PRESIDENT'S COMMISSION ON THE
ACCIDENT AT THREE MILE ISLAND

Third Meeting
May 31, 1979
Afternoon Session

New Executive Office Building
Room 2000
Washington, D.C.

Attendees

Commissioners

John G. Kemeny, Chairman
Bruce Babbitt
Patrick E. Haggerty
Carolyn Lewis
Cora B. Marrett
Lloyd McBride
Harry McPherson
Russell Peterson
Thomas Pigford
Theodore Taylor
Anne Trunk
John Fabrikant
Barbara Jorgenson
Bruce Lundin
Ronald B. Natalie

Appearances Before the Commission

James S. Floyd, Supervisor of Operations, TMI-II, Met Ed
Boyce Grier, Nuclear Regulatory Commission (NRC), Region I, Philadelphia
John Davis, Acting Director, Office of Inspection and Enforcement, NRC, Bethesda
Charles Gallina, Region I, Office of Inspection and Enforcement, NRC, King of Prussia
Harold Denton, Director, Office of Nuclear Reactor Regulation, NRC

[illegible] REPORTERS
Box 600, College Park, Md. 20740
(202) [illegible]

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P R O C E E D I N G S

CHAIRMAN KEMENY: Will the meeting please come to order. Will Chief Counsel call the next witness, please.

MR. NATALIE: Mr. Floyd, would you come forward and be sworn, please.

WHEREUPON

JAMES S. FLOYD

was duly sworn in and

testified as follows:

CHAIRMAN KEMENY: Mr. Floyd, I understand you're Supervisor of Operations at TMI-II. We understand you were not at TMI-II at the time of the accident. Perhaps you might just tell us where you were at the time.

MR. FLOYD: I was in Lynchburg, Virginia at the simulator for my annual training, or retraining.

CHAIRMAN KEMENY: Thank you. How did you first hear about the accident?

MR. FLOYD: About seven o'clock in the morning of the twenty-eighth I went down to the restaurant in the motel for breakfast with the rest of the crew that was down there training with me. One of the gentlemen had been in contact with a person on the site who claimed that the main steam safety valves on Unit 2 had been open for two hours. We sort of scurried through breakfast and ran over to the B&W office building and got on the phone, 7:30 in the morning. I was fortunate. I got a line in to the Unit 2 Control

Room. And I found out it wasn't the main steam safety valves. In fact it was the atmospheric dump valves which had been open, but they come up about the same location in the plant and they make similar noise with large volumes of high pressure steam escaping.

CHAIRMAN KEMENY: And I understand you ran a number of simulation attempts while you were at Lynchburg.

MR. FLOYD: I managed to get just a few pieces of information from the Control Room: the fact that both feed pumps had trippe which in turn caused the turbine trip and the reactor trip, of course; that emergency feedwater flow was delayed for about 10 minutes was the way I received it; and that the radiation monitors were off scale in many cases.

As I recall, I got a quantified number on the reactor building dome monitor in the area of 80 or 90 thousand R per hour on the meter face, and I also got a number off of the gas sample coming out of the reactor building atmosphere. And I don't recall what that number was, but I wrote it down when I got it.

And with these few pieces of information, I went into the simulator to try to reproduce what had happened to the plant because it seemed awfully strange to me.

During those simulation runs, by delaying the emergency feed for 10 minutes and then bringing it on again, I was not able to pull the plant pressure down as low as a

thousand or 12 hundred pounds, which is the number I heard was present at the site.

About nine-ish, nine A.M., several familiar faces from days past appeared in the hallway outside the simulator. It was, I don't know, maybe 10 or 15 of the B&W people who I've dealt with over the years, and they wanted to know what I knew about Three Mile Island Unit 2. So I sat them down in their classroom and proceeded to tell them the few facts that I got from the plant, what I could infer logically from those facts, and then what I might on top of that speculate could have happened.

At that time I did not know that the electromatic relief was stuck open.

After I talked to those gentlemen, it must have been about 9:30, I got back on the phone to the plant. I got into the plant. I think the plant was in respirators at that time. It was very difficult trying to communicate with the Control Room. And I did get the piece of information that the electromatic relief valve was thought to have leaked severely post transient. So I introduced that variable into the simulation also.

None of these simulation runs which were being done in real time did I let go out past 15 or 20 minutes. Once I threw the emergency feedwater in, whether it was full flow or partial flow, varying one parameter at a time, the plant would

come down to a pressure and stabilize, but frequently it was above the high pressure injection set plane. And I knew that they had had a high pressure injection. So I was fairly unsuccessful in any of the simulations that I tried. They did not represent what was going on at the plant.

CHAIRMAN KEMENY: Yes. Let me ask you just a couple of questions about the simulator. I gather from earlier statements you've given to our staff you're quite expert at that simulator, I believe. Is that not true?

MR. FLOYD: That may be my own pomposity. I didn't mean to imply that.

CHAIRMAN KEMENY: That's all right. We'll take your word for it. The questions, the two kinds of questions: you said you were running the simulations in real time. Is it possible to run them in speeded up time, or are they, in other words, what I'm trying to poke for, is that simulator designed only for operator training, in which case you need it in real time, or can it be run somehow--

MR. FLOYD: I think they have a fast time on it, but it's not a feature which I have used.

CHAIRMAN KEMENY: It's not a feature you have used before. Do you with the knowledge you now have of the accident--I'm not asking what you had then--was the simulator then as it existed capable of simulating the accident?

MR. FLOYD: I do believe it was. I believe I

was outside the simulation at what I was trying to do.

CHAIRMAN KEMENY: Yes. So the simulator was not designed to simulate the kind of thing that actually happened on that day.

MR. FLOYD: I could not make it reproduce it.

CHAIRMAN KEMENY: Okay. Professor Pigf--sorry, Mr. Lundin, did you wish to--

MR. LUNDIN: One question on a similar--you were trying to reproduce, Mr. Floyd, the events of the first 10 or 15 minutes of the accident.

MR. FLOYD: Yes, sir.

MR. LUNDIN: Were you inputting into the simulator the pressure and temperature conditions in the primary loop?

MR. FLOYD: No, sir. I was starting with the plant at 98 per cent power and trying to force it to come down to those temperature and pressures conditions.

MR. LUNDIN: Were you simulating the effects of an open relief valve?

MR. FLOYD: After 9:30 in the morning I was.

MR. LUNDIN: And at that time did the simulator indicate saturate conditions in the primary loop?

MR. FLOYD: No, sir. We always maintained a hot pressurizer. It was as though the--I opened the valve and the pressurizer had an infinite supply of hot water available to it, or infinite heater capacity.

MR. LUNDIN: Speaking to the liquid or steam conditions in the primary loop rather than the pressurizer.

MR. FLOYD: I know, but as long as I've got the saturated conditions in the pressurizer, I can't flash in the loop.

MR. LUNDIN: The simulator does not make steam in the primary loop, is that it?

MR. FLOYD: It supplied steam to the pressurizer faster than I could take it out with the electromatic relief valve.

MR. LUNDIN: Thank you.

CHAIRMAN KEMENY: I see. You're saying that, to put it in less technical language, that this was a feature of real life that the simulator did not correctly reproduce. Is that correct?

MR. FLOYD: That's the way it appeared to me.

CHAIRMAN KEMENY: It appeared to you. Okay.

Professor Pigford.

COMMISSIONER PIGFORD: In the simulation, do you also simulate the possible occurrence of loss of off site power?

MR. FLOYD: Yes, sir, we can.

COMMISSIONER PIGFORD: Which corresponds to no operation of the reactor coolant pumps.

MR. FLOYD: Yes, sir.

COMMISSIONER PIGFORD: Have you simulated that occurring at the same time that you have a small pipe break?

MR. FLOYD: I don't believe I've ever seen that on the simulator.

COMMISSIONER PIGFORD: Does the simulator take you to the conditions of establishing natural circulation cooling?

MR. FLOYD: It can, yes.

COMMISSIONER PIGFORD: Is that an identified objective in your emergency action procedures that takes the plant to the situation of natural circulation cooling?

MR. FLOYD: I guess I must ask if you mean at the plant or at the simulator.

COMMISSIONER PIGFORD: I mean at the plant, at TMI-II.

MR. FLOYD: We have a procedure which puts us into natural circulation. It's a loss of off site power procedure. It's an emergency procedure.

COMMISSIONER PIGFORD: Now earlier you have such a procedure. Is that your main objective when you have an emergency on the reactor, is to take it to natural circulation cooling?

MR. FLOYD: No, sir, only on a loss of off site power.

COMMISSIONER PIGFORD: I see. Now in this particular accident, you didn't lose off site power, but I

guess you had the equivalent of it for a while when the pumps could not start. Is that correct?

MR. FLOYD: As far as the reactor coolant pumps were concerned, yes.

MR. PIGFORD: Yes. And would it be reasonable to expect then the operators to take as an objective then, they must go toward natural circulation cooling?

MR. FLOYD: Yes, sir.

COMMISSIONER PIGFORD: Do you know of any analyses that would indicate any difficulties of approaching that condition if you had a relief valve open?

MR. FLOYD: No, sir.

COMMISSIONER PIGFORD: And that's not, then, simulated on the B&W simulator?

MR. FLOYD: Not until March twenty-eighth, I don't think it had been.

COMMISSIONER PIGFORD: Has that been simulated since then?

MR. FLOYD: Since then they have changed the program in the machine. They have published a training tape which we have purchased a copy of that replays the scenario that Unit 2 went through. And we are now showing that as part of our operator requalification program.

COMMISSIONER PIGFORD: Then does that simulator now indicate that it would be possible to go to natural circulation

cooling under those conditions, namely, a small break, and the coolant pumps not operating?

MR. FLOYD: What they did simulate was what we went through and I think they've also simulated that if the high pressure injection pumps were left on, you didn't need emergency feedwater. Now that's not the question you asked me, sir.

COMMISSIONER PIGFORD: Doesn't sound like it.

MR. FLOYD: I don't know what they've done with your question, if they've done anything with your question.

CHAIRMAN KEMENY: Let's see, could you repeat that, Mr. Floyd? Did you say that what the simulation shows is that if the high pressure injection is kept on, that you then do not need the emergency feedwater?

MR. FLOYD: I believe that to be true, sir.

CHAIRMAN KEMENY: Therefore may one infer from that, if that simulation is accurate, that even though those two famous valves were apparently closed on the emergency feedwater, that if high power injection had been continued, the system would have come down smoothly?

MR. FLOYD: That would seem to be a fair inference.

CHAIRMAN KEMENY: Thank you.

COMMISSIONER PIGFORD: How much difference would it have made, how much longer would it have taken, or how much greater transient, as opposed to, say, Case A, when you have

lost the emergency feedwater, or Case B, when you have it available?

MR. FLOYD: I don't understand the beginning of your question. I got lost somewhere.

COMMISSIONER PIGFORD: I'm trying to get you to tell me what how big is the consequence on this transient of not having had the emergency feedwater available, as opposed to the case where it would be available?

MR. FLOYD: Purely speculation on my part, sir. I can't address i- with anything but speculation, because I'm guessing. I haven't run the transients myself on the simulator. I've just seen the training tape which has been published by B&W. So I can say that during the first--if you put the emergency feed on after eight minutes, as happened in this transient, that from then on, of course, there is no concern. Your only real concern of not having the emergency feed would be those first eight minutes, when the high pressure injection flow may not be supplying sufficient inventory to remove your decay heat. But within eight minutes it certainly, the deficit will not be large enough to uncover the core.

COMMISSIONER PIGFORD: You haven't actually seen any numerical results from the simulator relating to my question?

MR. FLOYD: No, sir.

COMMISSIONER PIGFORD: To your knowledge, though,

if the emergency feedwater had been available, would it then have been possible to go into natural circulation cooling?

MR. FLOYD: I do not know.

COMMISSIONER PIGFORD: To your knowledge, was natural circulation cooling ever established during this accident?

MR. FLOYD: Well, there's a mechanism for flow through the reactor coolant loops when the pumps are off and the loops are steamed down. And that steam will condense over in the steam generators. The cold water will run back eventually into the core. And there is in that case some natural circulation flow, although it is two-phase flow, in the sense that going up the hot leg it will first be liquid and then it will become steam and when it comes down into the steam generator, it will go back to liquid, it will probably go back to the core.

COMMISSIONER PIGFORD: That's separated flow.

MR. FLOYD: Separated flow would be a good terminology.

COMMISSIONER PIGFORD: You have a liquid level and then a separated gas.

MR. FLOYD: Yes, sir.

COMMISSIONER PIGFORD: And then the consequence of that is what?

MR. FLOYD: Well, that's what we saw. That's what we had.

COMMISSIONER PIGFORD: Can you establish natural circulation when that happens?

MR. FLOYD: Not in the true sense of natural circulation, in that natural circulation we normally think of as single phase flow.

COMMISSIONER PIGFORD: Can you cool the reactor adequately by natural ciruclation under that condition?

MR. FLOYD: No, sir.

COMMISSIONER PIGFORD: All right. And apparently that condition is what prevailed when they were trying to establish natural circulation?

MR. FLOYD: Yes, sir.

COMMISSIONER PIGFORD: Did the physical layout of the piping and the steam generators contribute to that problem?

MR. FLOYD: Yes, sir.

COMMMISSIONER PIGFORD: In what way?

MR. FLOYD: Well, if we'd have had a horizontal steam generator lying on its side at the same elevation as the reactor coolant nozzles, I guess you could hypothesize that only the upper portion of the system would have been steamed down and there still would have been liquid in the bottom half of the pipe. You might come up with some

configuration like that which would make it possible. But that's not a normal design in any reactor plant I've ever seen.

COMMISSIONER PIGFORD: With regard to the auxiliary building sump tank, I'm seeking to clear up some earlier line of questioning and I think you're probably familiar with this and perhaps can help us. Now evidently at the time of the accident, the rupture disc in the auxiliary building sump tank was blown.

MR. FLOYD: Yes, sir.

COMMISSIONER PIGFORD: Had already been blown previously.

MR. FLOYD: Yes, sir.

COMMISSIONER PIGFORD: Now at the time of the accident, to your knowledge, was the piping leading from the reactor containment sump connected through valves to that particular tank?

MR. FLOYD: I heard Mr. Zewe's testimony yesterday and I know the operator that he spoke to to check the valve lineup, and I must believe that valve operator also, that auxiliary operator, that the valves were lined up to the miscellaneous waste holdup tank.

