beginning to get a little concerned about the amount of time. Do you have an estimate of how much longer it will take?

MR. JONES: Not much longer. I just have basically the risk assessment to discuss.

MR. KRESS: Okay.

MR. JONES: To clarify, not referring to the PRA, but in the actual analyses under these conditions with recirc off and the standby gas treatment system operating, the only flow path to the reactor building is the drains because all the vent paths are being drawn into standby gas and out the building because the standby gas treatment system capacity exceeds by quite a bit the volumetric release rate from the pool.

This is a simplified even tree that adds the loss of offsite power consideration. Other than that, the event tree follows the same path to boiling.

MR. MICHELSON: As the steam goes through the building, are there any automatic fire protection systems for this plant that will be actuated by not the high humidity -- you're talking about water droplets circulating around in air, which looks a lot like smoke particles circulating around, and smoke detectors pick them up. You are also getting very close to where some of the thermal detectors might pick it up, although at 148 you shouldn't have a fire signal yet, but it depends on how they are set and how accurate they are, and so forth. Did you look at all at the actuation of fire protection during this event?

MR. JONES: For the case of the standby gas treatment system, yes, there are fire dampers installed in the system.

MR. MICHELSON: That's inside the system.

MR. JONES: Right.

MR. MICHELSON: I'm talking about outside the system, in the rooms, particularly lower reaches of the building where the important equipment that needs to function is located.

MR. JONES: That was outside the scope of our assessment.

MR. MICHELSON: Steam is always a potential means of setting off fire protection, as we well know from several events. It doesn't have to be 212 degrees either.

MR. JONES: The results of our assessment using the LOCA initiator are near boiling frequency of about one times ten to the minus six. That is reaching 170 degrees. That is just for the LOCA and the LOCA/loss of offsite power initiators, and it assumes that the normal fuel pool cooling system is load shed.

MR. CARROLL: And not restarted.

MR. JONES: There is some probability of recovery, but not automatically restarted.

What was intended to be a bounding assessment, a core damage frequency of one times ten to the minus eighth per year. This is using the Susquehanna IP LOCA event tree for that.

MR. MICHELSON: Environmental failure only includes that for temperature. That is the only mechanism of environmental failure, because that is the only one included in your model. You do not include any other phenomenon. This is the problem with PRAs. You've got to have a complete model if you want to talk about the bottom line.

MR. JONES: The way we attempted to bound that is that if we believe steam is propagating through the system because either standby gas fails -- well, the standby gas failure hasn't been modeled, but if it isn't operating and recirc is off, an environmental failure is assumed to occur with a probability of one. The safety system completion time is compared with when it reaches the temperature for situations when there is no steam propagating but just temperature heat-up.

MR. MICHELSON: What do you think the completion time is for RHR?

MR. JONES: The completion time modeled in the report is -- I have it right here.

MR. MICHELSON: You don't know it just off hand? Maybe you can look it up. Let's go on.

MR. JONES: Twenty-four hours for completion for RHR.

MR. MICHELSON: I guess completion in your definition means that that is as long as you need the function and RHR is only needed for 24 hours after a LOCA and then you can walk away. I doubt it seriously, but if that's your completion time -- I thought that's what the definition of completion time means, just as long as you need the function. I think you are going to have to look at RHR for tens of days, not for one or two.

If you have lost the pumps, they are not easily recoverable. Particularly with the building and the condition it's in, you're not going to get down and repair those pumps. Or not too likely, at least, if I understand the model of the whole event to begin with. The kind of damage that would probably be done to the pumps is something that requires motor replacement or just pulling them out.

You're talking about a long time.

MR. CARROLL: And high radiation areas.

MR. MICHELSON: Potentially, depending on which event you want to name to cause the LOCA. These are the flaws of the PRA if you don't keep them up.

MR. KELLY: You have two aspects that are associated with the way we did our risk analysis. The first was the probability of getting boiling, and then once you got boiling, the probability of getting core damage. Boiling, depending on the conditions that the two units are in, can take on a worst case basis as quickly as ten hours. Other times it might take over 50 hours to get to boiling. Once I've got boiling, it might take me another ten to 15 to 20 hours to get temperatures high enough in the rooms under our conservative assumptions to get to the point where we are going to start worrying about that 148 degrees for failing equipment.

This is what we have taken into account. When we say 24 hours, this is the time we are saying that if I get RHR started before that, I'm going to start cooling the pool --

MR. MICHELSON: Twenty-four hours is measured from what point in time?

MR. KELLY: It's usually from point of scram.

MR. MICHELSON: I don't understand. You're saying you only need the RHR for 24 hours after a scram?

MR. KELLY: No. It means that if I get it back, if I have my function for 24 hours.

MR. MICHELSON: Yes, but if the 24 hours leaves you all these problems, you are not going to get it back.

MR. CARROLL: Are you saying that if I restore pool cooling within 24 hours I'm okay?

MR. MICHELSON: I think that's what they are claiming, yes.

MR. KELLY: If you get the cooling back, you are going to stop boiling and you're okay.

MR. MICHELSON: And you've got 24 hours to do that.

MR. KELLY: So we are looking at how much time we have to complete our function here.

MR. MICHELSON: Yes. That's a different duration but it's also a legitimate definition of one.

MR. JONES: In order to encompass everything, we also looked at the overall frequency of boiling events and assuming all initiators, such as a simple failure of the normal fuel pool cooling system or a loss of offsite power. With that approach, we concluded that the near boiling frequency would be about two times ten to the minus four per year and that the best core damage estimate is around one times ten to the minus six.

MR. CARROLL: When you use core damage in this context, you are assuming a LOCA has occurred but the core has initially been successfully cooled, and then at some later time, because of the pool boiling situation, the situation deteriorates and core damage does occur.

MR. JONES: This core damage frequency is solely resulting or coincident with a fuel pool boiling event. The majority of the contributor is environmental failures of components and not necessarily due to a LOCA. This part of the model except for the LOCA case uses the Susquehanna transient event tree, which allows you multiple modes of cooling the core, but if you have an environmental failure because of boiling, then that would lead to core damage of either the high pressure or depressurization or the low pressure systems.

MR. MICHELSON: Are you saying it's a conditional failure probability, that given the boiling of the pool, this is the probability?

MR. JONES: No.

MR. MICHELSON: It's something in between.

MR. KELLY: We performed our analysis in two parts. The first part was what's the chance of us having boiling. When we looked at all the different ways that you could have failures, the different types of equipment that could fail, we said about two times ten to the minus four per year is how often we might see boiling.

Given all of these different events and the potential effects associated with it, we said how often are we going to have core damage. The total core damage, including the probability that we are going to have boiling which caused it in the first place, is ten to the minus six per year.

The LOCA contribution out of that ten to the minus six is ten to the minus eight. The LOCA contribution is very small.

MR. JONES: From our risk assessment and the deterministic reviews, we determined some lessons learned, some of which have been implemented at Susquehanna, including cross connecting the fuel pools, as I mentioned earlier, because you have the capability of using either unit's cooling systems.

And then updating procedures.

The emergency organization guidance refers to just keeping the supervisory staff aware of the fact that the pool could eventually boil during an event.

A procedure to isolate the boiling pool refers to isolating the ventilation system basically to keep the steam on the refueling floor level or being vented via a ventilation system to the outside.

MR. MICHELSON: At Susquehanna on the LOCA signal they isolate everything, I assume. Even the standby gas treatment is momentarily isolated if it were in operation. All ventilation is isolated? How do they do it?

MR. JONES: Normal ventilation system stops. For a LOCA signal from Unit 1, for instance, the Unit 1 recirculation system would start and the standby gas treatment system would start.

MR. MICHELSON: At that point?

MR. JONES: Right. And you'd have a zone 3 ventilation, the refueling floor ventilation operating. So the refueling floor and the LOCA unit would be mixed.

MR. MICHELSON: At what point might they be isolated? Is there a high radiation signal on the exit from the system? There must be some automatic isolation. On a very large release you don't want to ventilate normally anymore. At least you go to standby gas treatment.

MR. JONES: This is standby gas treatment.

MR. MICHELSON: Whether it is isolation signals, if any?

MR. JONES: It doesn't have any.

MR. MICHELSON: It starts automatically and then it manually stops?

MR. JONES: It has one very high temperature isolation at around 400 degrees for a charcoal bed fire.

MR. MICHELSON: And that's it?

MR. JONES: Right.

MR. MICHELSON: Strictly manual. So it's running until somebody either shuts it off or it breaks down from the extremely high humidity.

MR. JONES: Right.

MR. CATTON: What does all that water do to the charcoal bed?

MR. MICHELSON: It loads it right up.

MR. JONES: As I mentioned, the heaters are designed for 180 degree, 100 percent humidity air, and there are de-misters in front of the standby gas treatment filter train.

MR. CATTON: They can handle this 20,000 pounds per hour?

MR. MICHELSON: No.

MR. JONES: By the time it gets to the standby gas treatment system the proportion of water in the air is relatively low.

MR. MICHELSON: How did it get relatively low?

MR. CARROLL: Condensing.

MR. JONES: It is being diluted by outside air and also by condensation in the duct work.

MR. MICHELSON: You're on recirculation; you are not bringing in outside air anymore, and you are sucking off of the recirculation.

MR. JONES: The system is designed -- I need to get into the analyses a little bit.

MR. MICHELSON: We've taken too much time already. Okay. I'll pass on it.

MR. JONES: It's just to provide adequate flow for the fan. The fan is rated at 10,000. If it's only drawing 3,000 from the reactor building, it makes up the rest with outside air. That's the outside air.

MR. MICHELSON: That's downstream of the charcoal beds?

MR. JONES: That's in the control structure. It's not even in the reactor building.

MR. MICHELSON: But it is downstream of the beds?

MR. JONES: No, before the beds.

MR. MICHELSON: Upstream of the beds.

MR. JONES: Right.

MR. CARROLL: Yes. You'd want to do it that way.

MR. MICHELSON: I just wanted to make sure which side it was on.

MR. JONES: Environmental effects of boiling pool. We are looking at generic applicability of this event for any of these improvements, and also looking at single unit sites.

The last slide I have is on the licensing basis. We concluded that the event is --

MR. CARROLL: Back to what you are looking at. Did I read that you are also going to look at this issue with respect to Mark III's and with respect to pressurized water reactors?

MR. JONES: We have already taken a quick look at Mark III's and PWR. In general, we find that a lot of them have safety grade fuel pool cooling systems, which kind of places this in the very low risk category. Also they have buildings separate from their ECCS equipment to store the fuel.

MR. MICHELSON: Are you looking at Mark I's also?

MR. JONES: Yes.