COMMISSIONER PIGFORD: Is that a different tank than the one I'm speaking of?

MR. FLOYD: No.

COMMISSIONER PIGFORD: Because this calls it the auxiliary building sump tank--

MR. FLOYD: Okay, that is a separate tank, all right?

COMMISSIONER PIGFORD: Well, please answer the question on this tank, this auxiliary building sump tank.

MR. FLOYD: On the auxiliary building sump tank, I don't know that the rupture disc was blown, but, and I understand the valves were lined up to the miscellaneous waste holdup tank. Which question am I missing?

COMMISSIONER PIGFORD: Yes, well, let me start off and I'll give you my source. And I'm adopting what Mr. Miller said in his testimony specifically. It should be noted that the auxiliary building's sump tank had a blown rupture disc for a few weeks prior to this event. And that tank was oscillated from the vent header.

Now I asked Mr. Logan and he said, I think, yes, indeed it did have a blown rupture disc.

MR. FLOYD: Okay, then, to my mind, it was just confused here for a minute.

COMMISSIONER PIGFORD: All right. Now then, I'm asking you, to your knowledge, was that particular tank lined up through the valves to be connected with the sump line from the reactor containment building?

MR. FLOYD: It was not.

COMMISSIONER PIGFORD: It was not. Instead that line was connected to a different tank?

MR. FLOYD: I think it was connected to the miscellaneous waste holdup tank.

COMMISSIONER PIGFORD: Yes. Now what evidence do you have on this, to form that conclusion?

MR. FLOYD: Well, Mr. Zewe testified here yesterday, I think, that it was, and I know the operator he had to speak to to make that testimony. And I believe that man also.

COMMISSIONER PIGFORD: And there was some confusion as to whether--

CHAIRMAN KEMENY: Mr. Floyd, who is that operator?

MR. FLOYD: I'm drawing a mental blank.

CHAIRMAN KEMENY: That's all right. I'll pass over it.

COMMISSIONER PIGFORD: There's some confusion apparently as to some apparent lack of level change in the tank you're speaking of which made one wonder, did the water get to that tank instead? Can you explain that?

MR. FLOYD: No, sir, I cannot.

COMMISSIONER PIGFORD: Now is it--did any water containing radioactivity get into this auxiliary building sump tank during the accident, to your knowledge?

MR. FLOYD: I do not know.

COMMISSIONER PIGFORD: Yes. Are there--

MR. FLOYD: The plant records, however, will show samples on that tank, I believe, which will tell us the answer to that.

COMMISSIONER PIGFORD: Are there any procedures, written procedures, that say to the operators, or whatever, that you must not connect up to such a tank if it has a blown rupture disc?

MR. FLOYD: I do not believe so. We may have written a special operating procedure for this case which would then probably tell the man not to do that, but it would have been, no normal plant procedure would say that, but only a special operating procedure designed for this particular valve lineup that you're in would go into that detail.

COMMISSIONER PIGFORD: Since we're going to get later into some testimony from NRC concerning this, and this is back to the first earlier question, what is the effect of this candy cane arrangement of the piping upon this issue of natural circulation?

MR. FLOYD: Well, I guess in one sense it makes it possible and in another sense it makes it impossible. If the candy cane is full of liquid, hot liquid, and the steam generators are full of cold liquid--

COMMISSIONER PIGFORD: May I interrupt? Excuse me.

To be sure that I understand what the words mean, could you describe what the candy cane means? I just picked those words out of--

MR. FLOYD: It's the hot leg pipe that connects the reactor vessel to the steam generator, and the water leaving the core exit will go through the candy cane on the way to the steam generator. It's the large vertical run of pipe that carries the water to the top of the steam generator. It looks like an upside down candy cane.

COMMISSIONER PIGFORD: And would you now please complete your answer. What is its effect upon the establishment of natural circulation?

MR. FLOYD: Okay. In the event that the system is liquid full, or the piping is liquid full, then the difference in densities between the hot water in the candy cane and the cold water in the steam generator tubes makes natural circulation possible.

COMMISSIONER PIGFORD: Do you know whether or not that issue was addressed in what we have heard is called the Michaelson report, written concerning the B&W reactors?

MR. FLOYD: I have only scanned the Michaelson report. I believe that it is in the Michaelson report, but I cannot testify to that.

COMMISSIONER PIGFORD: Did you know about the Michaelson report prior to the accident?

MR. FLOYD: No, sir.

COMMISSIONER PIGFORD: When did you learn about it?

MR. FLOYD: Well, I heard about it right after the accident, and the next day or two. I didn't get around to even scanning it until some two or three weeks after the accident.

COMMISSIONER PIGFORD: Now, Mr. Floyd, we are very much interested in what were the main pathways for radionuclides to have gotten from the reactor, say, into the auxiliary building and finally to the atmosphere? Could you describe those for us, please?

MR. FLOYD: There are, I think, three paths from the reactor building to the auxiliary building through which radionuclides could have transported. Two of them come off of the reactor coolant drain tank, one off the liquid space, one off the gas space. The third is from the reactor building sump, which normally pumps to the auxiliary building.

COMMISSIONER PIGFORD: I'm sorry. Would you go back to the drain tank? Which drain tank is this? Is this the one the pressure relief valve drains into?

MR. FLOYD: Yes, sir. And it's normally connected to the gas header on the gas space, and we can pump the contents of that tank to the auxiliary building also, to tankage in the auxiliary building. So all three of those paths are in parallel, going from the reactor building to the

auxiliary building.

COMMISSIONER PIGFORD: I'm going to ask you to repeat them once more. What three paths?

MR. FLOYD: Two from the reactor coolant drain tank, one from the gas space and one from the liquid space; and one from the reactor building sump to the auxiliary building.

COMMISSIONER PIGFORD: What about the letdown system?

MR. FLOYD: All right. It's an obvious one. It'll be four. Seal return would be another.

COMMISSIONER PIGFORD: Is it possible we're getting to some that are not so important now? Is that why you didn't mention them?

MR. FLOYD: No, sir. I think your previous line of questioning on sump tanks and miscellaneous waste holdup tanks led me into those paths first.

COMMISSIONER PIGFORD: All right. Now then, can you tell us which are the more important pathways at the different points in the accident? Let's just get at the important ones first. By importance, the ones that then contributed to the release of most of the radionuclides.

MR. FLOYD: Okay. The reactor building sump transfer to the auxiliary building we know pumped early in the transient before there were fission products loose

in the system, and the pumps were secured, and I believe the valves to have been closed. If the valves were not closed, it would have been possible to run a siphon through that line, even with the pump shut off. But I believe those valves were closed. So that line should have been sealed before radioactivity was free and circulating in the reactor coolant system.

COMMISSIONER PIGFORD: When--excuse me, I'm going to interrupt just a moment, concerning the closing of those valves. Is that what happens when this system "goes on isolation," containment isolation?

MR. FLOYD: Yes, sir. Those valves would close automatically at four pounds internal pressure in the reactor building. In fact, all the first three lines that I mentioned would be sealed at four pounds automatically.

COMMISSIONER PIGFORD: All right. Please proceed.

MR. FLOYD: The other two paths out of the reactor coolant drain tank to the auxiliary building certainly had fission products available to the end of the pipe in the reactor building with a couple of pounds, a pound or two or three, in the reactor building, it's probable that there were radionuclides moving out through the gas space line.

The liquid space line needs to be pumped, and the pumps were not running. In fact, they were, fairly early in the transient, probably under water and not capable of running.

But the gas space line would be open to the waste gas header in the auxiliary building that comes off the top of the reactor coolant drain tank.

So now I guess you have to know whether there's steam or liquid in the reactor coolant drain tank, but either one will transport and carry fission products with it out into the auxiliary building, to the gas header, to the gas compressor, in the compressor--if it's liquid or steam it doesn't make much difference, the steam will compress and condense, if it is steam, into liquid, and if it's liquid--if it's already liquid--it will go out with the seal water. The seal water overflow goes to the auxiliary building sump.

So, in either case, whatever came out of that line before we got to four pounds should have been--one possible source of radionuclides getting from the reactor building to the auxiliary building, whether it was steam or water.

COMMISSIONER PIGFORD: Is there any way that gaseous material can get out of that vent system?

MR. FLOYD: Yes, sir, there's a leak in that system

that we know of.

MR. PIGFORD: There was a leak?

MR. FLOYD: There is.

CHAIRMAN KEMENY: There still is?

MR. FLOYD: We're still trying to find -- locate that leak.

MR. PIGFORD: How do you know that there is a leak there?

MR. FLOYD: Everytime I put some radioactivity into it, I get radioactivity in the auxiliary building, and --

MR. PIGFORD: Into what?

MR. FLOYD: Into the auxiliary building and the field handling building.

CHAIRMAN KEMENY: And do you think that leak was present during the accident?

MR. FLOYD: Yes, sir.

MR. PIGFORD: How do you know?

MR. FLOYD: Everytime we went to take gas off the make up tank into the waste gas header, we got a puff of activity in the auxiliary building and the field handling building.

MR. PIGFORD: Was there any penetration of that make line intentionally during the accident?

MR. FLOYD: Uh --

MR. PIGFORD: Of any kind in the system?

MR. FLOYD: Yes. Not where I was thinking of as a leak. I was thinking of the leak on either the suction of the gas compressor or on the discharge of the gas compressor.

We did, however, rig two temporary lines -- one from the makeup gas tank base to the reactor building, and one from the waste gas decay tanks to the reactor building to effectively turn the reactor building into a large waste gas decay tank so that we could contain these curies (ph.sp.) on site.

MR. PIGFORD: Well, was that because the pressure was building up in the vent system?

MR. FLOYD: Yes, sir.

MR. PIGFORD: And so was there any pathway for leakage to the atmosphere introduced by that process?

MR. FLOYD: That piping was all hydro-tested before it was put into service, and leak tested before it was put into service.

MR. PIGFORD: You are speaking of the new piping that was added?

MR. FLOYD: The two new pipes, yes, sir.

MR. PIGFORD: I see.

MR. FLOYD: So, I would say that we did not introduce additional leakage by putting these two lines in.

MR. PIGFORD: Or by operating that, there is no additional leakage?

MR. FLOYD: No, sir.

MR. PIGFORD: Normally the vent system is supposed to be a gas tight system, isn't it?

MR. FLOYD: Yes, sir.

MR. PIGFORD: And you described the only way material gets out of it is by condensation -- you condense the steam or whatever gases are condensable, is that right?

MR. FLOYD: No, sir. The condensation of steam was only if I had steam being transported from the reactor coolant drain tank through the waste gas piping to the gas compressor.

Normally the system is airtight and the only way gas could get out of that system is if we let it out, either by discharging them to the atmosphere or recycling them to the water tanks, the gas base of the water tanks in the auxially building.

MR. PIGFORD: I would like to ask you a question about how to approach this. I have been trying to trace your piping diagrams, and not only am I going blind, I'm having some difficulty. Now, can your operators trace one of those diagrams and trace this vent system?

MR. FLOYD: Yes, sir.

MR. PIGFORD: At what levels through your operation and your engineering, would that capability arise?

MR. FLOYD: We teach it to the auxiliary operators and when we first bring them in as auxiliary operator C's, and we carry through when they become B's, A's. The control room operators know how, the shift foremen, shift supervisors, myself. The mechanical engineers certainly can on the flow diagrams, the electrical engineers can get through the electrical elementaries as can my control room operators.

COMMISSIONER PIGFORD: Are they helped by having any simplified functional diagram that is a little larger to read that you don't need a magnifying glass?

MR. FLOYD: We have large copies of those prints in the control room, and when they can't read their little one at their desk, I'm sure they come to the control room and get our big ones.

MR. PIGFORD: Yes, but even the big ones must be foreboding. Do you have any simplified diagrams that are functional, that shows the main valves without regard to that particular physical location?

MR. FLOYD: In the system description for each system there is probably a simplified diagram, yes.

MR. PIGFORD: It would sure be helpful if we could have one for reference.

MR. FLOYD: Which system?

MR. PIGFORD: Well, that's one. There's that

system, and the let down system, and the sump (ph.sp.) system. Maybe someone else has some other systems, I don't know.

CHAIRMAN KEMENY: I certainly hope you can get that copy because I'm very anxious for Professor Pigford not to go blind during this.

MR. FLOYD: I share your concern, and I will supply him those prints if they exist.

CHAIRMAN KEMENY: Mr. Floyd, I have one small question. I am told that you are able to answer a question we asked earlier and didn't get an answer on: Are the same as Number 12 -- Number 12 valves on the auxiliary reheat water system, are those on the daily check list as to their status?

MR. FLOYD: No, sir, they're not. That check list is for engineered safety features valves only, and they are not considered engineering safety features valves.

CHAIRMAN KEMENY: They're not considered that, okay. I just heard that you would be able to answer that.

I would like to go for a moment to a different role you played -- as I understand -- during this accident.

Is my memory correct from things that I read that on Friday morning you were, in effect, in charge?

MR. FLOYD: Yes, sir.

CHAIRMAN KEMENY: And is it correct that during this time you made the decision to vent certain vessel

MR. FLOYD: Yes, sir.

CHAIRMAN KEMENY: Would you describe the circumstances of that happening?

MR. FLOYD: At that time I was working from 12 midnight to 12 noon. I believe that day Joe Logan was still on with me, so he was the senior man in charge. When I came on shift at midnight Mike Ross, in turning over the plant to me, said that we were venting the makeup tank as necessary to keep the pressure down.

As the course of the night went on, we got more and more gas into the makeup tank. It got to the point where we lifted the relief valve which is on the water side of the tank due to the over-pressure of gas.

At that point, I was effectively running water from the BWST, my source of emergency core cooling water, down into the liquid waste system and the reactor coolant bleed tanks, through a four inch line. I shared Gary's concern from the first day as in his testimony where he was concerned about running out of water in the boiler water storage tank.

I had that one source of water between me and another loca. It was still possible to have a loss of coolant accident on that plan as long as it was pressurized and above atmospheric saturation temperature of 212 degrees.

If there were one way to hurt the public, I would

it would have been by having the core melt. I had fairly well convinced myself that a core melt could not happen, and certainly as long as I had that source of water behind me, it would not happen. I could delivery it to the core and keep the core cool.

So, I found the plant in a condition which was wasting the water in this tank. I had to stop that wasting.