MR. MICHELSON: There it gets to be more interesting. Now you've got 10-inch steam lines running through the building to the HPSI turbines, for instance. They produce an enormous building pressurization and humidification when they break. Very large. A 10-inch steam line.

MR. KRESS: Are you finished, Mr. Jones?

MR. CARROLL: He has one more slide.

MR. JONES: This is the last slide. The other thing I have to mention is that the fuel pool was licensed to the regulatory guides and not the standard review plan.

That's it.

MR. KRESS: Before we start into more questions of the staff, while we still have some additional time, I do have a request from the public to make a few comments. I would like to hear that first and then we can have the questions, if that's all right.

MR. CATTON: I was just going to comment, I thought it was a good presentation.

MR. DAVIS: Yes.

MR. KRESS: Yes.

MR. CATTON: He stood up very well under some rather obtuse questioning.

MR. KRESS: Would you please introduce yourself. You can use this mike or the one up front, whichever you prefer.

MR. PREVATTE: Good morning. My name is Don Prevatte. Mr. Lochbaum and I are the two engineers who filed the Part 21 report.

I wanted to respond to statements and comments that have been made this morning and also try to answer any questions you folks may have.

First off, I would like to say that it appears that the focus of the presentation this morning has been on probabilistic aspects of this concern. Doing a probabilistic risk assessment is only as good as the assumptions and the input that go into that. We have some deep concerns about that. I will address those in a moment.

Also, in listening to the presentation this morning I heard at least three systems that were identified as potentially failing as a result of this event. Those are core spray pumps, standby gas treatment --

MR. CARROLL: Pumps or pump? I heard pump.

MR. PREVATTE: Okay, pump. Standby gas treatment and RHR pump or pumps.

I know that PRA is a very useful tool, but I don't believe it is a substitute for following the regulations. The regulations don't allow you to have any of your safety-related equipment fail as a result of it not being designed correctly.

To address some of the details that were discussed this morning and some of the questions that you gentlemen have raised, Bechtel's original design of the standby gas treatment system recognized very early that the system would not stand up to a boiling fuel pool. As early as 1979 there are documents that they had originally looked at that and come to the conclusion that it was not capable of withstanding the effects of the boiling spent fuel pool, and at that time the decision was made that it would not be designed for those effects.

The calculations that were done at that time show that the temperature in the reactor building would be as high as 180 degrees.

MR. CARROLL: That is hard to believe. Isn't that a typical steel superstructure for both the pools?

MR. PREVATTE: The building is steel reinforced concrete up to the level of the reactor refueling floor. From that level on up it is a steel structure with sheet metal siding.

MR. CARROLL: That's a pretty effective condensing surface.

MR. PREVATTE: It is a very good condensing surface, but you have to look at the relative heat loads we are talking about here. I did the redo of the reactor building heat loads for Susquehanna -- that's how we discovered this problem -- as a part of the power uprate project. The initial heat loads that were considered in the building, not counting the boiling spent fuel pool, were approximately 5.2 million BTUs per hour. When you add the heat load of the boiling spent fuel pool, you are adding heat loads in the range of 20 million BTUs per hour to the 5.2 that you already have. The equipment in the building was originally qualified for 5.2 million BTUs per hour, approximately. So it's easy to see that there is a very high potential at the higher heat load that you are going to have equipment whose qualification will be challenged, to say the least.

MR. MICHELSON: Would you agree that the equipment is qualified for 148 Fahrenheit at 100 percent humidity?

MR. PREVATTE: At the point in time when I left PP&L, when my contract was finished there, there may have been some equipment that was qualified to 148. They may have subsequently requalified some to that temperature. Most of the equipment in the building, most of the EQ temperatures for most of the rooms were in the range of 135 degrees.

MR. MICHELSON: That I would believe. Thank you.

MR. PREVATTE: If I may, I would like to address some of the comments that were made in the presentation. I will go through the slides that were presented.

A comment was made that you didn't know about this concern until the October notice that came out from the NRC.

MR. CARROLL: I didn't know about it until a week ago Saturday.

MR. LINDBLAD: As an individual.

MR. CARROLL: As an individual.

MR. PREVATTE: We turned in our Part 21 report in November of 1992. This notice didn't come out until we demanded a formal presentation to NRR and had contacted congressional oversight committees. I believe that you probably wouldn't have known about it today had we not made this contact with congressional oversight committees.

Another comment was made about the pools being connected. As the plant is currently designed and operated, the pools are not connected.

Another comment was made that the operators would pull the gates out in an accident so they would be connected. I would like to point out that to do that would entail operator entry into a reactor building which is potentially going to be a very high radioactivity area; it requires a lot of time and a lot of exposure, and I'll get into more details on that in just a minute.

MR. MICHELSON: It requires the building crane probabl , too.

MR. PREVATTE: I'm sorry??

MR. MICHELSON: It requires the building crane to do it.

MR. PREVATTE: Yes, it does.

MR. MICHELSON: And it's not qualified for this.

MR. CATTON: The building crane is probably going to be out of commission due to all the condensation.

MR. MICHELSON: Yes. Right up there on those electrical rails is about all it would take, probably.

MR. PREVATTE: Another comment was made to the effect that for the LOCA event the load would only shed the non-safety-related service water system and not the fuel pool cooling system. If that is the case, that is a change that has been made since we were there. At the point in time when we made this report the fuel pool cooling system would be load shed as a result of the LOCA; it was designed that way.

With regard to the qualification of the standby gas treatment system, the focus so far has been on the water going through the system. There are other mechanisms whereby the standby gas treatment system will fail. One of those mechanisms is you're going to have higher temperature air passing through the duct work. The fans are actually located in the control building, in a room. The qualification temperature in those rooms was set based on a non-boiling spent fuel pool condition. Those fans will tend to see the higher temperature generated as a result of higher temperature air coming through the duct work. In our last look at that that higher temperature qualification for those fans had not been addressed.

Additionally, a question was brought up with regard to the fire protection in the system. When this report was initially made there were fusible links in the standby gas treatment system that fused at 165 degrees. If you have 180 degree air trying to go through there, it's obvious that the dampers are going to close, and that was one of the mechanisms for loss of standby gas treatment system. It was designed that way.

MR. MICHELSON: That also actuates a water spray inside the standby gas treatment?

MR. PREVATTE: I don't believe it does, sir.

MR. MICHELSON: It just closes the dampers?

MR. PREVATTE: Just closes the dampers. There are other things that actuate the water spray at higher temperature. It's my understanding that a plant modification has been made to correct that, but that modification was not made until after we made our report.

Statements have been made to the effect that the backup systems are adequate to supply cooling to the fuel pool in case the fuel pool cooling system is not available. We believe that is not correct, and I will give you some details on that in just a moment.

MR. CATTON: Are you going to address the spray pond?

MR. PREVATTE: Yes, I will.

MR. CATTON: Okay.

MR. PREVATTE: Other questions came up regarding the cooling equipment for the ECCS pumps. I would like to address that if I may, because that is an area where I had particularly close involvement in the power uprate project. None of the safety-related coolers, none of those in the reactor building are designed for latent heat cooling. That is, if you have a steam environment in that building, those coolers aren't designed to handle it. That environment will tend to cause either a reduction in cooling capacity or a complete failure of those coolers. They will not handle latent heat cooling.

Additionally, there are other rooms besides the ECCS pump rooms which have to be considered. Those are the safety-related switchgear rooms and load center rooms. Those are also cooled by coolers which are not designed for latent heat cooling, only for sensible heat cooling.

MR. MICHELSON: Aren't those outside of secondary containment?

MR. PREVATTE: No, they are not.

MR. MICHELSON: In this plant they are inside of secondary containment?

MR. PREVATTE: That is correct.

MR. MICHELSON: That's real interesting now. Switchgear is inside of secondary containment, in the same environment. Most plants have got it outside of secondary containment.

MR. PREVATTE: If those coolers fail, there is a high potential that the load centers and switchgear will fail. If the load centers and switchgear fail, the safety-related equipment powered by those will not be serviceable.

MR. CATTON: What's the elevation of this switchgear relative to the pool?

MR. PREVATTE: I don't remember exactly. I think it's two floors down from the pool. Well, it's not all on the same floor. As I recall, some of it is one floor down and some of it is two floors down, but I don't remember the exact layout. I've looked at a lot of plants since then. They kind of run together.

MR. MICHELSON: Presumably that switchgear is also qualified for 148 Fahrenheit? What is it qualified for? When I asked the question I should have asked what is the weakest point in the system and what is it qualified for, but I didn't realize that the electrical switchgear was in there as well.

MR. JONES: I would have to review their environmental qualification report to get exact temperatures. One hundred forty-eight corresponded to much of the equipment that we were examining in the probabilistic risk assessment as failed.

MR. MICHELSON: I hope the PRAs include the power supplies and the things that you are counting on in the PRA to work. That's a part of a real PRA. I think you must have done a very piecemeal PRA and ignored the auxiliary systems required to make these things function, because that's an auxiliary system that is essential to the functioning of the motor. Without power it doesn't work too well. Again, that's my complaint on PRAs. You've got to watch to make sure the model is complete and then next that the data is any good that goes into the model. I can't believe they put it inside of secondary containment.

MR. CARROLL: It came as a shock to me.

MR. MICHELSON: I didn't realize that. I didn't do my homework as well as you did.

MR. PREVATTE: Another statement has been made to the effect that the spray ponds are adequate for handling the heat load from the boiling spent fuel pool. If that has been analyzed by PP&L and determined, that's a new determination. That had not been done before we made our report.

We don't know absolutely for certain, but just based on our knowledge of the system, we believe that in this condition if the spray pond is capable of handling the heat load, we believe that the RHR system operating in this mode is not single failure proof, and I will get into more details on that in just a minute.

A statement was made by someone to the effect that, well, there were a lot of things people could do to reestablish fuel pool cooling before the rad levels get too high. That may be true, assuming that you have procedures and training in place that tells the operator, hey, as soon as this LOCA occurs, you better get out there real quick and start doing all these things before the rad levels get too high. To the best of my knowledge, at this point in time those kind of procedures and training aren't in place. As I understand it, the response to this event would be a reaction rather than a preemptive action.

MR. CARROLL: Staff, is that the current situation?

MR. KELLY: In the probabilistic risk assessment we took no credit for any room cooling from the normal cooling systems when we looked at the time for heatup. If you had a normal HVAC system, we didn't credit that.

MR. CARROLL: My question had to do with the status of training.

MR. KELLY: I'm coming up to that. I was just making that point. With regard to recovery, we assumed that procedures would be in place to do this and to turn off the recirculation system and turn on the standby gas treatment system. These areas were treated within the fault trees.

MR. CARROLL: Not my question .

MR. KELLY: I'm sorry.

MR. CARROLL: I don't care what you assumed. I want to know what the real situation is.

MR. KELLY: My understanding at this time is that PP&L is working on procedures for turning on the standby gas treatment system and turning off the recirc fans. That is not in place at this time.

MR. CATTON: The answer is no?

MR. KELLY: Yes. At this time it is not in place at the plant.

MR. CARROLL: How about restoring spent fuel pool cooling?

MR. KELLY: The restarting of spent fuel pool cooling is dependent on which system needs it. Basically it's racking in the system again and going into the --

MR. CARROLL: Have they got procedures and training to do those things?

MR. KELLY: I don't know.

MR. JONES: The licensee does have an off-normal procedure addressing loss of normal fuel pool cooling, including expected indicators in the control room. There is a single trouble light that gets a variety of input, including loss of the cooling pumps or low level in the surge tank. They also have a recently revised procedure to place the RHR system in the fuel pool cooling mode.

MR. PREVATTE: Mr. Chairman, may I address those two points, please? We have reviewed their loss of fuel pool cooling procedure. A number of the actions that it tells operators to take in there they can take only if you don't have design basis conditions. If you have design basis conditions in the reactor building as required by regulatory requirement, the operators will not be able to carry out those actions.

MR. CARROLL: You say you have reviewed their procedures?

MR. PREVATTE: Yes, we have.

MR. CARROLL: I thought a minute ago you said they didn't have any.

MR. PREVATTE: No. I said they didn't have any at the time of the report that addressed this situation. Even the procedure they have today does not demonstrate the capability of operators to handle this situation under design basis conditions. If you look at emergency procedures, typically they are aimed at telling the operator to do whatever he can do with whatever he has, but if you look at design basis conditions, he doesn't have the wherewithal to do the things that the procedure tells him to do.

Also, with regard to the procedure to line up RHR in the fuel pool cooling mode, I would like to address that in detail in a moment. There are a number of reasons why that cannot be done.

MR. PEDERSEN: This is Roger Pedersen in the Radiation Protection Branch, Nuclear Regulatory Commission Staff. I would like to address the timing question, as to whether operators can access the reactor building to take these various actions. The statement was made that they could only get in there if procedures were put into place to initiate that action immediately after the accident. That might not necessarily be the case. The licensee's evaluation, the radiological assessment, they assumed that they have 24 hours in which to take these various actions. So they did the radiological assessment at the 24-hour time slice in time post-accident.

The evaluation that we are doing is looking at that time dependency of the source term. You heard earlier the PRA states that the pool may boil as early as ten hours, depending on the configuration of the plant. So we are looking at those various slices in time and the source term that would be in the building in a realistic sense, but we haven't finished that analysis yet.

MR. MICHELSON: Apparently you are looking only at the classical LOCAs that occur inside of containment. This LOCA could very well be a line outside of containment looking directly back at the reactor, such as reactor water cleanup. I don't know if this plant has a HPSI turbine or not. It probably has a RCSI turbine. Those are LOCAs. Breaks of any of those are LOCAs until isolated. Of course we have a little question about how well we can isolate. Those kind of events, you're not going to get in that building immediately.

MR. PEDERSEN: You're correct. We are looking at the classic LOCA within containment.

MR. MICHELSON: It's overwhelming. It has pressurized the building; it's blowing out siding. The calculations show it does a lot of interesting things.

MR. CARROLL: What source term are you using in this evaluation, TID or the new source term?

MR. PEDERSEN: In the staff's determination, currently we are using the new source term.

MR. CARROLL: That makes a big difference, doesn't it?

MR. PREVATTE: I'm sorry. The what source term?

MR. PEDERSEN: The source term based on the information in NUREG-1465.

MR. PREVATTE: Mr. Chairman, I would like to comment on thate when my turn comes.

MR. KRESS: Sure.

MR. CARROLL: Doesn't that make a big difference in terms of radiation levels you'll see and the timing of them?

MR. PEDERSEN: We haven't finished the analyses. We are looking at what the difference is. It does make a difference. I'm not sure if I would characterize it as a big difference at this point. I'm not the source term person. Maybe I should have Jack Hayes get up here and discuss it. With the "new source term" more of the activity gets washed into the suppression pool so that the dose to the operators from the systems that are recirculating suppression pool water increases. We haven't gotten this far in the analysis, but it looks like the dose from the airborne source term from the leakage outside of containment and the leakage from ECCS systems will be slightly lower.

As I said, we haven't finished the analysis. Those are the considerations that we are taking.

MR. CARROLL: Thank you.

MR. CATTON: Let this guy finish. He didn't interrupt them. We should let this guy finish.

MR. KRESS: Let's let him complete.

MR. CARROLL: He was going to amplify on the last comment, and then he can have it back, I guess.

MR. HAYES: This is Jack Hayes from the staff. I just wanted to add one thing, and that is that with respect to source terms, we are looking at a number of different scenarios. We are including both the NUREG-1465 source terms and we are also looking at TID source terms to see the effect of the two different values.

MR. CARROLL: Thank you.

You have it back.

MR. PREVATTE: Another comment was made about building pressurization due to the boiling spent fuel pool. The design of this building is that it shall operate at a negative pressure post-LOCA in order for the standby gas treatment system to work. The standby gas treatment system is designed to have approximately 100 to one cleanup ratio. If the building becomes pressurized as a result of the boiling spent fuel pool, you've now defeated the function of the standby gas treatment system, and you now have nullified that 100 to one cleanup ratio.

MR. CARROLL: To say nothing of the fact that you're going to have ground level releases as opposed to elevated releases.

MR. PREVATTE: That is correct.

MR. MICHELSON: It isn't going to work anymore with all that moisture in the air.

MR. KRESS: The moisture is going to load up the charcoal but it's not going to load up the HEPA filters.

MR. MICHELSON: No.

MR. KRESS: I'm not quite sure I understand why having a pressurized building defeats it.

MR. PREVATTE: The reason it defeats it, sir, is because in order for standby gas treatment to work you just assume that all building leakage is inward leakage.

MR. KRESS: You're saying it just bypasses it.

MR. PREVATTE: It bypasses the system.

MR. KRESS: I understand.

MR. PREVATTE: A statement has been made that we are talking about a lot of water here. Just to give you an idea of just a rough approximation, over a 30-day period of time we are talking about approximately 20 million gallons of water into the building that is not taken out. A number of statements have been made along the way about how it's going to be sent to radwaste, et cetera, and a number of other ways of getting it out, none of which are practicable.

MR. MICHELSON: A fire hose won't solve this problem because making up water isn't the problem. The problem is taking the heat out.

MR. PREVATTE: A number of statements have also been made about, well, the equipment would last -- they have done their Arrhenius equations calculations and it would last for 30 days. My question is, if the RHR system dies at 30 days, then what? As was pointed out, you don't go into the building and repair it after there has been a LOCA, but that core still requires cooling at 30 days, as does the fuel pool.

Another point that was addressed was the moisture of this condensing on the refueling floor doesn't just go into the accident unit. Even if you have the non-accident unit isolated on the ventilation, the water drains down into that unit. This is contaminated water. Therefore the accident unit also becomes contaminated, albeit probably not at the same level of contamination.

MR. CARROLL: The non-accident unit.

MR. PREVATTE: The non-accident unit. I'm sorry.

Another point was raised with regard to fuel pool instrumentation. Only after we made our report has PP&L gone back and addressed the fuel pool instrumentation. The original instrumentation that was in there was essentially non-usable in this situation. They have now come back and they are installing equipment that can be read from the control room.

However, we question the design of that. The level instrumentation is a very, very narrow range instrumentation. Since it's narrow range and they intend to feed the fuel pool by a batch process, being narrow range means that in order to keep it in range they are going to have to make many trips into the reactor building in order to refill the pool as it boils away, and each trip into the reactor building is another heavy duty exposure to the operators.

Another comment I would like to make is with regard to the focus of the presentation today. The primary focus of the presentation today seems to have been on core damage, and that is a very important consideration. However, before you get to core damage, our main concern has been damage to the fuel in the fuel pool, and that is another issue that seems to have been addressed very lightly today. I would like to make some more comments on that in just a minute.

By the way, the core damage typically is a focus of PRAs. In order to do proper assessment on something like this you need to look at all of the potential adverse consequences and do PRAs on those, not just the core.

MR. CARROLL: Do you or your colleague have a particular background in PRA? I guess I read someplace that you said you didn't.

MR. PREVATTE: I don't have a background in PRA. Neither does my colleague. We both, though, have been exposed to PRA and we've both been exposed to abuse of PRA. PRA is touted to do a lot of things that it cannot do. It is a very useful tool, but it is only useful to those people who really understand it and who use the proper assumptions and the proper inputs. With the improper assumptions and inputs, you can prove the moon is made of green cheese if you want to.

MR. CARROLL: You should have been here yesterday.

MR. KRESS: We needed some green cheese, did we?

MR. PREVATTE: Throughout the presentation this morning I've heard a number of comments by the staff to the effect that these analyses aren't completed yet on a number of points that have been raised. I've also heard it said that the SER on this issue is going to be issued within the next couple of weeks. I don't understand how you can issue an SER on something when you haven't completed the analyses.

I have some more specific comments I would like to make that address in more detail these points, if I may. These are points that we generated in anticipation of what would be presented today.

Much of what we have heard today we've heard before. We don't agree with it, and I wanted to make sure that you folks had the opportunity to hear the other side and that it went on the official record.

Is it okay to proceed?

MR. KRESS: Yes.

MR. PREVATTE: The staff has made the point that this event that we are concerned about is not within the licensing basis of the plant, and the points they have made to us before as the reason why it wasn't in the licensing basis was that it wasn't specifically identified in the FSAR and they did not respond with any specific identification in the SER, the implication being that FSAR and the SER constitute the entire licensing basis.

Our response is as follows. We have three reasons why we consider this to be incorrect and unacceptable.

Per NRR's own official definition, the licensing basis consists of more than just the FSAR and the SER. NRR's document NUREG-1412, which is entitled "Foundation for the Adequacy of the Licensing Basis," section 1.3.2, states, "The current licensing basis is the set of NRC requirements applicable to a specific plant and a licensee's written commitments for assuring compliance with and operation within applicable NRC requirements and the plant-specific design basis, including all modifications and additions to such commitments over the life of the license, that are docketed and in effect [at the time the license was granted]."

I've added in the part "at the time the license was granted," but it is obvious from the document that is what they mean.