CHAIRMAN KEMENY: It sounds very important, in what way was it wasting the water?

MR. FLOYD: I was running it from where it was available to cool the core into a tank that is a waste tank, and is not available to cool the core.

MR. KEMENY: I see. You were trying to cool down the waste tank?

MR. FLOYD: No, this relief valve had lifted on me because of the gas pressure in the makeup tank. So, to stop that flow path of water, I ordered the vent open on the makeup tank. Now, we had permission to open that vent, and we were doing it on very short verse, because every time we opened it we'd get this puff of radioactivity into the auxiliary building. And now I was ordering it opened, not just jogged open every now and again, and I knew this would lead to a radioactive gas release into the buildings, a release which I controlled and could have stopped if I had to.

I could have sacrificed that tank of water, but that was a decision I did not want to make -- if I had enough wind speed and direction and variability to not hurt the public with the radioactivity I was releasing.

CHAIRMAN KEMENY: Doctor Fabrikant, would you like to follow up on that?

DR. FABRIKANT: Thank you, Mr. Chairman.

For example, would you just summarize the main technical reasons that led you to make the decision to vent the makeup tank, and who gave you permission when you said, "They gave me the permission," or you had the permission?

MR. FLOYD: Well, I'll answer the second part of the question first, if I may. It was an on-going evolution that apparently had been agreed to by all interested parties that as necessary we would open this vent to get rid of the gas, but the instructions were to open it in short bursts to minimize the amount of radioactivity released into the auxiliary building, and hence picked up by the auxiliary building ventilation and the fuel handling building ventilation discharged through the filters to the environment.

The main events in that train again, then, was the gas was coming out of the reactor coolant system into the makeup tank, and causing the pressure in the makeup tank to rise. The only way I had to get rid of it was to open the vent to the gas header and let the gas compressors [illegible]

would normally do, compress this gas into the waste gas decay tanks. It also brought much pressure to bear on this temporary line that we installed from the waste gas decay tanks back to the reactor building. Because, once those tanks got full, then their relief valves would lift, and you would have a release going to the biosphere again.

The main motivation for getting the gas out of the makeup tank was twofold: One, to continue to get -- to continue t degasing reactor coolant system which was, at that time, I feel, siltzer water. It was gas mechanically entrained in the water. It was that large -- we call a hydrogen bubble when we speak of it, but, in fact, it has radio-nuclaeds, non-condensible gases like Xenon (ph.sp.) and Krypton which are both radioactive and bad for people.

And, it had gotten to the point that to protect my boarded water source for eventual core cooling if I had a further loca (loss of coolant accident) in the plant. It was my choice to open the vent, try to get the gas pressure down, if it was too hot then I would have to order that vent closed, and then waste that water, and increase the probability of damaging the public although I did that to prevent damaging the public with the same decision.

DR. FABRIKANT: So, you were very much aware of the possibility of the release of radio-activity that could

endanger the health of the public as well as the workers on the island?

MR. FLOYD: Yes, sir.

DR. FABRIKANT: Were you prepared at that time to evacuate the island? Had preparations been made prior to the release, or prior to the decision to release?

MR. FLOYD: I'll choose my words carefully here because I think we got into a shouting contest once before or at least I did with someone else.

Our normal state of preparedness on Three Mile Island is to evacuate at any time. That is the normal state of preparedness of the staff on the Island, so, yes, I was ready to evacuate the Island, but not because of that evolution, just because of the normal state of preparedness.

DR. FABRIKANT: Had you contacted anyone, either at a state or local level -- for example the Civilian -- Civil Defense -- with regard to the possible need for evacuation of the general public in view of the possibility of an uncontrolled release when you vented?

MR. FLOYD: Yes, sir, I did. I took that precaution. I just earlier here, two or three minutes back, I just said that I was going to open the valve and if it was too hot, I was going to close it. But I had no assurance that that valve would close. Now, it had closed every other time I turned it on that shift, which might have been 20 times. So, I had reason

faith that it would close. But, if it didn't, then I would have had the uncontrolled release on my hands, and that's when I would have needed Civil Defense.

So, I called state Civil Defense, because I had no idea what their state of preparedness was at that point in time.

I knew my son, who's a member of the volunteer fire company, was living at the fire hall, but that wasn't sufficient reassurance to me at a time like that, so I called state Civil Defense and I asked them if they were prepared to evacuate the public.

FAINT VOICE: What time was this?

MR. FLOYD: It might have been 7:40 in the morning, somewhere in that region. Probably somewhere between 6:00 and 8:00, but something leads me to believe it was 7:40 in the morning.

The other possibility is, I've been participating in these emergency drills for some seven years, I guess, six years, however long we've been running them, and it seems like that's one of the things I always did was contact state Civil Defense and then have the Bureau of Radiation Protection call me back, and carry on some of these conversations with these people. In the past, I just -- force of habit when I was talking with the state Civil Defense later in the drill, I would

say, "Do you have buses ready to move people if we need to move people?"

And the answer I usually got back was, "Yes, we have 72 of them we can roll directly."

So, while I was talking that morning I may have asked about buses, I don't know that I did or I didn't, but it wouldn't surprise me from force of habit.

DR. FABRIKANT: Did you feel, under the pressure of making this decision preventing, and the ultimate consequences that could occur, that you were getting support from state and local agencies under those circumstances, or did you feel that it was rather vague and ill-defined?

MR. FLOYD: At the time I ordered the valve open, I did not know what the state Civil Defense preparedness was. So, I called them just like I would at the start of an emergency plan, and I was fully expecting the Bureau of Rad Health or Rad Protection to call me back, but in fact the State Civil Defense called me back. I thought that was an anomaly. It was unexpected. But, in fact, I did get a call back from state and maybe one of the classic mis-communications of all times took place at that point, if the man said, "Are you ready to evacuate?"

Purely speculation now.

DR. FABRIKANT: Who asked this?

MR. FLOYD: Whoever was calling back from state

Civil Defense.

DR. FABRIKANT: A man?

MR. FLOYD: Yes. If he would have said, "Are you prepared to evacuate?", I would have answered, "Yes, we're always ready to evacuate."

And maybe he heard the "yes", and not the, "We're always ready to evacuate." I don't know.

He may have meant, "Are you ready to evacuate the island?" or, "Are you ready to evacuate the people?"

And I would have answered for the Island because I was on the Island. It could be a classic.

DR. FABRIKANT: So, there was no definite communication or understanding at that time?

MR. FLOYD: (Apparently nods head negatively).

CHAIRMAN KEMENY: Mr. Floyd, I just wanted clarification on your last statement. From that statement, does one infer that you gathered that state Civil Defense got the impression that an evacuation was imminent?

MR. FLOYD: I was quoted as ordering the evacuation, which is beyond my authority.

CHAIRMAN KEMENY: You were quoted as ordering the evacuation?

MR. FLOYD: Yes, sir.

CHAIRMAN KEMENY: Commissioner Trunk?

COMMISSIONER TRUNK: May I ask you one question? Did

you notify the local Civil Defense?

MR. FLOYD: No, ma'am. My emergency plan says that state will take care of that for me. I've got enough to do to take care of a reactor.

DR. FABRIKANT: Do you know whether the Governor's office or the Mayor's office in the surrounding cities and towns were notified at all, directly or indirectly?

MR. FLOYD: I do not know. I have heard Governor Thornburgh come out the day after Mr. Henderson used my name in ordering the evacuation, and saying that based on that he recommended to the Governor that there be an evacuation, and then hours later the Governor comes out and says none of his senior staff recommended an evacuation.

So, I don't know whether Mr. Henderson is not part of his senior staff, or whether they didn't communicate, but, other than that, I don't know of any communication to the Governor nor to the Bureau of Rad Health at that time.

DR. FABRIKANT: Do you know whether the Pershaw Medical Center was apprised of this?

MR. FLOYD: No, sir, they would not be unless we had a medical casualty that was contaminated.

CHAIRMAN HEMMY: Just one quick question: You were you monitoring while you were hearing the vent open, you said, that if it turned to hot you would shut it or what kind of monitoring were you doing?

MR. FLOYD: I called our emergency director who was over at the TCS unit one control room, and ordered the helo in the air over the stack --

CHAIRMAN KEMENY: That's your helicopter?

MR. FLOYD: Yes, sir. We had the helicopter standing by, and we put it in the air, and I think that's when they got the reading of 1200 MR directly above the stack, which is a high number, the highest we'd seen ever, but, in fact, with the wind speed and direction that we had, and the fact that it dropped off very rapidly, I left the vent open.

CHAIRMAN KEMENY: How rapidly did it drop off?

MR. FLOYD: I was listening to the on-site teams that were monitoring, the off-site teams that were running around as well as the helicopter. I was tuned in in the control room to all those circuits. I heard all their numbers coming back in to the TCS, which was over the Unit One control room, and I monitored them very closely. Up until the 1200 number came up, the numbers from the helo were going up, and from there on they came back down. In other words, they went up on a very steep ramp, and they came down a very slow ramp, but they were ramping down.

CHAIRMAN KEMENY: Are we talking seconds, minutes, or an hour?

MR. FLOYD: We're talking minutes.

CHAIRMAN KEMENY: All right. How long was that ramp

open all together?

MR. FLOYD: Days, from that point on.

MR. KEMENY: Oh, that stayed open?

MR. FLOYD: Yes, sir.

DR. FABRIKANT: What was the rate per hour?

MR. FLOYD: 1.2 R per hour, yes, sir.

PROFESSOR TAYLOR: I'd like to go back to Wednesday morning when you were at Lynchburg. You were told, I gather, by phone, among other things, that the two pairs of reactor coolant pumps had been shut off. Were you told why?

MR. FLOYD: Was I told that the reactor coolant pumps were turned off?

PROFESSOR TAYLOR: I was presuming that you were told that they were turned off at sometime during the morning on Wednesday.

MR. FLOYD: I'm not sure that I was, and I never wanted to run the simulation out to 70 minutes or 100 minutes anyhow, so it would have been of academic interest to me. I wasn't planning to simulate out that far into the transient.

PROFESSOR TAYLOR: Then can you remember roughly when you first were aware that the two pairs of pumps had been turned off? I mean, could that have been after you came back, got back, to the Island?

MR. FLOYD: No. I was aware of it later in the day, I'm sure, and I may have learned it in the morning.

PROFESSOR TAYLOR: How about the reason for turning them off?

MR. FLOYD: I was just trying to get some information out of the room on perameters, and I talked to the man maybe a total of three or four minutes to relay what information I had - - and reasons he was not prepared to defend why things were the way they were. I could tell that from the tone of his voice. He wanted to just get off the phone with me, and get on with protecting the plant.

PROFESSOR TAYLOR: I see. So, is it true, then, that there was no time on Wednesday that you had the information that the operator had turned off the two pairs of pumps apparently because he suspected cavitation, expected a lot of excessive vibration in the pumps?

MR. FLOYD: Well, he didn't suspect the vibration, he could read that in the control room. That was a known fact, that they were vibrating badly, and the flows indicated low which was an indication of some cavitation, and the amperage dropping off was probably also an indication of that.

So, he had fairly firm reasons for turning them off.

PROFESSOR TAYLOR: Well, let me ask it this way: When you first did get that sort of general picture that they were turned off for that reason, did you ask yourself where the source of voids causing the cavitation in the pump might have come from?

MR. FLOYD: I think I learned the fact that they were steamed down in the hot legs about the same time that I learned the pumps were turned off.

PROFESSOR TAYLOR: When was that about, roughly? Do you think that was on Wednesday sometime?

MR. FLOYD: The only thing I could do would be go back and ask the people I talked with at B and W that day, when and if I told them, or when and if they told me that.

I don't remember.

PROFESSOR TAYLOR: Well, let me explain. There is a reason I'm following this line of questioning, and that is: I'd like to have your reaction to this statement, and that is, it would seem to me that under conditions where everybody is focusing on trying to maintain "solid water" in the whole primary system, except the upper part of the pressurizer, that any indication that there is steam or some other gas in the primary system -- not up at the top of the pressurizer -- would be cause for very serious immediate concern.

MR. FLOYD: Yes, sir, I agree with you.

PROFESSOR TAYLOR: But, if you had any indication that that occurred to anybody Wednesday morning that, in fact, there was steam that must have come from some overheating, presumably, that perhaps was continuing at the time the pumps were turned off -- it was the source of that steam or void.

MR. FLOYD: I believe when I first became aware of

that condition in the plant was when I was called up to the board room on the second floor in B and W's offices in the afternoon, and was told at that time that B and W felt that there was not enough high pressure injection flow to the core, and they thought I might have had some secret telephone numbers to dial into the Island, and in fact, I had some unlisted numbers in my wallet.

In fact, I tried to transmit that information for them. But, I think at that time I was then aware for the first time, of the 700 degree type number in the hot legs (or links), and in fact, as soon as I finished that call to the site, which I didn't get into the Unit Two control room, I went through the Unit One control room -- I couldn't get into Unit Two, and sent a messenger, a courier, over to the Unit Two control room with the information.

As soon as I rang off from that call, a B and W representative at the Island called into the board room to transmit some more current information to B and W, and I stayed and listened to that, and he said that the plant staff felt that they had collapsed the bubble in the hot legs and quoted us some temperatures and pressures, and I immediately recognized that as being in a superheat region on the steam tables, and so told him, and got a B and W engineer to back me up with a set of steam tables, that they weren't, in fact, superheated at that point.

CHAIRMAN KEMENY: Mr. Floyd, about when on Wednesday was this?

MR. FLOYD: I think I was called to the board room about 2:30 in the afternoon, so this would be on the order of 3:00.

CHAIRMAN KEMENY: Yes, now, one thing I just want to be sure we understand because it's relevant to something else we're probing, and that is: That B and W, by this time, was convinced that a great deal more high pressure injection should go in. Do I understand that they felt that that was necessary?

MR. FLOYD: Yes, sir.

CHAIRMAN KEMENY: And they could not get through on the telephone, is that correct?

MR. FLOYD: Yes, sir.

CHAIRMAN KEMENY: Thank you.

PROFESSOR TAYLOR: At what time, roughly, did you first begin to believe that very serious core damage had taken place, and on what basis?

MR. FLOYD: There may be some conflicting times that I made on this. I don't know whether it was with your technical staff, or with your legal people, or the NRC, or our people, there are tapes of all these, but somewhere on one of those tapes I think I said I didn't know if it was the 7:10 phone call to the site, or the 9:10 phone call --

PROFESSOR TAYLOR: On what day?