The current licensing basis includes the NRC regulations contained in 10 CFR Parts 2, 19, 20, 21, 30, 40, 50, 51, 54, 55, 70, 72, 73, 100, and appendices thereto; license conditions, exemptions; and technical specifications. It also includes the FSAR and licensee responses to NRC bulletins, generic letters, and enforcement actions, as well as licensee commitments documented in NRC safety evaluations, or as described in licensee event reports.

In other words, the licensing basis includes not just what the licensee said in the FSAR and the NRC said in the SER, but also all of the regulatory documents which were applicable at the time the license was granted. Our concerns are completely within the regulations which were in effect at the time the license was granted and therefore completely within the licensing basis.

The primary regulation not being followed which was in effect at the time this plant was licensed among others which are not being followed is 10 CFR 50, Appendix A, Criterion 61. I'll give you a quote from that.

"Fuel storage and handling and radioactivity control" is the name of that criterion. This regulation states, "The fuel storage systems shall be designed to assure adequate safety under normal and postulated accident conditions. These systems shall be designed to prevent significant reduction in fuel storage coolant inventory under accident conditions."

The second reason why we consider this to be within the licensing basis is that even if it weren't, 10 CFR 50.100, which is entitled "Revocation , Suspension, Modification of Licenses and Construction Permits for Cause," states, "A license may be modified because of conditions which would warrant the Commission to refuse to grant a license on an original application or for failure to observe any regulations." NRR has stated on several occasions that had they known about these concerns at the time of the licensing, they would not have granted the license. This federal regulation says it's still not too late for them to do that job.

The third reason that we don't agree with their licensing position is that even if none of the above legal reasons are applicable, and they are, NRR's position defies common sense. They're in effect saying the licensee didn't catch the problem, neither did we, so it's not something we must consider now as being applicable. In other words, two wrongs make a right. I'm sorry, but that logic doesn't hold with us or the American public whom the NRC is charged to protect.

The next issue that we strongly disagree with is regarding the NRR's position on the risk of the accident of concern. Their position essentially is that the risk of this accident is very low because the probability of its occurrence is low. They maintain that the probability is very low because it requires concurrent low probability events. Or at least that's the position they've taken before. It seems to have been modified a bit this morning.

We strongly disagree with this position for the following five reasons:

1. The condition does not require -- I repeat, does not require concurrent events; it requires only a LOCA, which has always been considered to have credible probability. For this event, by design the fuel pool cooling system shuts down on load shed, or at least it did. No failure is necessary; it's designed that way.

2. The licensing basis does in fact require that certain concurrent events be assumed in spite of their low probability. This is part of your defense in depth concept in the design of a plant. These also would or could cause the loss of fuel pool cooling simply because it's not designed for them.

3. The fuel pool cooling system is not designed to operate in the LOCA environment. Even if you can restart it, it may fail as a result of the environment created by the LOCA.

MR. CARROLL: Why is that again?

MR. PREVATTE: The fuel pool cooling system is not a safety-related system. It was not designed to operate in the LOCA environment. In a LOCA you not only have a harsh environment inside the dry well, but you also have a relatively harsh environment inside the reactor building. That is, the temperature in the reactor building before was typically around 135 degrees and radiation levels in the reactor building go up to several thousand R per hour and the humidity goes up to approximately 100 percent. The fuel pool cooling system equipment was not designed for that environment; it's not environmentally qualified.

MR. MICHELSON: Some of the older PWRs have got a problem. That big bear taurus in the basement becomes a real heat source, because the water is approaching 200 degrees Fahrenheit, and that just heats the whole building from that taurus.

MR. CARROLL: I understand.

MR. PREVATTE: Another reason we don't agree with NRR's risk assessment is that it appears that they are only looking at one of the fundamental elements of risk assessment, that is, the probability element. The other element which they appear to be ignoring is the consequences element. As I'm sure you know, risk is the product of these two elements, and for failure to maintain cooling of the spent fuel pool, the consequences are catastrophic. Per the NRC's own estimates which are contained in NUREG-1353, if fuel pool cooling is lost and the water is boiled off, it can result in not just a failure of the spent fuel pool, but in the fuel elements actually catching fire.

We have been talking this morning about the boiling spent fuel pool. The underlying assumption seems to have been that we have the capability of making up to it. We do not believe that under design basis conditions you have the capability of making up to it. If you don't, eventually you are going to boil the water away, and if you boil the water away, per the NRC's own assessment you will probably have a fire in the fuel pool.

This document, NUREG-1353, states that the "best estimate of the consequences of a spent fuel pool accident which results in spent fuel pool damage to approximately one-third of an equivalent reactor core is eight times ten to the six person-rem." That's eight million person-rem, and that is the consequence of only one-third of a core failing. There are many times more fuel than this in a loaded fuel pool. Trying to put this somewhat into perspective, the maximum allowable offsite LOCA exposure to a member of the public per 10 CFR 100 is 25 rem whole body and 300 rem to the thyroid.

MR. MICHELSON: What was your estimate?

MR. PREVATTE: It wasn't our estimate, sir. It's an NRC estimate.

MR. MICHELSON: What was that estimate?

MR. PREVATTE: Eight times ten to the six person-rem, or eight million.

The NUREG goes on to state that "The health risks are dominated by the risk of latent cancer fatalities." It also states that the "best estimate offsite property damage cost is 4,000 million (1988 dollars) and the onsite costs for a spent fuel pool accident is 1,180 million (1988 dollars.)" That's 5.2 billion in 1988 dollars. That's an NRC assessment.

Additionally, if the fuel pool boils, it creates an environment in the reactor building significantly more harsh than the environment for which the safety-related equipment is designed, as we have discussed. If this equipment fails, the reactor core will melt down and the primary and secondary containment will fail, creating substantially worse consequences even than were identified in the NUREG.

It's not difficult to see that the consequences of the accident in question are much, much worse than what the regulations state are acceptable and therefore the risk, which is what a risk assessment is supposed to assess, is much higher.

MR. CARROLL: In that regard, do you believe that there are some risks that have sufficiently low probability even though they have enormous consequences that you can safely ignore? Example. Failure of a reactor pressure vessel.

MR. PREVATTE: Yes, I do. I believe with the concept that you espouse, there are certain risks even though the consequences are very high where the probability is very low that the resultant product is acceptable. However, in this case we see the probability of this event being one if you have a LOCA.

MR. CARROLL: I understand what you are saying.

MR. PREVATTE: Another point that has been made by NRR that we strongly disagree with is regarding the operator access to the reactor building post-LOCA. Our understanding of their position is that the radiation and other conditions in the reactor building post-LOCA will be acceptable for operator entry to restart the fuel pool cooling system, to open and close the manual emergency service water valves, to line up the RHR system in the fuel pool cooling assist mode and all of the other manual actions required in the reactor building to reestablish and monitor fuel pool cooling because (1) Regulatory Guide 1.3 and NUREG-0737 requirements for source term consideration are not "realistic" and also are not applicable for operator access, and (2) --

MR. CARROLL: Do you believe what they say?

MR. PREVATTE: No, sir, I do not.

MR. CARROLL: They are not realistic?

MR. PREVATTE: No, sir. I will give you the reasons why.

MR. CARROLL: All right.

MR. PREVATTE: The second point that they say why it's not a problem for operators is that airborne contamination from containment leakage does not have to be considered.

We disagree with both of these points very strongly for the following reasons:

1. NUREG-0737, section II.B.2 specifically requires that, as a minimum, the source terms of Reg. Guide 1.3 must be used in determining the radiation exposure to

operators in "any areas which will or may require occupancy to permit an operator to aid in the mitigation of or recovery from an accident."

In other words, 1.3 is applicable by regulation.

MR. CARROLL: But you are aware of the fact that a great deal of work has been done on the source term issue in the intervening years since all that you read.

MR. PREVATTE: Yes, I'm aware of that. There are some other points here that address that point also.

MR. CARROLL: All right.

MR. PREVATTE: The second reason we don't agree with their assessment of the operator access is that Reg. Guide 1.3 specifically requires that "the primary containment should be assumed to leak at the leak rate incorporated in the technical specifications for the duration of the accident." This leakage will in fact create an airborne radiation source in the reactor building. Such leakage plus the contained sources in the piping systems would generate radiation levels on the order of thousands of rem per hour. As I'm sure you are aware, a 100 percent lethal dose is approximately 450 to 500 rem, and per NUREG-0737, the limit on operator exposure is 5 rem whole body.

MR. CARROLL: I wanted to ask about that. Why do I have the impression that under emergency conditions the acceptable dose is 75 rem?

MR. PREVATTE: I can address that, sir. There are other regulatory documents that say under emergency conditions you may allow up to 25 rem to save equipment and 75 rem to save a life. Those are not design limits; those are limits that are imposed when things go awry in spite of your best design. The design limit is 5.

MR. CARROLL: So why can't I use 75?

MR. PREVATTE: Because the regulations say you have to design for 5. The regulations in effect say we design for 5, but if by whatever circumstance it is more than that, you may take these other actions up to 25 or 75, but that's not a legitimate design limit.

MR. CARROLL: Okay. I understand what you mean by a design limit.

MR. PREVATTE: The third reason is that in addition to the extremely high radiation, the operators would be required to perform in temperatures as high as 180 degrees per the Bechtel calculation, 100 percent humidity, in the dark because the power is going to be off, and all in several layers of anti-Cs and with an airpack on for breathing. I think it's pretty obvious that to enter the reactor building under these conditions would probably be a suicide mission.

The fourth reason is that the only significant commercial reactor accident in this country to date was

Three Mile Island.

This is to address your question a moment ago, sir. You said you've done a lot of subsequent assessments on source term since Reg. Guide 1.3. Subsequent to Three Mile Island NUREG-0737 came out and said, hey, we want to make sure that you look at Reg. Guide 1.3 when you are assessing this because of what they saw at Three Mile Island. The fuel damage and source term in that accident were substantially greater than what is required by Reg. Guide 1.3. In view of that experience, is it realistic to assume a source term less than what Reg. Guide 1.3 requires?

Another position that we disagree with very strongly is NRR's assertion that the RHR system can be used in the fuel pool cooling mode post-accident. Basically they are saying if the fuel pool cooling system is not available, RHR system can provide the required cooling in the fuel pool cooling mode. We would like to respond to that by saying there are five very strong reasons why it cannot.

The first is to use the RHR system in this mode also requires operator entry into the reactor building for alignment of manual valves, which, per the previous comments I've had, would be a virtual suicide mission.

The second reason is the system has never been demonstrated operable in this mode. In fact, the licensee's own analyses show that it cannot provide the required flow under accident conditions due to insufficient NPSH. They have done analyses that show that it can if they do certain things, like raise the fuel pool level and other things, but those analyses do not take into account that the operator can't get in the reactor building to raise the fuel pool level.

Their analyses were also confirmed during the start-up of the plant when this mode of operation was attempted during testing under conditions much less severe than accident conditions. That is, the fuel pool temperature was way, way down; there was no fuel in the pool It failed this test due to loss of pump suction. So they've had both analyses and tests to show that the system won't function in this mode under design basis accident conditions. This mode is designed as a supplement for cooling the fuel pool when you are in refueling mode; it is not intended to be used for accident conditions.

The third reason we disagree with their position is when you are operating in this mode, the RHR system, which is required for accident mitigation, is no longer single failure proof as required by regulation.

The fourth reason is that, at least up until this morning, it was our understanding that the ultimate heat sink, the spray pond, was not designed for the very significant heat load it would see on top of the accident heat load. We have not seen those analyses and we would question the assumptions that went into those analyses, considering the assumptions that have gone into some of the other analyses we've see subsequent to our report.

The fifth reason that we say that the RHR system is not suitable for this mode is that if you operate the system in this mode, you will send extremely radioactive accident water from the reactor to the fuel pool, thereby essentially bypassing the primary containment and increasing the offsite and control room operator dose as well as further increasing the reactor building radiation levels, thereby further restricting access and invalidating the qualifications of safety-related equipment in the reactor building with regard to radiation exposure.

By the way, let me make one other comment with regard to the qualification of this equipment in the reactor building. One of PP&L's responses to this accident has been they are going to manually shut down the ventilation recirculation system, which is a safety-related system. That's another one to put on the list, by the way, that is no longer available.

The whole purpose for that system is to mix the air in the building with the leakage that is coming out of primary containment such that the leakage is diluted before it goes into standby gas treatment system. If you don't run the recirc system, there are two problems with that.

One is you are going to increase your offsite dose due to the fact that now the standby gas treatment system is sucking on a building that is not being diluted.

The second problem with it is that if you are not diluting that leakage that is coming out of the containment, that invalidates your equipment qualification for all that equipment in the reactor building. The radiation aspects of its qualification were based on consideration of dilution from this huge volume of air that you have on the refueling floor. If you are not diluting it any longer, the radiation levels from leakage on that equipment will be significantly higher.

MR. KRESS: Mr. Prevatte, could we have a copy of your written comments?

MR. PREVATTE: Yes, sir.

MR. KRESS: Are there other questions or comments of Mr. Prevatte?

I would also like to give anyone else in the public a chance to make any comments.

MR. MICHELSON: I've got a question for the staff.

MR. KRESS: Fine. This is a question and answer response period right now.

MR. MICHELSON: I think it's something you had better go check real quick to see where we are at, or maybe you can tell me you already have, and that is, how is this stacking up against the ABWR final design approval? This was not an open item, and I suspect it is at least being peaked at as a reopened item. I don't know. Can you tell me where we are at?

MR. JONES: We have looked at the ABWR situation. Their alignment of RHR, since they have three redundant loops, allows the RHR system to meet single failure criteria for cooling the spent fuel pool and cooling the core adequately, although not at the rate that was designed.

MR. MICHELSON: The reason I am pursuing this slightly beyond that point is that, as you probably are aware, as a result of looking at the reactor water cleanup line break, they finally ended up with a 250 degree, 15 pound qualification. Is that going to be applied to the fuel pool cooling equipment as well? I consider it safety related, but once in a while we get into a little Mickey Mouse as to what is safety related. Is this included in that commitment?

MR. JONES: No. The normal fuel pool cooling system will not be safety grade, but the RHR system is.

MR. MICHE'SON: So we definitely depend upon RHR to keep them out of trouble.

MR. JONES: Right.

MR. MICHELSON: And you've looked at that and you are satisfied that since they have qualified the RHR for 250 and 15 pounds that that will take care of this issue. Is that what you are saying?

MR. JONES: Right. From the qualification aspect, the boiling pool will not cause the temperature to exceed the limit for the --

MR. MICHELSON: And you're satisfied that the RHR system has got sources of water that can make up however many million gallons of water you are going to need to do this and that the basement will accommodate the water as it comes back down, and so on?

MR. JONES: No, not from that aspect.

MR. MICHELSON: Well, you've got to look at all aspects, of course. In other words, you are looking and until you are satisfied, the FDA will not be issued. Is that safe to say? This is clearly an issue that is last minute, admittedly, but it's certainly something that we can't ignore since we have not taken an irrevocable action yet.

MR. JONES: I need to say one thing. The dose aspects have not been addressed for the ABWR as far as access to operate the system.

MR. MICHELSON: I wasn't so much concerned about that. I was concerned, of course, about the reactor water cleanup line break and what view you are going to take of it, if any. We have discussed long and hard about what problems it is introducing. In fact, we see from design what problems it has introduced. The question is, was that design adequate to cover this issue as well? I think that's how you have got to look at it. The design was changed to accommodate the issue, and the question is, does that also encompass whatever concern we might have on the fuel pool? If it does, then the problem goes away. If it doesn't, then you do something.

MR. VIRGILIO: Carl, we would have to go back and look. I can't say what changes were made.

MR. MICHELSON: I would be a little more comfortable if you made real sure real quick that it's okay.

MR. VIRGILIO: The design basis for the ABWR, as Steve has said, is much different than the design basis that we used for Susquehanna.

MR. MICHELSON: It's in much better shape as long as the fuel pool boiling does not get back into jeopardizing operations, and that includes worrying about all the water that is going to have to be made up, that has got to come down, and how you make it up, how you take care of it as it comes into the building, and so forth. It simply wasn't looked at, to my knowledge, in our recent review. Clearly it is something that we would be remiss not to look at now that we are aware of it.

MR. VIRGILIO: We'll take your comments.

MR. PREVATTE: Mr. Chairman, may I make one other comment, please?

MR. KRESS: Certainly.

MR. PREVATTE: Just a comment on the point that was just raised about RHR. It is true that the RHR system is a safety-related system. However, the fuel pool cooling mode of RHR is not a safety-related mode.

MR. CARROLL: The issue had to do with the advanced boiling water reactor, which is quite a different design.

MR. PREVATTE: I'm sorry. I misunderstood.

MR. MICHELSON: But even there, of course, there is going to be an interface where the safety-related part of the system ends. If there are valves downstream or other devices that require adequate control, you had better be sure at least those are qualified for this environment. In other words, you have got to go back and rethink the issue. It's not obvious that the answer is, oh, I've got plenty of RHR. That alone isn't quite an adequate answer. But I don't think it's a problem. It may require a couple more noodles to fix it.

MR. PREVATTE: Mr. Chairman, I would like to say I appreciate the opportunity to speak to the Committee this morning. Thank you very much.

MR. KRESS: You're welcome.

MR. KRESS: At this point, I think I'll declare a 15-minute recess, unless somebody has a burning question or comment they want to make.

MR. VIRGILIO: Are we going to come back and talk more about Susquehanna, or are we going to go on to another subject?

MR. KRESS: We had intended to go on to another subject. Would you like to come back?

MR. CARROLL: I think we want to know where the staff is going and at what point we should interact again, if any.

MR. KRESS: Would you like to do that before the recess?

MR. VIRGILIO: Yes, I would.

MR. KRESS: Let's continue then. We don't need a recess that badly.

MR. VIRGILIO: As I said in our opening comments, our evaluation isn't complete. Specifically, areas where we have got to go and finish our assessment is in the risk probabilisti ty assessment area, our concerns about post-LOCA accessibility for the operators to take some of the actions, and issues associated with the failure of the standby gas treatment system after some period of time.

The plant was licensed on a specific licensing basis, and that was that a seismic event leads to a fuel boiling and this must be within the capability of the standby gas treatment system to handle, and that the capability for make-up from emergency service water must be available during design basis events. We consider a LOCA a design basis event.

Notwithstanding the licensing basis for this facility, we are going back and we are doing both deterministic and probabilistic safety assessment analyses of the concerns that were raised by the Part 21 report, and concerns that we have tumbled to ourselves as a result of this assessment.

I have to remind you that we have got the backfit process and you've got to make a case, either quantitatively or qualitatively, that a change is necessary in order to support a backfit on the plant.

Steve Jones talked about some of the lessons learned that we have seen out of this that may have generic applicability. We've all talked about some of the changes the licensee has made as a result of their own assessment of this, such as cross connecting the spent fuel pools to ensure safety and changes to procedures and changes to guidelines; additional instrumentation. These are all changes that are currently being made by the licensee and now being considered by the staff and may be the subject of an information or may be the subject of some more forceful imposition by the staff when our evaluation is complete.

Again, we have to recognize there is a licensing basis for the facility and we have to show some adequate protection issue or some increase in safety that is justified in order to pursue and address each one of the concerns that have been raised. Many of them are far outside of the licensing basis for the facility. Like I said, we haven't ignored them; we've poured a lot of staff resources into characterizing them.

We've heard a lot of good things come out of the ACRS today in terms of suggested areas the staff should consider. I think some of the systems interaction issues that were raised were really good questions that I want to go back and make sure that we consider in our safety evaluation. As I said earlier, we are scheduled to complete that within the next few weeks.

MR. CATTON: I got the feeling that you weren't really going to take a hard look at the environmental conditions. It seems to me that you have the tools to do that, codes like CONTAIN, or whatever. A lot of the issues that are raised have to do with the environment at some given time.

MR. VIRGILIO: I think some of the better comments that we have taken back involve the environmental conditions.

MR. CATTON: It would really be helpful to me if I knew temperature, humidity and the radiation level as a function of time, which means you would sort of have to track the accident from the beginning. But these are not difficult calculations to do.

MR. VIRGILIO: We are certainly looking at the radiation levels as a function of time in order to assess whether the operators can get in and take actions.

MR. CATTON: Then you need temperature and humidity as well if you are going to evaluate.

MR. MICHELSON: You need to know how much water you've got in the air, which is more than just the humidity. That's supersaturated over the pool; it's a fog.

MR. CATTON: They should do the calculations, Carl

MR. MICHELSON: Oh yes, definitely.

MR. CATTON: If you haven't done the calculations, it is all speculation. And it's not difficult.

MR. VIRGILIO: I think our risk assessment would not be complete unless we considered some of the things that you have brought out. Exactly how we are going to address them isn't clear.

MR. CARROLL: If you can make the case that pool boiling just isn't going to happen, it's just such a low probability, then the need for doing what you are suggesting goes away.

MR. CATTON: But what do you do about the regulations? If we don't give a damn about the regulations, that's one thing.