MR. FLOYD: On Wednesday, the day of the accident.

But, in retrospect, thinking about it some more, I got the numbers for the activities at 7:00 phone call. I did not get to act on them until after I had briefed B and W people in the training class room, and that was on the order of 9:30.

The two numbers I have already related to -- the one on the reactor building dome monitor being 80 or 90 thousand R per hour on the meter face, I could not and did not believe. I happened to have made the calculation that set the 8R per hour on that instrument as the action point for the emergency plan five or seven years ago in Unit One, when we first invested that number. I remembered from that calculation that if I took the source term in the reactor building which was dictated by TID 14844 which is the reference document for all nuclear plants to use, and it basically takes the gap activity. It takes all the noble gases, 50 percent of the -- and turning up something like 100 million R per hour in the dome.

Based on that remembrance, I didn't really think that the dome monitor was accurate because it would have been a factor of 100 larger than that since they were giving me a comparable number, 90 thousand -- okay, it's possible it was true, but I went to check it the other way by taking the number off the gas channel, and I didn't have a source [illegible]

but I did happen to have Florida R Company's sensitivity available at the simulator, and I figured an instrument's an instrument, at least it's a check, and so I used their sensitivity in our reading, and I came up with a number that looked to me like an eighth to the gap activity, at that point in time.

VOICE: A what?

MR. FLOYD: One-eighth of a gap activity. And, in fact, I then mentioned that to B and W, the people in the room at the simulator, our people, as well as the B and W people, that it looked like at least an eighth of the clatting (ph.sp.) had failed.

And when I was in the board room at 2:00, 3:00 in the afternoon, I also put it out there to the 40 or 50 people assembled in the board room. I got some stares of disbelief, but I put it out anyhow because I thought it was within the range of trueness. It's not accurate because of the way I got to it, but it's in the ballpark.

PROFESSOR TAYLOR: Well, to whom did you give this information during the course of the day on Wednesday, outside the people you are immediately involved with at Lynchburg?

MR. FLOYD: No one.

PROFESSOR TAYLOR: No one. Were you assuming that people at the plant knew this?

MR. FLOYD: Yes, sir.

PROFESSOR TAYLOR: When did you first communicate with someone at the plant and discuss these high numbers, particularly the implications for fuel clatting failure? When did you first discuss that with anybody at the plant?

MR. FLOYD: I don't think, I'm sorry, after I returned to the site about 2:30 in the morning on Thursday.

PROFESSOR TAYLOR: 2:30 on Thursday morning?

MR. FLOYD: Yes, after I had completed the day in Lynchburg, I drove back to --

PROFESSOR TAYLOR: When you did that, did you get a reaction that in fact it was a surprise to them, or not?

MR. FLOYD: No, I don't believe it was -- I don't know who I would have discussed it with. I was going there to take charge of the plant, and that was history at that point. It was hours old data, so to speak, and it would not have been actively discussed in the turnover.

PROFESSOR TAYLOR: Well, this, in my mind, is very important. Is this correct: That, as far as you know, some quantitative reasoning was telling people at the plant that a substantial fraction of the clatting had failed?

MR. FLOYD: Yes, sir.

PROFESSOR TAYLOR: By early Thursday morning? By early, I mean very early in the morning.

MR. FLOYD: I think that information was available early Wednesday morning. In fact, that's how I got to my conclusion, was from information early Wednesday morning. Anyone else that was at the Island was free to arrive at a similar conclusion if they remembered a source term like I remembered, all right.

But, unfortunately, I was privileged to have made the calculation.

PROFESSOR TAYLOR: So then there was a general -- I gather from what you're saying that, looking backward now, that Wednesday morning there was a general understanding that there had been a substantial fraction of the clatting --

MR. FLOYD: No, sir. I said the information was available to draw that inference.

PROFESSOR TAYLOR: I see. Do you know whether the management of Med-Edison (ph.sp.) knew this?

MR. FLOYD: From the testimony I hear here in the last two days, I have to assume it was several days later before this became a commonly held belief.

CHAIRMAN KEMENY: Mr. Floyd, in view of a misunderstanding a moment ago, I'd like to clarify an earlier statement. You arrived at the plant at something like 1:30 Thursday morning. At that time, did you have the feeling that there were people in the control room aware that there had

been serious clatting damage? I don't mean that they had information available.

MR. FLOYD: I don't believe I discussed it, per se, with anyone that I can remember. I can remember my first impression of walking into that control room where the radiation monitoring panel was lit up like a Christmas tree. All the red lights and all the yellow lights. The alerts and the alarms were all in, and I had conditioned myself to expect this with these kind of readings in the building. But then to see it in reality; it was shocking.

I don't know that we got around to discussing the percentage of failed fuel at that time because we now were liquid full in the system again, and we had other things to do, to go forward with in the operation of the plant.

In my mind, I felt I knew there was a significant amount of failed fuel, and there is no use quibbling over the second decimal place, if you will, when you've got other things to do.

PROFESSOR TAYLOR: Had you sometime Wednesday made the connection in your mind between the high temperatures in the core, cladding failure, and hydrogen?

MR. FLOYD: Yes, sir.

PROFESSOR TAYLOR: So, were you ready to explain that there was a substantial amount of hydrogen in the system already at sometime on Wednesday?

MR. FLOYD: Well, I don't believe. It's hard to say. The thing that did catch my attention -- I didn't know, for instance, in core temperatures on Wednesday -- this magic 2400 number that keeps being bandied about --

PROFESSOR TAYLOR: You did know that or you did not know that?

MR. FLOYD: I did not know that.

PROFESSOR TAYLOR: You did not know that.

MR. FLOYD: But I did know that the hot legs were above 705, and when you're above 705 degrees Farenheit, you can't compress it back to liquid until you cool it below 705.

I once operated a super-critical loop for Westinghouse, and I happened to have recognized it in 3208, the magic pressure for that temperature, and even if you took the pressure to 10,000 pounds per square inch, above that temperature it won't liquify. So, in fact, their challenge was to really cool the hot legs, and they did this by filling the steam generators up higher, and getting the bubble small enough, the steam bubble, to pass through the pump eventually.

Raising that steam generator level to 110 percent was just a glorious thing to do. I don't know if it's come out that clearly before, but those traces that you've probably seen of the steam generator levels -- the point where they took the A steam generator level up to 110 percent from 81 percent, was just a glorious thing to do. I wish [illegible] taken it higher.

I don't know that I was mentally prepared for an awfully lot of zirc (ph.sp.) water reaction at that time.

PROFESSOR TAYLOR: I'd like to ask a question which is going to involve some subjective judgment, but the question is this: Do you think that the fact that you were at Lynchburg, and therefore not involved in the immediate commotion of the accident, help to contribute to your being able to make these connections between various pieces of information that you had gotten about the accident, to give you a quicker line of reasoning to what had actually happened to the fuel than if you had, for example, been at the site?

In other words, was the fact that you were in a somewhat less than an immediate -- state of immediate pressure, would you think that contributed at all to your clarity of mind about what was going on, and speculating and so on?

MR. FLOYD: I don't believe the pressure had so much to do with it as the difference in information levels that were available to me as opposed to the person in the control room, had I been in the control room.

In Lynchburg I had a half a dozen pieces of information. that's all I had to work with. I had to mill them for what I could get out of them. If I were in the control room, I would have had all of that instrumentation staring me in the face, and I would have been overwhelmed with information, and maybe I wouldn't have been able to reflect on those couple of little

pieces that I extracted in Lynchburg.

PROFESSOR TAYLOR: Well, is it fair to suggest that there was a kind of a filter acting, which would be quite understandable, that tended to get to you the half dozen or so pieces of most important information, perhaps excluding some like that 2500 degree figure, if that really was real?

Do you think that's a fair characterization of the kind of information you were getting?

MR. FLOYD: I pretty much asked for the kind of information I wanted, and what I felt the man would give me in time, and sort of took them by priorities coming down the list, but I really can't say how I would have performed if I would have been in the control room.

PROFESSOR TAYLOR: Well, just one more quick question: When would you say it was really generally common knowlege among the people responsible -- at responsible levels at TMI itself, that there had been cladding failure and a substantial amount of core damage?

When was that generally known and accepted?

MR. FLOYD: Well, I guess I was never aware that they weren't aware until I heard testimony here in the past two days. What really was the clincher, of course, was the first gas sample that we got out of the reactor building which we wanted to take a hydrogen analysis of.

But the second number on that sheet of paper is oxygen, percent oxygen. And when I saw that number and saw that it was four percent oxygen missing out of that building, that's when I confirmed in my own mind that the 20 pound spike had, in fact, been a hydrogen burn, and for that much hydrogen to have been present, there must have been gross zirc water reaction.

PROFESSOR TAYLOR: And when was that?

MR. FLOYD: That was -- that's documented when that sample result was analyzed, but I think it was Friday morning, about the time I was having all the trouble with the gas.

PROFESSOR TAYLOR: Thank you.

CHAIRMAN KEMENY: Dr. Fabrikant, had you finished all your questions?

DR. FABRIKANT: I have one more.

CHAIRMAN KEMENY: All right, one more question and then I'll go down the line.

DR. FABRIKANT: I just want to ask about two points. When you opened the vent, which was the first active release of radioactivity and which was not in conjunction with any other state or Federal or local authority, that was a decision making process that you were involved in directly, based on the technical facts that you had had, you stated that you made

aware that you would release radioactivity into the environment, that you would affect the public, but that you did not know how much radioactivity would be released. Is that correct?

MR. FLOYD: Yes, sir.

DR. FABRIKANT: Did you open the vent, or did you order someone else to open the vent?

MR. FLOYD: I ordered the vent open.

DR. FABRIKANT: You ordered the vent--who opened the vent?

MR. FLOYD: Probably my operator.

DR. FABRIKANT: Did you know or have any idea of what the inventory of radioactive materials were or could have been released at the time; what their energies were, for example; what the distribution was?

MR. FLOYD: Well, we knew that every time we vented that tank, which was happening several times an hour, and so I did have NRC concurrence to open that valve; and probably the State of Pennsylvania also, by that point in time. I knew that we saw gaseous activity, and I felt confident it was xenon and krypton. But I didn't know how much. All I could do was guess that when we vented it before we opened it and we got a big puff, the meters came up to here and leveled off; from those meters I can get a curie per second release if you will. And I had some feel for what had been in the tank historically. And I had no reason to

think that it would be anything different now. There was just going to be more of it.

DR. FABRIKANT: If Governor Thornburgh's advisory to evacuate pregnant women and preschool children was based on the release of radioactivity, would you have changed your decisions to vent, had you known the consequences?

MR. FLOYD: Well, the question almost begs itself, sir. I don't know that his decision to evacuate the women and children were based upon that release--

DR. FABRIKANT: No, weren't based on it.

MR. FLOYD: I think he announced that as a precautionary evacuation, which was rapidly lost in transmission to the public. The word 'precautionary' disappeared after his first release, his initial statement to that effect. It was not stressed in the future announcements that it was in fact a precautionary release.

Now if we go back and hypothesize that he took this precaution based on the activity coming out of Three Mile Island, then I say I would be, at that time, I could have been controlled by EPA guidelines in my thinking, as opposed to the conservatism which I think the Governor displayed with his precautionary evacuation.

DR. FABRIKANT: One final question. Yesterday Secretary Joseph Califano of the Department of HEW announced, based on the potential effects from radiation released during

the recent accident at Three Mile Island Nuclear Power Plant, and I quote: "The best scientific estimate, based on what is known, is that as a result of the accident, there will be one additional cancer death, one additional nonfatal cancer, and one additional birth defect among the two billion people within 50 miles of the facility."

Mr. Floyd, would you please explain to this Commission how you perceive Mr. Califano arrived at this estimate, what were the facts and hypotheses he has based this, and what this means to you and your fellow citizens living in south central Pennsylvania?

MR. FLOYD: First of all, I cannot know what was going through his mind or how he or his staff arrived at these numbers. All right? That's not in my technical jurisdiction, and I don't want to touch it with a 10 foot pole.

As to how I perceive this in central Pennsylvania: I was born and raised there; I've lived there all my life; I know the people. I don't want to be that one even nonfatal cancer. I certainly don't want to be the one fatal cancer. Neither does anyone else in central Pennsylvania. Even though there's going to be 360,000 deaths due to cancer, I don't want to be the three hundred sixty thousandth and one, and no one else does. Self-preservation.

CHAIRMAN KEMENY: Just one thing for Dr. Fabrikant.

You joined our staff after the first meeting. I did tell the Commission at the first meeting Secretary Califano couldn't come then, but he asked that we should call him as a witness at an appropriate time, so please let's not forget that, because that's an interesting question to ask.

Commissioner Trunk, and then Pigford and McPherson.

COMMISSIONER TRUNK: In Gary Miller's statement, he said that they had a radiation reading of 13 MRs at Kunkle School at 10:30 in the evening. Now it might have dissipated during the night, but was anybody told, like the School Board, that this was happening, and to take precautionary measures, because there are young children there?

MR. FLOYD: I understand that, and our plan calls for us to advise the State, and the State to advise the people. As far as I would be concerned, if I were running that Emergency Plan, communication to the public would be a State responsibility.

COMMISSIONER TRUNK: Well, apparently the State wasn't too fast on this. Couldn't somebody have been appointed to call up the School Board of Middletown?

MR. FLOYD: That gets awfully personal, because I probably would have been the person, since I know the School Board, but I wouldn't have looked forward to that job. trying to explain what 13 MR per hour meant to the Londonderry School Board, for instance, would not be my idea of a fun time.

COMMISSIONER TRUNK: Well, it's no fun time for the parents who--

MR. FLOYD: No. I understand. But there is a tremendous need for public education in this area and we're, I guess, slowly doing it by default, but someone ought to take on that burden, and I don't know if it's the public school systems or the local governments or the state governments or where. But someone has to do this. And to call them in the middle of the night and say, "Hey, you got 13 MR per hour at your school," that's a little bit too much scare tactics to suit me.

COMMISSIONER TRUNK: Well, can you imagine what the people are now--they're much more afraid because they don't believe anybody. That 13 M may not hurt anybody, but they just don't believe that any more.

MR. FLOYD: That's why we have the need for education.