MR. VIRGILIO: The plant has a specific licensing basis, and some of the regulations that Mr. Prevatte cited and some of the reg. guides that he cited are not appropriate for a realistic assessment of determining whether a backfit is warranted. There are regulatory requirements that the plant was required to meet, and they do meet them. There are regulatory requirements and reg. guides and standards that were promulgated either before or after that are not part of the licensing basis that we don't use when we do our backfit assessment. We use realistic assessments; we use realistic assumptions.

MR. CATTON: I understand, but somehow I don't understand how the boiling fuel pool got out from under the LOCA.

MR. MICHELSON: It has been talked about since 1965.

MR. CATTON: Then why isn't it part of their licensing basis? I don't understand.

MR. MICHELSON: It's a phenomenon that people worried about a long time ago and have been worried about ever since.

MR. CATTON: So why isn't it a part of this process?

MR. CARROLL: What Carl is saying is that it was looked at in connection with a seismic event.

MR. MICHELSON: Not necessarily.

MR. CARROLL: Or some event.

MR. MICHELSON: Some event that caused the pool to lose its cooling capability.

MR. CARROLL: But not in conjunction with a LOCA.

MR. MICHELSON: That's right. Not as sophisticated as this event that has been put together here. This is a much more exotic situation.

MR. CARROLL: It is kind of funny. I was thinking back on it the other day when I was reading this stuff. We have gone full circle about five times on whether or not you need a safety-related spent fuel pool cooling system or whether it's adequate just to have a safety-related make-up system. I can see that is still going on.

MR. MICHELSON: It looks like a little more than make-up might be in order.

MR. CATTON: If the pool boils as a result of the LOCA, it seems to me it is part of the design basis accident, and what I wonder is how the hell it got excluded.

MR. MICHELSON: I don't think you really can.

MR. CATTON: I don't either. It is part of this thing called the DBA.

MR. CARROLL: I think the question we have is, do we want to look at this again when the staff has completed its SER?

MR. CATTON: I think the answer is, you bet.

MR. MICHELSON: I'd like to see. I'd like also to make sure that they check it out before ABWR gets out the door, because that is a backfit if you let it go out the door.

MR. CATTON: And we had better pay attention for SBWR.

MR. MICHELSON: Yes. Do you have the same problem on 80+ at all?

MR. CARROLL: No, because it's a separate fuel building.

MR. KRESS: I declare a recess for 15 minutes.

[Whereupon at 11:00 a.m. the recorded portion of the meeting was concluded.]

REPORTER'S CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission
in the matter of:

NAME OF PROCEEDING: 409th ACRS Meeting

DOCKET NUMBER:

PLACE OF PROCEEDING: Bethesda, MD

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Michael Paulus

Official Reporter
Ann Riley & Associates, Ltd.

RESPONSES OF DAVID A. LOCHBAUM AND DONALD C. PREVATTE TO THE ANTICIPATED NRC PRESENTATION TO THE ACRS ON FRIDAY, MAY 6, 1994

NRC Position Re. the Plant Licensing Basis - The concerns are not within the plant's licensing basis since they were not specifically identified in the Final Safety Analysis Report (FSAR)(the licensee's description of how the plant is safe) or the Safety evaluation Report (SER)(the NRC's response to the FSAR).

Our Response - This position is incorrect and unacceptable for the following three reasons:

1. Per the NRC's own official definition, the licensing basis consists of more than just the FSAR and the SER. NRR document NUREG-1412, "Foundation for the Adequacy of the Licensing Basis", Section 1.3.2, states, "The current licensing basis (CLB) is the set of NRC requirements applicable to a specific plant and a licensee's written commitments for assuring compliance with and operation within applicable NRC requirements and the plant-specific design basis (including all modifications and additions to such commitments over the life of the license) that are docketed and in effect [*at the time the license was granted*]. The CLB includes the NRC regulations contained in 10 CFR Parts 2, 19, 20, 21, 30, 40, 50, 51, 54, 55, 70, 72, 73, 100, and appendices thereto; license conditions, exemptions; and technical specifications. It also includes...the FSAR...and...licensee responses to NRC bulletins, generic letters, and enforcement actions, as well as licensee commitments documented in NRC safety evaluations, or as described in licensee event reports." In other words, the licensing basis includes not just what the licensee said in the FSAR and the NRC said in the SER, but also all of the regulatory documents which were applicable at the time the license was granted. Our concerns are completely within the regulations which were in effect at the time the license was granted and therefore completely within this licensing basis.

   The primary regulation not being followed, which was in effect at the time this plant was licensed, among others which are not being followed, is 10CFR50, Appendix A, Criterion 61, "Fuel storage and handling and radioactivity control". This regulation states, "The fuel storage... systems...shall be designed to assure adequate safety under normal *and postulated accident conditions*. These systems shall be designed...to prevent significant reduction in fuel storage coolant inventory *under accident conditions*."

2. And even if our concerns were not within the licensing basis, 10CFR50.100, "Revocation, suspension, modification of

licenses and construction permits for cause" states, "A license...may be...modified...because of conditions...which would warrant the Commission to refuse to grant a license on an original application...or for failure to observe any...regulations." NRR has stated that had they known about these concerns at the time of licensing, they would not have granted the license. Well, this federal regulation says it's still not too late for them to do their jobs.

3. And even if none of the above legal reasons were applicable, which they are, NRR's position defies common sense. They're saying, in effect, the licensee didn't catch the problem and neither did we, so it's not something we must consider now as being applicable. In other words, two wrongs make a right. I'm sorry, but that logic doesn't hold with us or the American Public whom the NRC is charged to protect.

NRC Position Re. Risk of the Accident of Concern - The risk of this accident is very low because the probability of its occurrence is very low. The probability is very low because it requires concurrent low probability events.

Our Response - This position is incorrect and unacceptable for the following five reasons:

1. The condition of concern <u>does not</u> require concurrent events; it requires only a LOCA, which has <u>always</u> been considered to have credible probability. For this event, by design, the fuel pool cooling system shuts down on load shed. No failure is necessary; it's designed that way.

2. The licensing basis does, in fact, require that certain concurrent events be assumed in spite of their low probability, and these also would or could cause the loss of fuel pool cooling simply because it's not designed for them.

3. The fuel pool cooling system is not designed to operate in the LOCA environment. Therefore, it must be assumed to fail.

4. The NRC is only looking at one of the fundamental elements of risk assessment, *probability*. The other element which they appear to be ignoring is *consequences*. Risk is the product of these two elements, and for failure to maintain cooling of the spent fuel pool, the consequences are catastrophic. Per the NRC's own estimates contained in NUREG-1353, if fuel pool cooling is lost and the water is boiled off, it can result in not just a failure of the spent fuel, but in the fuel elements actually catching fire. This document states that the "best estimate of the consequences of a spent fuel pool accident which results in spent fuel damage to approximately one-third of an equivalent reactor core is $8x10^6$ person-rem." That's eight million person-rem,

and that's the consequences of only one-third of a core failing; there are many times more fuel than this in a loaded fuel pool. Putting this somewhat into perspective, the maximum allowable offsite LOCA exposure to a member of the public per 10CFR100 is 25 REM whole body and 300 REM to the thyroid.

The NUREG goes on to state that "The health risks are dominated by the risk of latent cancer fatalities..." It also states that the "...best estimate offsite property damage cost is $4,000 million (1988 $s)...and the onsite costs for a SFP accident is $1,180 million (1988 $s)." That's 5.2 billion in 1988 $s.

Additionally, if the fuel pool boils, it creates an environment in the reactor building significantly more harsh than the environment for which the safety-related equipment is designed. If this equipment fails, the reactor core will melt down, and the primary and secondary containment will fail, creating substantially worse consequences even than were identified in the NUREG.

It's not difficult to see that the consequences of the accident in question are much, much worse than what the regulations state are acceptable and therefore the risk is much higher.

5. An *independent* study by a reputable consulting firm ~~[illegible]~~ concluded that the risk from this accident is several orders of magnitude higher than for a LOCA.

NRC Position Re. Operator Access to the Reactor Building Post-LOCA - The radiation and other conditions in the reactor building post-LOCA will be acceptable for operator entry to restart the fuel pool cooling system, to open and close the manual emergency service water valves, to line up the RHR system in the fuel pool cooling assist mode, and all the other manual actions required in the reactor building to reestablish and monitor fuel pool cooling because (1) Regulatory Guide 1.3 and NUREG 0737 requirements for source term consideration are not "realistic" and also are not applicable for operator access, and (2) airborne contamination from containment leakage does not have to be considered.

Our Response - This position is incorrect and unacceptable for the following ~~three~~ four reasons:

1. NUREG 0737, Section II.B.2 specifically requires that, *as a minimum*, the source terms of Reg. Guide 1.3 be used in determining the radiation exposure to operators in "Any areas which will or may require occupancy to permit an operator to aid in the mitigation of or recovery from an accident..."

2. Reg. Guide 1.3 specifically requires that "The primary containment should be assumed to leak at the leak rate incorporated in the technical specifications for the duration of the accident." This leakage will, in fact, create an airborne radiation source. Such leakage, plus the contained sources in piping systems, would generate radiation levels on the order of *thousands of REM per hour*. A 100% lethal dose is approximately 500 REM. Per NUREG 0737, the limit on operator exposure is *5 REM* whole body.

3. In addition to the extremely high radiation, the operators would be required to perform in temperatures as high as 180°F, 100% humidity, and darkness, all in several layers of anti-Cs and with an airpack for breathing. To enter the reactor building under these conditions would be virtual suicide.

4. The only significant commercial reactor accident in this country to-date was Three Mile Island. The fuel damage and source term in that accident were substantially greater than what is required by Reg. Guide 1.3. In view of that experience, is it "realistic" to assume a source term less than what Reg. Guide 1.3 requires?

NRC Position Re. Use of the RHR System for Fuel Pool Cooling - If the fuel pool cooling system is not available, the RHR system can provide the required cooling in the fuel pool cooling mode.

Our Response - This position is incorrect and unacceptable for the following five reasons:

1. To use the RHR system in this mode also requires operator entry into the reactor building for alignment of manual valves, which, per the discussion above, is virtual suicide.

2. The system has never been demonstrated operable in this mode. In fact, the licensee's own analyses show that *it cannot provide the required flow under accident conditions* due to insufficient NPSH. This was confirmed during the startup of the plant when this mode of operation was attempted during testing under conditions much less severe than accident conditions. *It failed the test* due to loss of pump suction.

3. When operating in this mode, the RHR system, which is required for accident mitigation, is no longer single failure proof as required by regulation.

4. The ultimate heat sink, the spray pond, is not designed for this very significant additional heat load on top of the accident heat load.

5. To operate the system in this mode would send extremely

5. To operate the system in this mode would send extremely radioactive accident water from the reactor to the fuel pool, thereby greatly increasing the offsite and control room operator exposure, as well as further increasing the reactor building radiation levels, thereby further restricting access and invalidating the qualifications of safety-related equipment in the reactor building with regard to radiation exposure.

NRR STAFF PRESENTATION TO THE ACRS

LOSS OF SPENT FUEL POOL COOLING

May 6, 1994

Martin Virgilio
Director (Acting)
Division of Systems Safety and Analysis
504-2884

Steven Jones
Reactor Systems Engineer
Plant Systems Branch/Division of Systems Safety and Analysis
504-2833

LOSS OF SPENT FUEL POOL COOLING - HISTORY

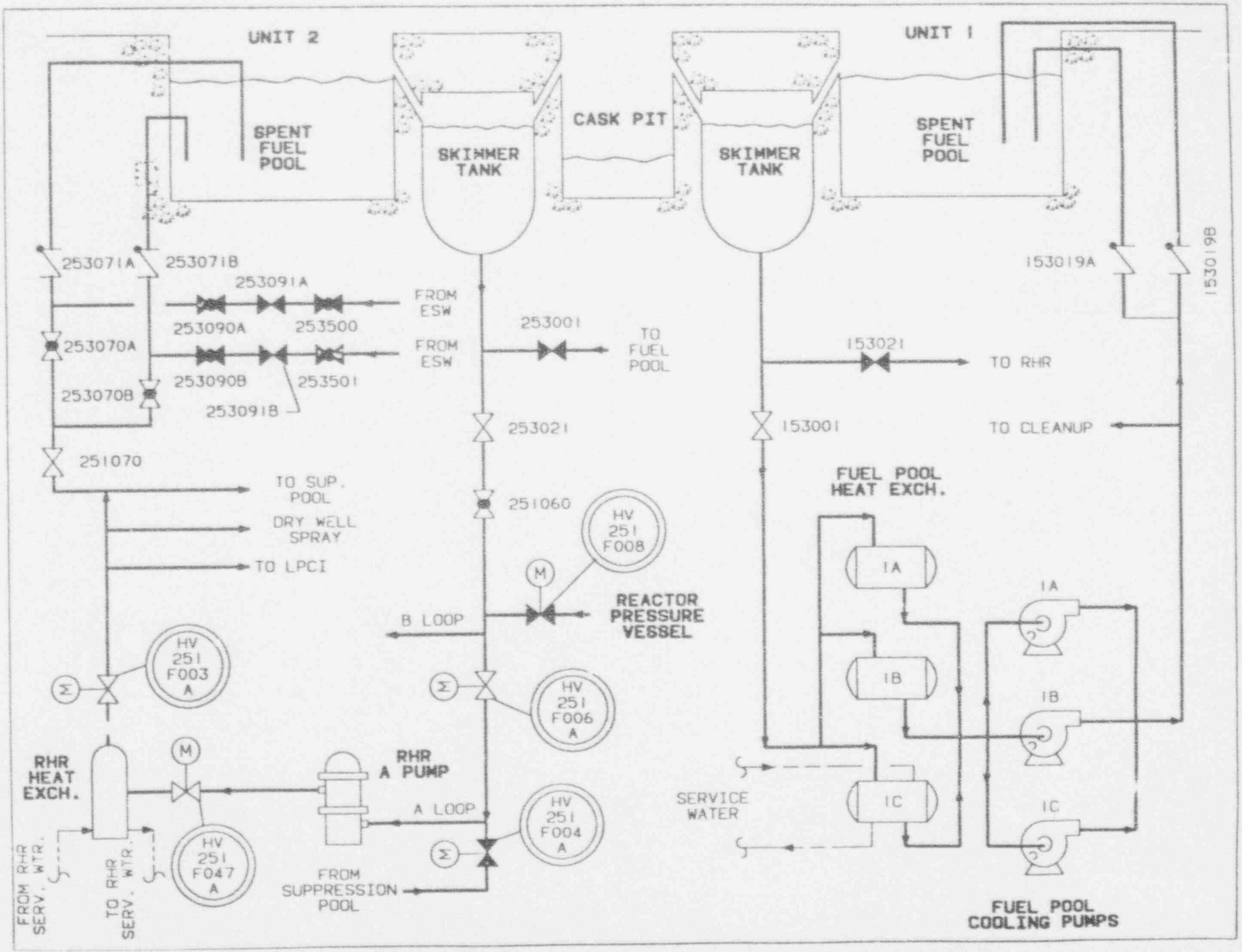
- Agency Approach: Non-Mechanistic/Stylized
  - Design Basis LOCA for ECCS Design
  - TID Source Term for Containment Design
  - Different Considerations for Spent Fuel Pool
- Prevatte & Lochbaum: 10 CFR Part 21 Report
  - Postulates that LOCA or LOCA/LOOP leads to pool boiling
  - Postulates pool boiling leads to severe consequences
- NRC View: Low Safety Significance
  - Probability of LOCA
  - Probability of Severe Source Term
  - Probability of Extended LOOP
- NRC Developed Task Action Plan

LOSS OF SPENT FUEL POOL COOLING- HISTORY

- Licensee Conclusions
  - Part 21 Scenario Beyond Licensing Basis
  - Adequate Capability to Cool Spent Fuel Pool
- BWROG Conclusions
  - Part 21 Scenario Beyond Typical BWR Licensing Basis
  - Recommend Owners Review Actions for Backup Cooling & Make-up
- Interactions Continuing With Prevatte & Lochbaum
- Congressional Staff Briefings Conducted
- Prevatte and Lochbaum Letter to State Officials, Media and Congress
- 2.206 Petition

PLANNED ACTIONS

- Public Meeting With Lochbaum and Prevatte
- Issue Completed Evaluation
- Conduct Prioritized Review of Other Plants
- Issue Information Notice or Other Generic Communication as Appropriate
- Respond to 2.206 Petition



UNIT 2
UNIT 1
SPENT FUEL POOL
SKIMMER TANK
CASK PIT
SKIMMER TANK
SPENT FUEL POOL
253071A
253071B
253091A
FROM ESW
253090A
253500
253070A
FROM ESW
253090B
253501
253070B
253091B
253001
TO FUEL POOL
253021
251070
251060
TO SUP. POOL
DRY WELL SPRAY
TO LPCI
HV 251 F008
M
REACTOR PRESSURE VESSEL
B LOOP
HV 251 F003 A
HV 251 F006 A
RHR HEAT EXCH.
RHR A PUMP
A LOOP
HV 251 F004 A
HV 251 F047 A
FROM SUPPRESSION POOL
FROM RHR SERV. WTR.
TO RHR SERV. WTR.
153019A
153019B
153021
TO RHR
153001
TO CLEANUP
FUEL POOL HEAT EXCH.
1A
1B
1C
SERVICE WATER
FUEL POOL COOLING PUMPS

PART 21 REPORT MAJOR POSTULATED EVENTS

- Loss of Normal Spent Fuel Pool Cooling System as a Consequence of a LOCA or a LOCA/LOOP

- Backup Cooling of Spent Fuel Pool Unavailable

- Effects of Boiling Spent Fuel Pool Cause Failure of Safety Systems

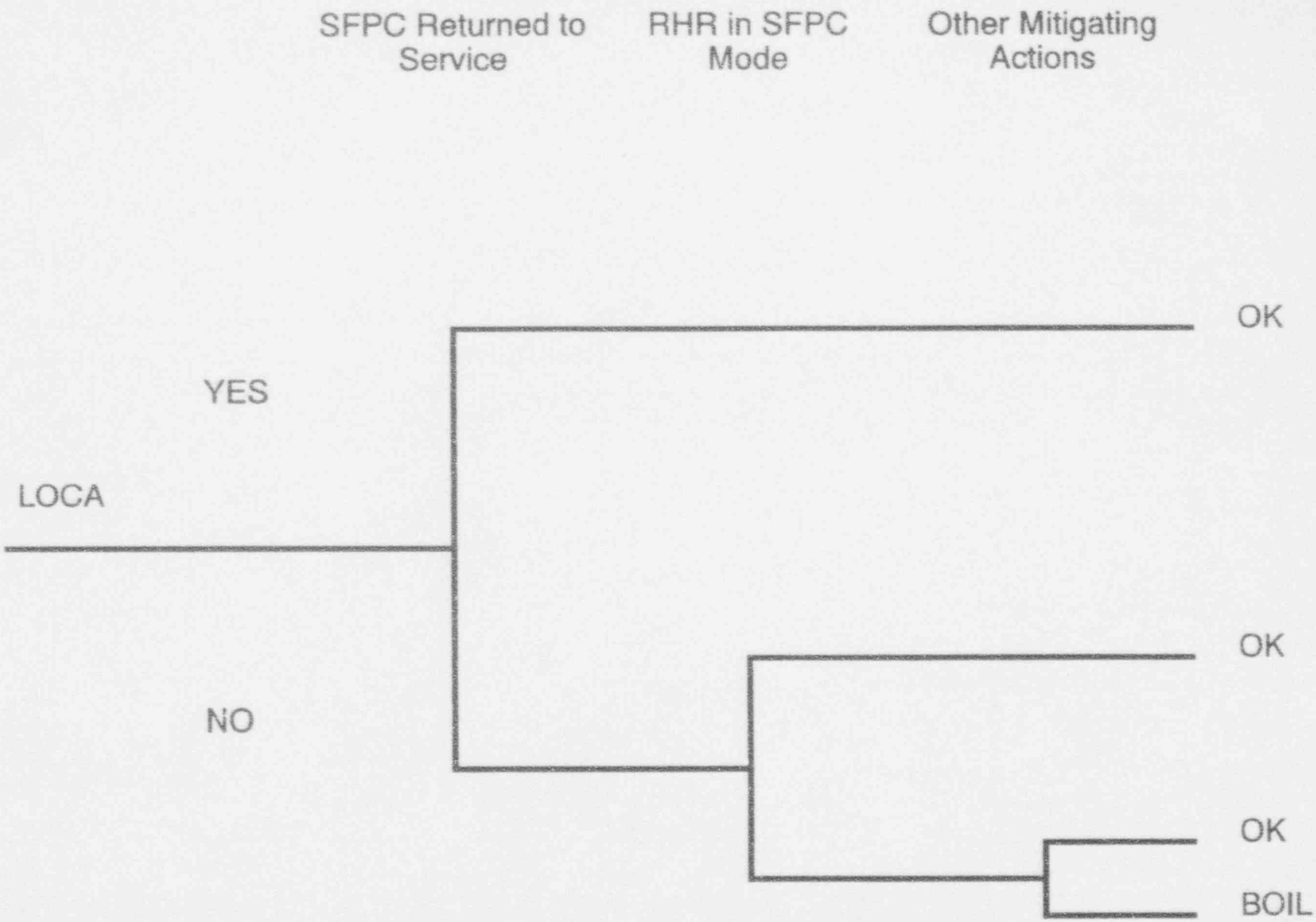
- Unacceptable Consequences Result from Safety System Failures