COMMISSIONER TRUNK: I want to also ask you: has anybody in the plant had more than their legal dose of radiation?

MR. FLOYD: We have had three, maybe four, incidences where men have gone over the three rem per quarter limit, but we have had none that went over the five rem limit.

COMMISSIONER TRUNK: Not even during this accident?

MR. FLOYD: No, ma'am. I spent many hours a day in that Control Room, and in the first month I picked up like 20 millirems.

CHAIRMAN KEMENY: Professor Pigford.

COMMISSIONER PIGFORD: I've got two or three follow-on questions, Mr. Floyd. Apparently when you were in Lynchburg, your message that you telephoned back to the plant in the early afternoon was that they must keep the high pressure injection on. Is that correct?

MR. FLOYD: No, sir. It wasn't phrased quite that way. It was, keep at least 400 to 500 gallons a minute of high pressure injection going into the core.

COMMISSIONER PIGFORD: How many high pressure injection pumps does that correspond to?

MR. FLOYD: One high pressure injection pump would deliver that much water if it's unthrottled.

COMMISSIONER PIGFORD: Then, as you have read the sequence of events, apparently as long as one had been left running full, from your conclusions, the core would not have become uncovered. Is that correct?

MR. FLOYD: No, sir, that's not. At two o'clock in the afternoon, four or five hundred gallons a minute was necessary and sufficient. It was necessary also in the morning, but not sufficient.

COMMISSIONER PIGFORD: What would have been sufficient in the morning?

MR. FLOYD: Off the top of my head, knowing how decay heat dies off, probably a thousand wouldn't have been

enough in the first couple of minutes, but in the first couple of hours, it would have been.

COMMISSIONER PIGFORD: Well, you know from the--

CHAIRMAN KEMENY: Excuse me. Could I just have that clarified, because that's the first time we heard this. When you said in the first couple of minutes it would not have been enough, but the first couple of hours it would, do you mean by that it would have been enough if a thousand gallons a minute had been kept up for two hours?

MR. FLOYD: No, if it had been kept on continuously.

CHAIRMAN KEMENY: Continuously for--

MR. FLOYD: In other words, the decay heat, sir, drops off very rapidly with time. And initially it's quite high, very high, in fact. But it doesn't stay high very long. And so even if you only had a thousand gallons a minute going in, the decay heat would rapidly drop out from underneath that required amount of water, and the amount of boiling that would have taken place in the boiloff in the core. The inventory would not have been decreased far enough to have harmed the fuel or the cladding.

CHAIRMAN KEMENY: Yes. What was the two minute versus two hours in your statement?

MR. FLOYD: Well, this is just a feel I have off the top of my head. I said that I think the decay heat in the first two minutes, if you wanted to remove it as it was

generated, you would need a larger quantity of water than one thousand gallons a minute. But by the time you're out to two hours, then it's a feel off the top of my head that a thousand gallons a minute would have been enough, and that would have decayed off to five hundred gallons a minute by two o'clock in the afternoon.

CHAIRMAN KEMENY: Thank you.

COMMISSIONER PIGFORD: Do you know of any post mortem analyses on this subject that would give you a more precise number?

MR. FLOYD: B&W had precise numbers available at two o'clock Wednesday afternoon of the accident in Lynchburg. And they were trying to get that information back to the site. I would imagine that in generating that number at two o'clock in the afternoon, it's only a constant multiplier that you put on to the decay heat curve, and you can change the axes to flow. And so yes, that information probably has been generated.

COMMISSIONER PIGFORD: Now with regard to the two-minute requirement, do you actually have to have that much coming in at two minutes?

MR. FLOYD: No, sir. Like I said, the decay heat will drop off very rapidly, and while for a short period of time I can tolerate a negative inventory, if you will; that is, I can be needing more water than I'm getting, if it

doesn't last very long--

COMMISSIONER PIGFORD: Why?

MR. FLOYD: Because I have --

COMMISSIONER PIGFORD: Please explain.

MR. FLOYD: Okay. I have a buffer in the system, known as the water volume above the core, physically higher elevation than the core. That will include the water in the upper portion of the reactor vessel, the reactor vessel head, the candy canes, and the steam generators down to the elevation of the core. Until I boil off that water, I will not experience cladding damage.

COMMISSIONER PIGFORD: How long will that take?

MR. FLOYD: That's on the order of 50,000 gallons of water. That will take hours. Well, I could come back. If I put no water in--you're trying to have me integrate the area under the cover and come up with a time, and it's difficult when I have a mental image of this curve to then integrate it.

COMMISSIONER PIGFORD: That suggests maybe some followup information I'd be provided--

MR. FLOYD: Yes, sir.

COMMISSIONER PIGFORD: On that subject. Clearly, the question: when do you have to have about a thousand gallons of water coming in?

MR. FLOYD: I would think just several minutes after

the trip.

COMMISSIONER PIGFORD: Yes. Now you stated earlier that you were worried about giving out of water. This was running out of source of water to cool the plant. Now doesn't your plant have the provision at least for the loss of coolant accident that you can recirculate the water in the containment building and use it for cooling?

MR. FLOYD: Yes, sir.

COMMISSIONER PIGFORD: And why could not you have done that in this case?

MR. FLOYD: I could have, but again I'm going to be bringing large numbers of curies outside of the reactor building into the auxiliary building where it has a much better chance of escaping to the public than if I can keep it bottled up inside of a leaktight building that is at a negative pressure with respect to atmospheric.

COMMISSIONER PIGFORD: Is the worry because those tanks that you would have to bring it in already had blown their relief valve or pressure?

MR. FLOYD: No, sir. If I were to recirc from the reactor building sump, I would not need to use any tankage in the auxiliary building, just lines and pumps and lines back in.

COMMISSIONER PIGFORD: Well, why would that release any radioactivity?

MR. FLOYD: There are valves that have packing on them, and valve packing traditionally leaks. Pump seals traditionally leak. And that would leak to the auxiliary building atmosphere and then be picked up by the vent system and distributed.

COMMISSIONER PIGFORD: But apparently that is the design plan in the case of a loss of coolant accident.

MR. FLOYD: Yes, sir, it is.

COMMISSIONER PIGFORD: And are you concluding that the design plan is faulty?

MR. FLOYD: No, sir. I'm concluding that we had a better way to protect the public by not bringing those curies out.

Now if I would have had to bring those curies out to get the cooling water, if I had run out of water in my BWST, and I had a loca, I certainly would have used that flow path. But if I could get by without using it--

COMMISSIONER PIGFORD: You see, the trouble is--

MR. FLOYD: I'm further ahead.

COMMISSIONER PIGFORD: We're limited by the vagueness. It sounds like you were worried about a lot of curies would get released if you used that. And then it says if that's true, that it just was a bad design

in the first place, because you couldn't have used it.

You see the dilemma here.

MR. FLOYD: Yes, sir.

COMMISSIONER PIGFORD: Can you clear that up for us?

MR. FLOYD: Well, to me, it was an untried system at that point in time. In other words, I had not recently run a surveillance check to check the leaktightness of that system, and therefore I didn't know how much leakage I would have if I put that system in service.

And in fact, if I would have had to put it into service, I have two of them, and I would have probably elected to use long term, the one with the least leakage on it.

COMMISSIONER PIGFORD: How frequently do you check the leakage of these two systems?

MR. FLOYD: It's a tech spec requirement, and it might be an annual surveillance. It might be a six month surveillance. I can't speak with assurance on either.

COMMISSIONER PIGFORD: And would you have any reason to doubt that during the last time it was tested, it was okay?

MR. FLOYD: No, sir. It passed its surveillance the last time it was tested.

COMMISSIONER PIGFORD: Are you then saying that since that period, whatever, six months, you were afraid that something might have become leaky?

MR. FLOYD: Afraid is probably not a very good choice of words. I would probably not apply it to myself in that respect.

I recognized that the probability of leakage could have increased during that period of time that the packing was sitting there dry.

COMMISSIONER PIGFORD: Isn't this system designed so that the leakage itself is caught and contained?

MR. FLOYD: No, sir.

COMMISSIONER PIGFORD: Not on that particular system?

MR. FLOYD: No, sir.

CHAIRMAN KEMENY: Commissioner Lewis.

COMMISSIONER LEWIS: Mr. Floyd, I'd like to go back to before the accident. According to Richard Hartfield, Director of the NRC's Management and Program Analysis Office, Unit 2 has had 50 percent more reportable occurrences than the nationwide average for nuclear reactors. That was before Unit 2 went on line and went commercial. What does that say to you about the readiness of Unit 2 to go into operation?

MR. FLOYD: I need to know if he is quoting the national average for nuclear reactors today, or if he is quoting the national average for reactors in their first year before commercial operation. It could make a great big difference to how I respond to your question as to which average he is comparing us to.

COMMISSIONER LEWIS: He is comparing you to the first year of operation for all nuclear reactors.

MR. FLOYD: Okay. This is not quite a fair comparison becuase we were in a test program during that year and not in our first year of operation.

But assuming it were a fair comparison: The number of reportable occurrences that a station has or a unit has is some kind of an index to what kind of an operation is being run. When you look behind just the number and at the consequences of what was wrong, the two occurrences might be much more important than 10 or 20.

There are many things which I have to put myself on

report to the NRC to, based on my technical specification. Some of them are fairly inconsequential to the health and safety of the public. Some of them are of the utmost importance to the health and safety of the public. If I keep tromping on those big ones, they ought to put the padlock on the door.

COMMISSIONER LEWIS: You had a lot of big ones before you went on line, didn't you, at Unit 2?

MR. FLOYD: Well, again, it depends on what's big.

COMMISSIONER LEWIS: You had a lot of scrams, a lot more scrams than other places had in their first experimental year.

MR. FLOYD: But that's perfectly safe. That's what we want to do if the reactor's in trouble; we want to trip it and shut it down. Even if it is on a spurious instrument signal, this is desirable. Put the plant in a safe condition. So that one, the number of times that the plant tripped, you've got to go behind the numbers to find the significance of what those numbers are really trying to tell us. It might be that I just have a very bad I&C Department. Now, this isn't the case, but it is a possibility that they don't do a very good job of calibrating instruments, for instance. In that case, when you see three or four of these coming in a row you jump on top of the leader of that group and you squeeze his head a little bit and you bring his people up to speed and you get

production out of them and you get good work out of them, quality work. We are always concerned with the quality of our operation.

COMMISSIONER LEWIS: But you get an impression of a pattern that led to a great many of your problems in terms of this accident, a pattern of valves that failed, of gauges that were untrustworthy. What I'm trying to get at in my questioning is whether you didn't have some preliminary warning before you actually went commercial that you had this kind of problem.

MR. FLOYD: I guess, first of all, we have to make sure we aren't running our facts together. That is, to take a quote from the number of reportable occurrences and mix it up in a pot with the numbers of valves that were left closed, for instance. There are valves and there are valves in the plant. There are valves that are vital to nuclear safety and we keep very tight administrative control on those, and when one of those are violated we get the investigation carpet out and we find out why and how and we try to prevent it from happening again.

There are many other valves in the plant that have nothing to do with nuclear safety and the administrative control on those valves is not nearly as tight because the health and the safety of the public is not affected by that valve.

So, even if you are going to just mix up all the

valve failures in a pot, you almost can't do it because some are important and some aren't. So you've got to try to sort out what is important and what isn't.

I cannot agree with your statement that there was a discernible trend leading up to this accident.

COMMISSIONER LEWIS: Let me ask you whether this is true. At the beginning of 1979 the company, Met-Ed, cut back hours committed to maintenance by one-third. Is that true? In other words, was there a reduction in hours committed to maintenance?

MR. FLOYD: I'm not the maintenance boss; I can't address that. I don't know.

COMMISSIONER LEWIS: Wouldn't you be aware of that?

MR. FLOYD: I should have been, but I'm not. If I was aware of it at the time, it is something that I totally threw out of the mind because it wasn't important to my future.

COMMISSIONER LEWIS: You say that even now after the accident?

MR. FLOYD: Yes, Ma'am.

COMMISSIONER LEWIS: Do you think that the reduction in the maintenance by one-third could seriously affect the operation of the plant?

MR. FLOYD: It would probably first show up as a reduced availability in the unit. And that doesn't affect the

safe operation of the plant. That only hits us in the economic pocketbook. We could have elected to do the maintenance that was important to nuclear safety and taken the economic penalty that would go with reduced maintenance in the rest of the plant.

COMMISSIONER LEWIS: What I'm leading to is we had this key pressurizer relief valve that everybody knew was leaking. One reason why there was confusion when you had the accident was that you knew it was leaking and, therefore, you didn't pursue the information that you were getting. You may say that is not a major safety feature of the plant, and yet when it came to this crucial moment, the failure to maintain that particular valve was instrumental in your having the accident.

MR. FLOYD: I think I would agree with your end of your statement there about it being important to the course of the transient. We responded to that situation responsibly in that our decision to live with the leaking valve and to schedule it for maintenance when the parts were available was done legally as a legal corporate citizen that we are. It was done within the technical specification which is imposed on our plant. And it's the difference, if you like, between driving 45 or 55 in a 55 mile an hour zone. I can go slower but I can't go any faster. As long as I stay within that technical specification the health and the safety of the public should be assured. That's why there is a technical specification.

COMMISSIONER LEWIS: Perhaps the technical specification is a bit too high. In other words, is it possible that that specification, as it eventually resulted, was dangerous because of what has happened here?

MR. FLOYD: Yes. We might want to look at that spec differently today than we did two years ago.

COMMISSIONER LEWIS: Thank you.

CHAIRMAN KEMENY: Commissioner McPherson.

COMMISSIONER McPHERSON: If the people at the plant on Wednesday had concluded, as you did when you were down in Lynchburg, that there had probably been substantial damage to the core, what do you think they would have done differently?

MR. FLOYD: The Met-Ed people at the plant, I don't think would have done anything differently, really, in hindsight now, going back and looking at it, what we did do, what we could do, By eight o'clock Wednesday evening the plant was in a basically stable position. We had reestablished forced cooling flow and that was their primary objective from the time the pumps went off in the morning at 6:20 or whenever it was--100 minutes after 4:00 o'clock.

And I think that was a desirable objective and I think they met it as quickly as they could, whether or not they recognited there was gross fuel failure--I don't want to use the word fuel failure. There's cladding failure and there is fuel failure in my mind. What we had was cladding failure

in the zirc water reaction. To this day I don't know that there is fuel damage.