DETERMINISTIC ANALYSES OF POSTULATED EVENTS

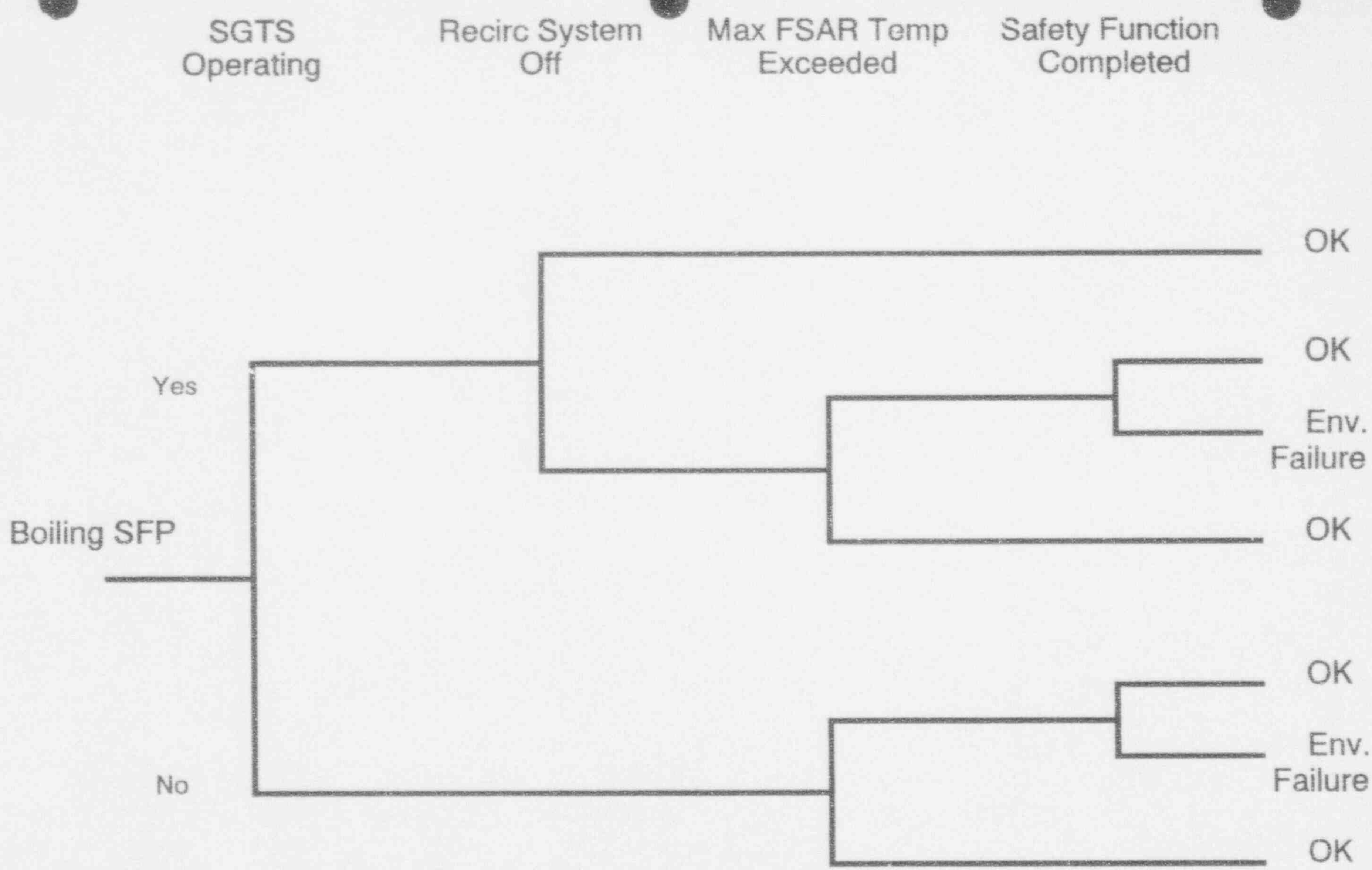
- Loss of Normal Spent Fuel Pool Cooling System
  - LOCA Induced Loads Unlikely to Cause Piping Failure

- Availability of Alternate Cooling and Make-Up
  - Design of Systems Adequate for Alternate Cooling of and Make-Up to Spent Fuel Pool Under All Conditions
  - Assessment of Radiological Access Continuing

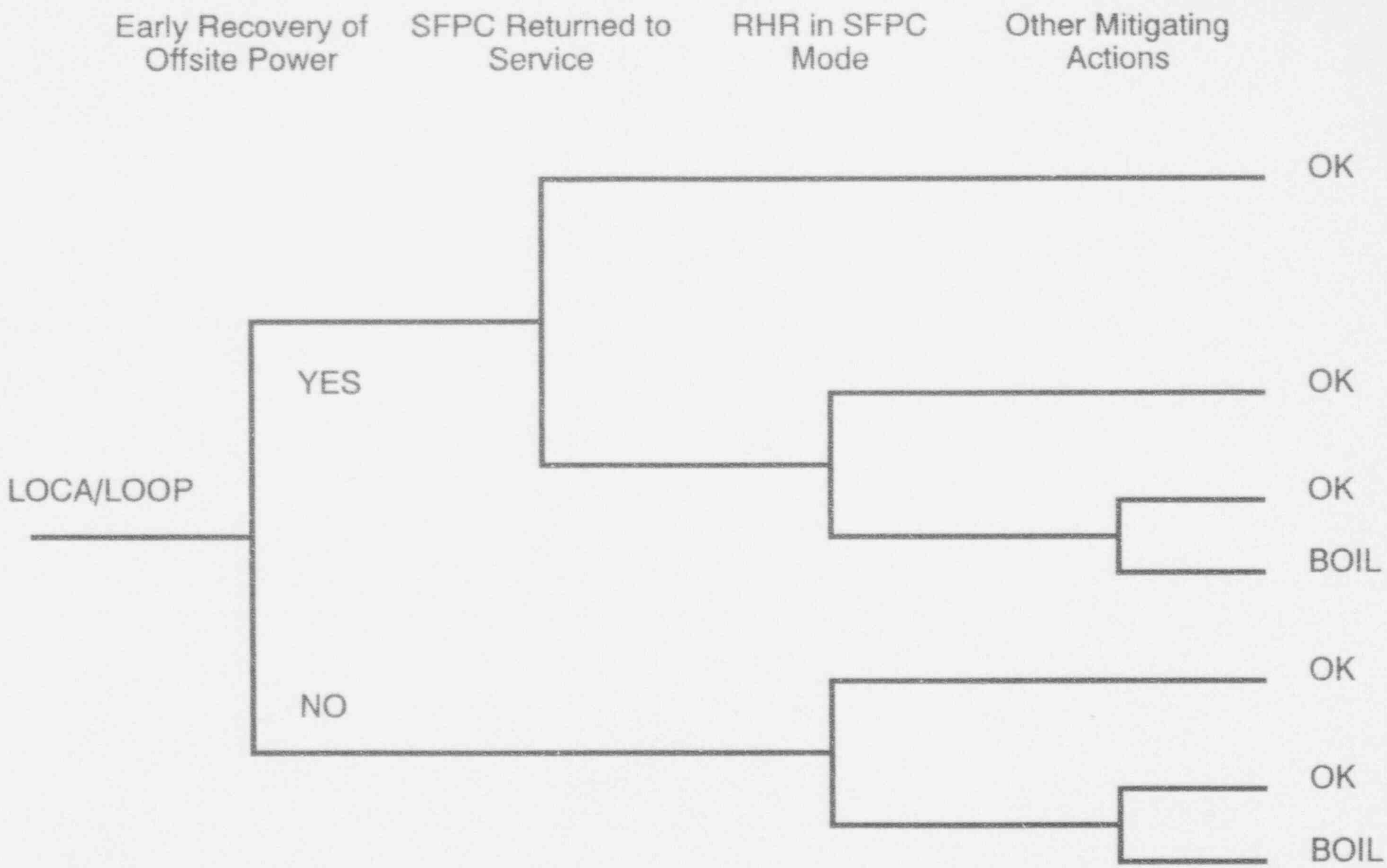
- Effects of Boiling Pool on Safety Systems
  - Effects of Flooding by Condensate Acceptable
  - Adequate Isolation of Reactor Building Environment from Pool
  - Standby Gas Treatment System May be Overloaded by Condensate within 24 Hours after Onset of Boiling



SIMPLIFIED LOCA EVENT TREE



Simplified Event Tree for Environmental Failures



SIMPLIFIED LOCA/LOOP EVENT TREE

RISK ASSESSMENT ADDRESSING PART 21 SCENARIO

- Near Boiling Frequency of $1x10^{-6}$/yr

  - Models:

    LOCA and LOCA/LOOP Initiators Separately
    Load Shed of Normal SFP Cooling System
    Mitigating and Recovery Actions

- Core Damage Frequency of $1x10^{-8}$/yr

  - Model:

    Uses Frequency of LOCA with Boiling SFP as Initiating Event Frequency
    Uses Susquehanna Individual Plant Examination LOCA Event Tree
    Includes Environmental Failure of Risk Significant Systems

OVERALL RISK ASSESSMENT

- General Approach
  - Estimate Frequency of Spent Fuel Pool Boiling Events
  - Estimate Frequency of Associated Core Damage Events
  - Support with Deterministic Analyses where Appropriate

- Results:
  - Near Boiling Frequency About 2×10^{-4}/yr
  - CDF Best Estimate About 1×10^{-6}/yr
  - LOCA Initiated Boiling Event Contribution < 1%

LESSONS LEARNED

- Susquehanna Specific
  - Cross Connect Fuel Pools: Decreases Risk Significance
  - Procedures and Guidance
    - Emergency Organization Guidance
    - Procedure to Isolate Boiling Pool
    - Procedures For Alternate Cooling
  - Analyses
    - Environmental Effects of Boiling Pool
- Evaluating Above for Potential Generic Applicability
- Single Unit Sites

LICENSING BASIS

- Plant Meets Licensing Basis for Cooling Systems

- Staff Questions Regarding Pool Makeup and Seismic Events

- Licensing Review Followed Applicable Regulatory Guides Rather Than The Standard Review Plan Cited in The Safety Evaluation Report