CHAIRMAN KEMENY: Professor Taylor.

COMMISSIONER McPHERSON: Let me yield to him.

COMMISSIONER TAYLOR: On this matter of fuel damage are you aware of some preliminary calculations done by NRC in which they introduced the possibility of zirconium and uranium oxide forming a eutectic that melts at quite a bit lower temperature than uranium oxide and that, as I understand these model results, suggests that quite a lot of uranium oxide was in fact converted or became involved in this mixture that forms the eutectic and in fact did melt. Would you call that fuel damage or not?

MR. FLOYD: I'm not aware of the study you refer to in NRC. Take at face value your statement that it will form a eutectic, and yes, I think if it formed a eutectic then that is fuel damage.

COMMISSIONER TAYLOR: Let me ask you this, then. On the matter of what actually might have happened to the fuel, who are you looking to to review the accident and try to calculate or one way or the other estimate the character as well as the extent of the damage? I mean, who is doing this for you? Is it B&W, or who?

MR. FLOYD: No. Well, I'm sure they are looking, too, and whatever they find out I'm sure they will report back

to us. But I think we as a company are looking to EPRI to do this for us.

COMMISSIONER TAYLOR: Is that as part of the EPRI, as I understand it, large scale study investigation of the accident or is that a separate arrangement that you have directly with EPRI and saying please do the following things?

MR. FLOYD: I don't know. I said I think we're relying on them. We could be relying on someone else.

CHAIRMAN KEMENY: Commissioner McPherson.

COMMISSIONER McPHERSON: Just to go back then. If people had concluded up there at Three Mile Island about the same time you did that there had been cladding damage, you don't think they would have done anything differently? It didn't really matter whether that had happened; that was understood in the minds of the operators?

MR. FLOYD: It would not have changed the number of curies that were circulating in the system or leaking out to the biosphere, or doesn't affect what you've got to do to get that pump restarted. It probably does affect the Governor's decision on what he advises people to do. But I don't think it would have affected the Met-Ed people. It might have affected their recommendation to the Governor, but that is purely speculation on my part.

COMMISSIONER McPHERSON: Mr. Floyd, you were reported I believe in the press to have said to a Congressional

committee that NRC personnel in the control room had been aware of the spike and then you told us up at Middletown a couple of weeks ago that you were misquoted in that regard. Would you tell us what the truth was?

MR. FLOYD: I think I did the last time, Sir. Let me just fill you in on how I got my information. I'm not sure which day it was but I think it was--where did the days go--I came to the site on Thursday morning. It would be Friday morning while I was having all the troubles with the hydrogen bubble. I overheard something in the control room amongst my people about the spike in the reactor building pressure. And I took the supervisor back in the office and I said, what's with this spike in reactor building pressure? He said, yes, it jumped up to 28 pounds and the spray pump started. I said, does the NRC know about this? Because I couldn't imagine if they knew about it, I had not heard about it in the some, I don't know, 16 hours I'd been on the site.

He said, yes, there were two NRC inspectors standing there watching us put the building spray pumps in poodeluck (ph) and to me that was NRC notification. If the man stood there and watched us go to poodeluck (ph), then he should understand why, or ask. And they normally are not bashful. Normally we communicate well with each other. When I didn't know answers to questions, I didn't hesitate to call on those people to work up details for me or to at least fill in my areas of

ignorance. We had a very good rapport in that respect with the NRC people in the control room.

We finally ended moving a whole lot of people out of the control room because we were wall-to-wall people for a while. But we didn't move them out because we didn't like them; just to quite down the operation of the control room.

COMMISSIONER McPHERSON: In other words, you make the assumption from what you heard that the NRC people must have deduced that there had been a spike?

MR. FLOYD: Yes, I'll grant that.

COMMISSIONER McPHERSON: Okay.

MR. FLOYD: Something started those pumps or the operator would not have been stopping them --

COMMISSIONER McPHERSON: They were said to be there. Okay. Two other questions. In what you told our staff in an interview, you said that among the conclusions you drew was that operator training was inadequate, that it was the best available until this transient, but since this one was unanticipated, operators were confused if not deceived by instrumentation. Do you recall saying that?

MR. FLOYD: Yes, Sir.

COMMISSIONER McPHERSON: Mr. Miller said that "the response of all Met-Ed personnel was excellent and the courage of the operators and health physicists and maintenance personnel was evident throughout the day. There was not during the

entire time a period of panic or unsureness within the control room." Would you agree with that?

MR. FLOYD: Yes, Sir, I would.

COMMISSIONER McPHERSON: There was not a period of unsureness in the control room? People were sure, although they were wrong. Is that what you're saying?

MR. FLOYD: I think I would go along with the fact that we had mobilized our forces. Gary was holding hourly meetings with his senior staff. They had outlined objectives to be accomplished. They were pursuing in those directions continuously throughout the day. In that respect there is some sureness.

Now the fact that some of their efforts were futile or did not bring the desired result does not necessarily imply unsureness. They would not have tried it if they didn't think it was going to work. And they were proven wrong, maybe. But these are some of the disappointments in life, if you will. You'll have this anytime. To say that that is unsureness, I don't think is fair.

COMMISSIONER McPHERSON: You agree that some of the things that were done there were to use the Washington word "counterproductive"?

MR. FLOYD: Yes. I think that is a proper Washingtonian word.

COMMISSIONER McPHERSON; People might have been

quite -- But wasn't that true in Middletown as well, that they worked against the control of this event?

MR. FLOYD: Yes, Sir. Okay.

CHAIRMAN KEMENY: Some of the operators themselves said exactly that; that if they knew then what they know now they would have acted differently.

COMMISSIONER McPHERSON: Finally, you said to our staff in Middletown that "while this transient has been programmed on the B&W simulator" your concern is "that another remote and unanticipated transient might occur." I guess if there is a single purpose that I feel in these hearings and in our ultimate report, it comes under the very general rubric of what can be done by the federal government and by the private industry, but since we will be addressing ourselves in great part to the federal government, what could be done to makes these plants as safe as human beings can make them?

Now you were concerned about other unanticipated transients occurring and people not being prepared for them just as they weren't prepared for this one.

MR. FLOYD: Yes, Sir.

COMMISSIONER McPHERSON: This is, I suppose, a question for a philosopher more than an engineer, and certainly than a lawyer. But how big is that universe in your judgment? How much do we have to worry about it, as far as the unanticipated? How much of the realm of the possible have we covered

with our anticipations and our simulations? And how much is uncovered?

MR. FLOYD: We in the industry, I think it is safe to say, feel that we have covered our bases on any single failure. To do that we have exerted great effort and gone to great lengths.

COMMISSIONER McPHERSON: To the extent that you know about it.

MR. FLOYD: Yes, Sir.

COMMISSIONER McPHERSON: For example, you were asked earlier about the Michaelson report. I believe everyone in your plant has testified that they had no knowledge of that from the NRC even though a commercial paper had been circulated which did have information about that. So that there are some cases where either the knowledge is not circulated or where it is circulated but nothing is done about it.

MR. FLOYD: Or where it is unknown. And that is the unknown portion that I find so hard to cope with. I think we can improve the communications within the industry. That's not too difficult to do. Wave the magic wand and it will happen. But in making those comments to your staff, I have been in the industry for 20 years. My life has been devoted to it. I have been in training most of those 20 years of myself and of other people. Here we were proved wrong. So I've got to admit to the fallibility of those of us who try to decide what training

should be done. And if we go to multiple casualties, which would be the next level of sophistication, if you will, it is just an horrendous group.

You take combinations of a thousand things, for instance, and you protect the plant against those thousand single events. And now if you take them two at a time, all of a sudden you go up geometrically with the number of events that you want to protect or train to, as the case may be.

COMMISSIONER McPHERSON: Do you think it is possible to do that? To protect against such geometric possibilities?

MR. FLOYD: I do not think that is humanly possible.

CHAIRMAN KEMENY: Mr Floyd, let me ask you a follow-up question on that. I think a thousand things taken two at a time is about half a million. That's too much, of course, to put any individual person through, but computers certainly can handle that many possibilities. More seriously, do you feel it is impossible to build a computer simulator that will accurately simulate, reasonably accurately simulate the behavior of a nuclear power plant?

MR. FLOYD: No, Sir, it is not. But it will only be as good as its designer and its programmer. We have simulators in the country that didn't recognize this possibility. We have admitted to the human frailty, if you will; the human failing of being omnipotent and omnicient.

But computers could go a long way toward solving

these million or two million things, whatever they were. And in fact, direct digital control is another possibility that is a proven technology that is not being used in this field, for instance. Maybe it should be. It is something that it would be beautiful for you folk to look to.

CHAIRMAN KEMENY: Yes, I did raise that yesterday. But on the simulator, you see, there are two kinds of problems with building a simulation model. I'm trying to probe what it is you are concerned about. One of them is that they may simply not know something from a scientific point of view. We may be ignorant. For example, if Professor Taylor says there is a certain kind of chemical reaction that people had not thought about earlier, you can't build that into the simulator if you don't think of it. The other thing is simply if the simulation is too over-simplified and therefore does not give realistic answers.

It sounded to me as if the example you mentioned when you could not recreate this accident, you had the simulator which was providing infinite amount of supply for your steam generator. That was not out of ignorance but because it was an over-simplified model.

Do I gather from that that there is a great deal of room in those simulators to build more known sophistication into them?

MR. FLOYD: I guess in the extreme you build a

nuclear power plant without any nuclear fuel and some kind of a heater in it and you go from there. Then you've got as close as you can get to reality. And you don't overlook some things because it's there. It is physically the same machine. But once you decide that you are going to simulate it, then it is a question of what level of detail is necessary in the simulation. And that is a subjective judgment that is probably going to based on economics, as most decisions are in this old world, and something will be sacrificed along the way.

CHAIRMAN KEMENY: I believe Governor Peterson was next.

COMMISSIONER PETERSON: A point of clarification and then a question. You have this radiation monitor hanging in the containment building, and as I understand it, it is surrounded by a lead shield, so when it reads 8 rads per hour there are really 800 rads per hour in the building. Now you mentioned earlier that you had a reading at the meter face of 80,000 to 90,000 rads per hour. Does that mean 100 times that in the building?

MR. FLOYD: Yes, Sir.

COMMISSIONER PETERSON: So it is 8 million to 9 million rads per hour in the containment building?

MR. FLOYD: If you believe that instrument, yes, Sir.

COMMISSIONER PETERSON: And you don't believe that instrument?

MR. FLOYD: No, Sir. If we had that kind of activity in that building we would certainly be reading much higher levels through four feet of concrete than we are reading. And it is based on those readings on the outside of the concrete reactor building, on both the vertical walls and the dome, and extrapolating into the building what the source term in there really is that we are coming up with numbers in the 500-600 r pre hour range. I must point out that those are gamma numbers--the 500-600--whereas it is possible that this lead shield has broken down in some way and now the detector is sensitive to beta also. And I don't think we've heard any speculation on any numbers of what the beta dose in that building is.

COMMISSIONER PETERSON: Now, my question is, relative to your earlier comment about you were so concerned about running out of the borated water in that supply tank that you thought it was a smaller risk to the community to release the gases from the makeup tank.

MR. FLOYD: Yes, Sir.

COMMISSIONER PETERSON: Can you describe -- And you were concerned because that could lead to the very serious problem of a core meltdown. Is that what you said earlier?

MR. FLOYD: No. It is not directly related. It is just that the water in that tank was my insurance policy that there wouldn't be a core melt down.

COMMISSIONER PETERSON: My question then is, let's

assume our insurance policy is no longer available because the water is all gone.

MR. FLOYD: Right.

COMMISSIONER PETERSON: Can you describe what is going to happen there?

MR. FLOYD: Then I must go to the decay heat removal system and recirculate water out of the reactor building sump and cool it and then put it back into the building. And that, of course, has some dose consequences associated with it also.

COMMISSIONER PETERSON: But could you assure the community by that technique that there would not have been a core meltdown?

MR. FLOYD: Yes, Sir. I believe that is true.

COMMISSIONER PETERSON: Then why did you have that concern before about a core meltdown if you ran out of borated water?

MR. FLOYD: The difference is the system pressure was higher than would be delivered by the decay heat removal pumps. So once I go on recirculation from the building sump, I go into what we call a "piggyback" mode where I first pump it out of the sump with a decay heat removal pump--3,000 gallons per minute type pump, 300 pound discharge head--and then I have to boost that up in pressure to 1000-1200 pounds to get it back into the reactor coolant system with a makeup pump, high pressure injection pump. I have this now 300-gallon a

minute pump running in series with a 3000 gallon a minute pump and it has been tested and it runs that way.

End #11

Begin #12

The trouble comes in post accident if the sump is not clean. The BWST is full of clean water. The tolerances in that makeup pump are very tight -- In order to gain the high discharge head, the clearance, the mechanical clearances in it have to be very tight. And it would be a significant probability that when I went into the piggyback mode I could start destroying high pressure injection pumps.

That doesn't wipe me out of things to do. I still have fall-back positions. I can blow down the reactor coolant system to where the decay heat system can deliver water to it. It is something that we didn't want to do, just the same as we didn't want to use the decay heat removal system at that time. But there is that further fall-back position. Again, it will keep the core cool and you will have no problems with core melt.

With the gas in the system at that time I could not estimate accurately how long it would take to depressurize the plant to get onto the decay heat removal system. I had a race that would have been going if I would have tried that. I would have opened all the valves I could have opened, which were two, to try to depressurize that plant--maybe three. And while that gas is blowing out of there I am not going to be delivering water to the core if I've destroyed my makeup pumps

and I'm boiling water off of the core and I have a chance that if the blowdown takes long enough the core would become uncovered again, causing further possible zirc water or even fuel damage, more fuel damage in this case, would now be appropriate.

So although there were many paths available to me, I chose the one which I felt I had control of. It didn't cost an awfully lot to try it. It was a reversible position. I could back off from it if it didn't behave properly. And I still had some fall-back positions which were less desirable but usable in the extreme.

COMMISSIONER PETERSON: One other question. You had the hydrogen explosion in the containment building which led to this 28 pump -- split. Have you calculated what was the potential kind of pressure buildup that might have come if some maximum amount of hydrogen oxygen had collected in the containment building before it was ignited?

MR. FLOYD: No, Sir.

COMMISSIONER PETERSON: I presume you are going to do that now, right?

CHAIRMAN KEMENY: Before we excuse you, Mr. Floyd, I cannot resist asking one more question, since you are the last witness from the company. You know we have a mystery on our hands over those two valves. You seem to be unusually knowledgeable about the plant--you have demonstrated that.

First, do you have any knowledge of how those valves, or why those valves were closed on March 28?

MR. FLOYD: No, Sir. I've dug in some detail trying to find out.

CHAIRMAN KEMENY: You did? Since the accident?

MR. FLOYD: Yes, Sir.

CHAIRMAN KEMENY: Do you have any conjecture -- You made several interesting and I thought sophisticated probalistic statements. What would you think is the most probable cause, based on your past experience? I know this is not an overwhelming cause of the accident, but it just bothers us as a clear-cut mystery.

MR. FLOYD: Most probable cause is operator error. Whether that operator error occurred in the control room or in the switch-gear room or at the valves themselves, I can't say. The most probable, though, is in the control room.

CHAIRMAN KEMENY: Most probable is in the control room. That could have happened any time within that two-day period?

MR. FLOYD: Yes, Sir. There the two switches are in close physical proximity. The other location, the valves and the switches are far apart. At that point you may be coming into something deliberate.

CHAIRMAN KEMENY: You said if it is not the control room, then it is something deliberate. From the control room

it could have been some sort of inadvertent mistake?

MR. FLOYD: Yes, Sir.

CHAIRMAN KEMENY: Thank you for your very frankness on this. The witness is excused.

CHAIRMAN KEMENY: I think the concensus of the Commission is that we will take a ten-minute break now and then go through to the rest of the afternoon.

(WHEREUPON, the meeting recessed; and reconvened at 4:10 p.m.)

(The meeting reconvenes following the break.)

WHEREUPON,

PANEL V

BOYCE H. GRIER
JOHN G. DAVIS
NORMAN C. MOSELY
CHARLES O. GALLINA

Were called as witnesses herein, and after having first been duly sworn by Mr. Natalie, were examined and testified as follows:

MR. LUNDIN : Mr. Davis, perhaps you should identify for us your colleague who does not have a sign and doesn't appear on the printed list.

MR. DAVIS: All right, Sir. If I may, I would like

to make some brief opening remarks to perhaps context the Office of Inspection and Enforcement involvement in the accident, Sir.

I'm John G. Davis, the Deputy Director and currently the Acting Director of NRC's Office of Inspection and Enforcement. I'm accompanied this afternoon by Norman C. Mosely, on my right, who is the Director, Division of Reactor Operations Inspection in IE Headquarters. To my left is Boyce H. Grier, Director of the NRC Region I office located in King of Prussia, Pennsylvania. To Mr. Grier's left is Charles O. Gallina, a member of the Region I staff.

The Three Mile Island facility is located within Region I and IE inspections and investigation activities for Three Mile Island are conducted under the management of that office.

Routinely, the Office of Inspection and Enforcement performs the field inspections to determine whether NRC licensees are meeting the requirements placed on them by the license, the regulations, or any other means of levying requirements. The Office of Inspection and Enforcement activities with regard to the Three Mile Island accident are several. These include:

(1) Participation in the NRC incident response program planning. Under the NRC manual chapter that covers the NRC incident response program, the Office of Inspection and

Enforcement maintains the overall program coordination for the NRC incident response program. Under this overall program coordination assignment, IE takes the lead in the development and coordination of the program. The NRC incident response organization is a standy-by type organization. That is, the organizational and operational framework is described but the individuals who make up the organization have other normal work assignments and the incident response organization is activated when there is an incident or when we are undergoing a test of the response program.

The incident response organization is management by an executive management team composed of the NRC Executive Director for Operations; the Director, Office of Inspection and Enforcement; and the Director of Other Concerr Offices. I, for the Three Mile Island accident, was a part of this executive management team.

Under the executive management team is the incident response action coordination team, which we call IRAC. It is planned as the implementation support element of the incident response program. The IRAC is composed of the Division Director level managers from the appropriate NRC offices. It performs notifications and actions necessary for evaluating the incident. During the response it is planned that IRAC identifies significant problem areas, develops alternate solutions and presents alternatives to the EMT (executive

management team). Mr. Mosely was with IRAC during the Three Mile Island accident.

(2) As an incident unfolds, the Office of Inspection and Enforcement is responsible for the initial NRC response to the incident until the Executive Management Team is available. During this period technical assistance is provided to the Office of Inspection and Enforcement by other offices upon request.

As soon as this EMT (Executive Management Team) is assembled, it assumes management of the NRC Incident Response activities.

Now, in addition to pre-planning for the NRC Incident Response Program, for the Three Mile Island Accident, IE was involved in the implementation of the program both on the Headquarters and the Regional level. This involved activating the Operations Center, establishing communications, and dispatching Office of Inspection and Enforcement personnel to the site.

(3) The third element of the Office of Inspection and Enforcement involvement in the Three Mile Island accident is the conduct of the Office of Inspection and Enforcement investigation. This has been underway for about six weeks and currently is scheduled for completion on August 1, 1979. The investigation is still very active. We are, as I say, scheduling for August 1, 1979, but will have to reexamine that

schedule.

The IE investigation has two basic goals: (1) To establish the facts concerning Three Mile Island accident within certain defined parameters. The investigation consists of two parts conducted in parallel. We have an operation investigation. This considers the in-plant reactor operation situation and this will cover the time period from immediately before the accident to the restart of the reactor coolant pump 1-A at 8:00 p.m. on March 28. This will include the closure of the auxiliary feed water valve.

The radiological aspect of the investigation. This will consider the in-plant and environmental radiological conditions. Initially we had planned that the time period covered would be from the beginning of the accident until about midnight on March 31. We are reevaluating this period and may close it on March 30 rather than March 31.

(2) The second goal of the IE investigation is to evaluate the performance of the licensee in association with the Three Mile Island accident as a basis for corrective action or enforcement action as appropriate.

You should be aware that in addition to what I have termed the IE investigation, which as you will see is somewhat limited in scope, the NRC has underway a broader investigation.

In order to identify a little more closely the four people you see before you and where we were during this

particular accident, Mr. Mosely and I were in Headquarters during the accident associated with the Incident Response Program. Mr. Boyce and Mr. Gallina were at the site in association with the Response program.

Now, I personally and the IE staff members with me will be as responsive as possible to your questions. However, the IE investigation still is not completed. We hestitate to come to conclusions and judgments before our investigation is complete and evaluated. Our knowledge of details may not be sufficient to satisfy you. I do not believe it is of the level of your line of questioning with the previous witness. However, I will be happy to identify IE staff members who have more detailed information and to provide information in writing or to bring these staff members for your questioning.

That concludes my statement, Sir.

CHAIRMAN KEMENY: Mr. Davis, just one thing. As you identified where people were, I wasn't sure if I heard whether you said if Mr. Grier was on site or not.

MR. DAVIS: Mr. Grier moved to the site, I believe it was on Saturday.

CHAIRMAN KEMENY: On Saturday.

MR. GRIER: Friday, the 30th.

CHAIRMAN KEMENY: Friday. Thank you. I'll ask Staff Director Lundin to lead the questioning.

MR. LUNDIN: Mr. Gallina, we have just heard that you

were on site. Where were you at the time of the accident and how were you employed?

MR. GALLINA: At the time of the accident I was at the Regional Office in King of Prussia. At approximately 8:10 that morning of the 28th I was notified by the Duty Officer that an incident had occurred at Three Mile Island and that Regional response was dictated by our Response Plan. Being the Emergency Planning Officer for the Office on that day, I proceeded to the Management Center, helped set up communications there, and then responded with four other inspectors to the site.

We left the Regional Office at approximately 8:45 that morning and reached the Three Mile Island site at approximately 10:00 a.m. on the morning of the 28th.

MR. LUNDIN: Your being on site, then, was downstream to about 10:00 o'clock in the morning.

MR. GALLINA: 10:00 o'clock was when we arrived on site, yes, Sir.

MR. LUNDIN: When you arrived, who did you report to in the plant or who was your principal contact withe the licensee?

MR. GALLINA: Inasmuch as the Emergency Control Center for the incident was established in the Unit I Control Room, the five inspectors--there was one reactor inspector and three health physics inspectors and myself acting in the

capacity of investigator/emergency planning officer--we all reported to Mr. James Selinger, who was the station superintendent for Unit I. We then received a briefing on the plant status as of that time and the reactor inspector and the health physics inspector, one of each, were dispatched to the Unit 2 control room.

The remaining two health physics inspectors were assigned to perform confirmatory measurements of the licensee's readings, both on-site and off-site. I personally remained in the Unit I control room, coordinating communications with the Region and with Headquarters and providing an evaluation of the off-site doses that we were seeing at the time.

MR. LUNDIN: I see. So your principal responsibility was to communicate to off-site agencies and people about the off-site monitoring?

MR. GALLINA: Well, our function was two-fold. As a team we primarily were providing any information that we could back to the Region and to Headquarters. We were also providing preliminary evaluative function of what we were observing and the conditions that we were observing at the time.

MR. LUNDIN: By conditions you were observing, would that include in-plant status as well as off-site monitoring?

MR. GALLINA: Yes. It would include, as I mentioned earlier, one inspector was reporting on in-plant status of the reactor. One inspector was assigned to evaluate the

in-plant health physics. One inspector was assigned to survey on-site levels and confirm licensee's measurements. Another inspector was assigned to confirm the licensee's off-site measurements and provide us with that information. I was able to obtain, all this information was coordinated through me, and I was able to obtain the off-site readings inasmuch as they were all being reported to the Unit I Control Room.

MR. LUNDIN: Thank you. Did I understand you to say you were communicating, too, with your Headquarters in Bethesda during this time?

MR. GALLINA: Yes. From the time the incident was initiated or the time we received notification at approximately 7:45, an open line was maintained between Region I and Three Mile Island site. Some time later in the morning of the 28th a conference call set-up was instituted whereby I could speak to the Regional Office and to NRC Headquarters. Some time later in the afternoon a similar set-up was instituted in the Unit 2 control room.

MR. LUNDIN: Thank you. Can you give us the names and the locations at the time of the other--you mentioned other inspectors being with you?

MR. GALLINA: Yes. The reactor inspector's name was Mr. James C. Higgins. The health physicist that was assigned to Unit 2 was Mr. Donald Neely, N-e-e-l-y. The inspector that was assigned to on-site health physics was

Mr. Ronald Nimitz. The inspector assigned to off-site monitoring was Mr. Carl Plumly (phonetic). Shortly after we arrived, approximately an hour after we arrived, an additional investigator and an additional reactor inspector arrived. The name of the investigator was Mr. Raymond Smith, and the name of the other Reactor inspector was Mr. Walt Baunack, that's B-a-u-n-a-c-k.

MR. LUNDIN: Thank you. Mr. Gallina, in general terms, at least, how familiar were you, are you, with TMI-2 plant? Have you been there many times or was this your first visit?

MR. GALLINA: Well, I was the inspector in charge of inspecting TMI-1 with respect to emergency planning. This was several years ago when they were going for a license. I had not been to the plant in recent history, say, about a year or two. I had been there several times before, so I was relatively familiar with the plant, but I am not a reactor inspector, per se; although I have some background in nuclear engineering. So I am not intimately familiar with the reactor operations, but I had been there before.

MR. LUNDIN: Thank you. Mr. Grier, could you tell us how you were first informed of the accident and where you were at the time?

MR. GRIER: Shortly after I arrived in my office on the morning of Wednesday, the 28th, the Chief of the Reactor

Operations Branch, Eldon Bruner (phonetic), came into my office with information which he had just received with respect to Three Mile Island having declared the site emergency at 6:50 in the morning and the general emergency at 7:24. He indicated that contact was being made with the control room and that more information would be forthcoming. That was about 7:45 in the morning.

MR. LUNDIN: Maybe you can help us out on a small point. We understand that efforts were made to contact your office, I believe, shortly after, a few minutes after 7:00?

MR. GRIER: Yes, Sir, that's correct. I will explain our situation during off hours. Our normal working hours are 8:00 to 4:45. During off hours we have a duty officer system and an answering service, the telephone answering service which receives calls that come to the office on the published office number. Their instructions are, on receiving a call, to call the duty officer. If they are unable to reach the duty officer, they are to page him. The duty officer carries a pager. When he receives a page he is to call the answering service to get the message.

The initial notification received by the answering service was, I believe according to their log, about 7:09 a.m. The answering service called the duty officer according to procedure and did not receive an answer. They then paged the duty officer and did not receive the call-in. They called

again and by now I believe it was something like 7:20. They called the duty officer's home again. The phone was answered by the duty officer's wife who informed the answering service that the duty officer was on his way to the office. He subsequently received a second page while enroute but by that time he was practically at the office, so that he did not return that call until he got to the office.

Now, how we then got the notification is when we have an operator or receptionist, the telephone operator in the office who, on arrival the practice and procedure is to contact the answering service and get any messages that may have been left during the hours that the office was unattended. When she called at about 7:40 to the answering service she got the messages that we had gotten these notifications from Three Mile Island.

MR. LUNDIN: When did you arrive at TMI at the scene and what did you do, what were your duties when you got there?

MR. GRIER: I did not go to the site until Friday, the 30th. I arrived at about 4:30 p.m. in the afternoon. My responsibilities were to direct the Inspection and Enforcement inspectors who were on-site in support of the total NRC effort at that time. Harold Denton was on site and in charge of NRC response.

MR. LUNDIN: How familiar are you with the plant, TMI-2?

MR. GRIER: I had been to TMI-2. I am not familiar with the details.

MR. LUNDIN: Mr. Davis, were you at the site during the early on days that this accident?

MR. DAVIS: No, I was not.

MR. LUNDIN: You remained in your headquarters in Bethesda?

MR. DAVIS: Yes, Sir. I remained basically with the Executive Management Team group, with the Incident Response Program in Bethesda.

MR. LUNDIN: So you were involved with the accident in the Headquarters position from about what hour on March 28?

MR. DAVIS: I received my first notification, it was about 8:00 o'clock in the morning, and it came from Public Affairs, and it was basically, I believe, something along the lines of "have you heard anything about what is going on at Three Mile Island?" something like this.

CHAIRMAN KEMENY: Excuse me, Mr. Davis, for interrupting. You said you heard it from Public Affairs. Did Public Affairs hear it from --

MR. DAVIS: I'm sorry. The NRC Public Affairs.

CHAIRMAN KEMENY: Oh, I thought maybe you read it in the newspaper.

MR. DAVIS: No, Sir.

MR. _____: That, I gather, was a normal duty --.

MR. DAVIS: Beginning, as soon as I hung from this, I contacted Norm Mosely, as I recall, to have him begin to find out what the situation was up there. About the same time, as I recall, I got a call a few minutes after 8:00 from Boyce Grier. He informed me, basically, that there was a site emergency and I began the activation of the Center. I moved to the Center which happens to be in the same building in which my office is normally located, and began to make the calls for the Executive Management Team.

I had initiated, I believe, one call for the Executive Management Team to the Executive Director of Operations of NRC before I went to the Center. I call the other members of the EMT.

The physical location of these other managers is in buildings other than the building in which the Operations Center is located. So they apparently arrived at the Center about 8:50 a.m. and we proceeded to do our notification of the Commissioners and try to determine what was going on.

MR. LUNDIN: So from about 9:00 or 10:00 o'clock in the morning on your emergency team was together and functioning?

MR. DAVIS: Yes, Sir, the EMT was. Now the IRAC, which is another segment of the Emergency Team, was also functioning. In fact, it was functioning before I was, before the EMT was in total. Norm Mosely headed that up during these early hours.

MR. LUNDIN: Thank you. Mr. Mosely, you are, I gather, an associate of Mr. Davis, and were kind of walking in step with him during those early hours?

MR. MOSELY: Yes. Mr. Davis, as he has already said, told me shortly after he received his first call. I subsequently called a member of my staff and asked him to get in touch with the Regional Office and get additional information. Then shortly thereafter I went in to the IRAC--there are two rooms in our emergency center--I went into the IRAC room and had members of my staff begin initiating our emergency plan implementation.

MR. LUNDIN: Thank you.

CHAIRMAN KEMENY: I would like to ask one question and I will turn it over to you, Commissioner McPherson. Mr. Gallina, since you arrived on the site first, you said about 10:00 o'clock you were briefed about the status of the plant. What were you told at 10:00 a.m. that Wednesday that the status of the plant was?

MR. GALLINA: Well, to the best of my recollection, they told us about the plant parameters on pressurizer level, temperature, etcetera. They were trying to identify and isolate the release of radioactivity. Somewhat later that morning they informed us that they did believe they had steam voids in the system and were attempting to bring the reactor to a normal cooldown. So it was basically plant parameters,

pressure, temperature, etcetera, the releases they were getting and their attempts to identify and isolate the releases.

CHAIRMAN KEMENY: When that day did someone tell you that there may have been significant core damage?

MR. GALLINA: Well, no one actually ever made the comment that day or most of the following day that they believed that there was serious core damage. From the radiation readings we were receiving when we did arrive at the site, we assumed that there had been damage, the seriousness of which we could not determine at the time, because some of the parameters we would have liked to have seen, for example, primary coolant sample, could not be taken immediately due to high radiation areas in the plant.

So it was more or less something that we arrived at, the decision or evaluation that we arrived at based on the radiation readings we were receiving inside containment that there was some core damage, but we could not put a quantitative number on it at that point.

It wasn't until Thursday evening or Thursday afternoon when the primary coolant sample was taken did we know that there was significant core damage.

CHAIRMAN KEMENY: Okay. Commissioner McPherson.

COMMISSIONER McPHERSON: Mr. Grier, I will address this to you, or perhaps any of you who know best. With whom was your reactor man talking? At what level of Met-Ed, to what person was your reactor man speaking in order to get this information about --

MR. GALLINA: -- -- was given to us by the Station Superintendent of Unit I. He was the emergency coordinator and had plant status information. Once he went over to Unit II, he would have been interacting with several individuals -- I would say primarily with Mr. Gary Miller, who was in charge of Met Ed operations in the Unit II reactor.

COMMISSIONER McPHERSON: So he got his information from Gary Miller?

MR. GALLINA: I would assume that that would be the case. That would be his primary source of information.

COMMISSIONER McPHERSON: Okay. Let me ask you all to step back from the details of your getting there, and tell the Commission for what purpose you went to Three Mile Island.

MR. GRIER: Well, the purpose, I think, really is three-fold in our response. One is information gathering. Our role is one of inspection and investigation, and in responding to an incident I think it is principally one of information gathering and communicating that information to NRC headquarters.

To the extent that we have the capability, we make independent measurements of, particularly in the environmental radiological area, we have that capability and independent also in terms of inspectors actually reading plant instrumentation to verify the data that is being reported.

And thirdly, there is a rule of assistance, advice to the licensee. One particular aspect of that that has not

been touched on yet, we have a mobile laboratory attached to the regional office that is normally used in a routine inspectio program, visiting sites periodically to verify their analytical capability, particularly with respect to affluence from the plant.

On Wednesday, the 28th, that laboratory was on an inspection in Connecticut, at the Millstone Plant. The inspectors were notified immediately after our notification on the morning of the 28th to terminate their inspection at Millstone and proceed to Three Mile Island.

That laboratory reached the Three Mile site about 7:00 in the evening. And so from that time on we provided assistance to the licensee in terms of laboratory analysis of samples.

COMMISSIONER McPHERSON: Does anybody have anything you want to add to that?

MR. DAVIS: Sir, I believe in our pre-planning in response to incidents of this type, we had not looked upon NRC as a great source of resources. We are a member of the NRC Radiological Systems Plan, and other agencies have been generally looked upon as those agencies with more manpower for radiation monitoring and this type of thing.

COMMISSIONER McPHERSON: For radiation monitoring?

MR. DAVIS: Right, sir.

COMMISSIONER McPHERSON: What about your horsepower as

far as offering advice on the operation of the plant?

MR. DAVIS: Basically, in our planning, this advice or evaluation is really not -- we don't look upon the man who is at the site as the primary source of that, rather he is is communicating information back to ARAD, and ARAD back into Bethesda office, as the technical specialists that can look at that information and come to some conclusions and make some good suggestions.

CHAIRMAN KEMENY: Could I ask a question on that? I think -- I am intrigued by something Commissioner McPherson has thought of asking. Mr. Gallina, I believe, your background is you have a doctorate in Environmental Sciences; is that not correct?

MR. GALLINA: Yes, Environmental Radiation Science.

CHAIRMAN KEMENY: Radiation Science. So you are in that area, but you had with you a nuclear expert, a nuclear power expert, didn't you, when you arrived? Sombody --

MR. GALLINA: Yes, we had one inspector who was reactor-oriented.

CHAIRMAN KEMENY: What would his background be?

MR. GALLINA: I believe he's out of the nuclear Navy program, and he has been a reactor inspector with our office for some years. I am not sure of his background.

CHAIRMAN KEMENY: Would he have an operator's

license?

MR. GALLINA: No.

CHAIRMAN KEMENY: Would he have had the technical capability when he was at the control room? Suppose everything were being done wrong? I'm not saying that it was, but suppose everything were being done wrong, would he have been able to assess that and say, "Watch out, these guys are doing everything wrong"?

MR. GALLINA: Well, I think what they were doing that day, several inspections were happening at various levels among Met Ed management as to what probable or possible causes of the problems were, and what some viable solutions were. And I am sure that our inspectors contributed to that deliberation, if you were, assisted by our people at headquarters and our suggestions and experience were taken into account as a decision was being arrived at.

I'm sure that if something was being done in any gross fasion, misdone or done incorrectly, that the inspector would probably be able to identify it, if not immediately through discussions, in his background he could interject the fact that he felt it was not proper.

CHAIRMAN KEMENY: What action would you have taken or could you have taken, could you have taken control of the plant? I mean, we are trying to find out what the powers

and responsibilities of NRC are.

MR. GALLINA: I would say -- this is my own personal opinion -- that when we arrived at the site, implicit to our being there, we had veto power. The licensee would come up with an idea and put it out on the table in front of us, and I think if we said, "No, I don't think that should be done," they probably would not have done it.

I think one thing the Commission should realize is that the nuclear power plant is a very sophisticated piece of machinery, and no matter how much background and experience a team from NRC or anywhere else brings to the plant, there is no one that really knows that plant as well as the licensed operators. So it is sort of a teamwork arrangement between the NRC and the licensee that sort of goes on during the time period. I don't believe any of us would feel competent in taking over the plant.

CHAIRMAN KEMENY: Commissioner McPherson, I interrupted you.

COMMISSIONER McPHERSON: That's just the line of questioning I was going to pursue, and I am glad you have done it.

So when you got there, Mr. Grier and Mr. Gallina, you were performing this information-gathering which went back essentially to the NRC headquarters in --

MR. GALLINA: Region I in Bethesda.

COMMISSIONER McPHERSON: Region I in Bethesda, you made some independent measurements to check on what they were reporting to you from Met Ed and you offered assistance and advice, but for the Commission and for the public, the NRC does not ordinarily have either the authority or the inclination to march in and take over the plant. Is that correct? Does it have the authority?

MR. MOSLEY: Could I try that one?

COMMISSIONER McPHERSON: Yes.

MR. MOSLEY: We have the authority to order them to do whatever we feel is necessary to protect the health and safety of the public. We do not have the authority to directly run the plant ourselves.

COMMISSIONER McPHERSON: You mean you could tell them --

MR. MOSLEY: We could order them to anything that, in our view, was necessary to protect the health and safety of the public.

COMMISSIONER McPHERSON: You don't throw the switch yourself, but you tell them to throw it?

MR. MOSLEY: That's correct.

COMMISSIONER McPHERSON: Okay.

MR. MOSLEY: This would not normally be done by the inspector, but would be done from the headquarters, based on recommendations made by the inspector.

COMMISSIONER McPHERSON: Right. Were there, during the first day suggestions made by, or orders given by NRC?

MR. MOSLEY: No, sir, there were not. There were times when questions were asked like, "Have you considered thus and so?", but no orders were given.

COMMISSIONER McPHERSON: Was that because you didn't think that they were needed or because you were uncertain o. what to do?

MR. MOSLEY: I guess a little of both.

COMMISSIONER McPHERSON: Okay. The licensee under law is required to respond affirmatively to whatever you tell him to do for health and safety purposes?

MR. MOSLEY: According to orders, he is required legally to respond to orders, yes.

COMMISSIONER McPHERSON: Mr. Grier or Mr. Gallina, did you give any such orders during your time there before, say between Wednesday morning and Friday evening?

MR. GALLINA: Personally, I gave no specific orders myself. I do know of one order being given through headquarters, and that was to cease the dumping of the industrial waste treatment water that was being discharged in the afternoon of Thursday, the 29th. That was the only direct order I remember coming from headquarters when they were told to cease and desist an action.

COMMISSIONER McPHERSON: That came from --

MR. GALLINA: That came from NRC headquarters in

Washington.

MR. GRIER: It came from the Executive Management team --

COMMISSIONER McPHERSON: That was based on information that you had supplied that that dumping was going on, is that right?

MR. GALLINA: I do not know where the basis of their decision to stop the dumping came from ---

COMMISSIONER McPHERSON: -- --- it was more likely from you. Do you know if permission was asked of NRC before that dumping began?

MR. GALLINA: I believe some of the operators asked if that could be dumped it it was in regulatory limits. They did know they had radioactivity, but they said it was within limits, could it be dumped?

And I am not sure who answered that question at the time, but I assume that if it was within regulatory limits it could have been discharged at that time. At some point down the line a decision was made that apparently regardless of whether it was within limits or not it should not be dumped at this time, and that's why the order was given.

COMMISSIONER McPHERSON: Let me see if I understand that. An initial NRC decision was made that it was okay?

MR. GALLINA: I believe we were informed that they were going to make that release, and based on the information

we had at the time, the activity in that release would have been below established NRC limits for discharge.

COMMISSIONER McPHERSON: Were you asked about it specifically?

MR. GALLINA: Not specifically. I was asked which MPC to use for this particular discharge, and I referred them to the proper legal limit, but I was not asked specifically is it okay to dump.

CHAIRMAN KEMENY: Excuse me. What is MPC?

MR. GALLINA: MPC means maximum permissible concentration. It's a table in Part 20 that gives you a concentration limit as to what you are discharging offsite.

COMMISSIONER McPHERSON: Who would they ask?

MR. GALLINA: I am not sure at this specific time.

COMMISSIONER McPHERSON: Does anybody know? Well, how long did the dumping go on before somebody said stop it?

MR. GALLINA: I'm not really sure because it occurred when I was called offsite to brief the Governor on the conditions at the plant at the time, so I am not sure when it started or how long it went on.

COMMISSIONER McPHERSON: Would you describe your role as a briefer of the Governor and a briefer of state and local officials?

MR. GALLINA: Well, that briefing, one might almost say occurred at various levels, and at one level or another

was going on almost continuously. From the moment we arrived at the site at 10:00 in the morning, when we entered the Unit I control room, actually it is a shift supervisor's office immediately outside the control room, we had an open line to Region I and also an open line to the state of Pennsylvania.

So from the time we got there we informed the Bureau of Radiological Health in Pennsylvania of the conditions as we saw them. Any time they had a question they could call us on the phone -- they had a man assigned to the phone -- he would say, "They want you."

I would pick up the phone and talk to Mr. Jeruski or one of his staff from the state of Pennsylvania, and if he had a question, we would answer it as best we could based on the information we had.

COMMISSIONER McPHERSON: Were you the primary contact for them as opposed to Met Ed?

MR. GALLINA: I think it was shared depending on who happened to be there at the time. If it would be a plant parameter that they were interested in, I would ask the shift supervisor who would be Met Ed person to get that information and I would relay it back to the state.

It was both Met Ed and NRC people keeping the state informed.

COMMISSIONER McPHERSON: Is that procedure written

in law or regulations that the state and local officials will go through NRC staff on the site?

MR. GALLINA: It is not written that they go through us. It is written in procedures that the licensee maintains contact with the state, and that the NRC will also brief the state if necessary. So it was just an accepted thing to do that whenever they wanted something, whether it was NRC or Met Ed who could provide the information who gave it to them.

COMMISSIONER McPHERSON: Right. Were you asked by the Governor's office for your recommendation as to evacuation?

MR. GALLINA: No, sir, I was not.

COMMISSIONER McPHERSON: Were you, Mr. Grier?

MR. GRIER: No.

COMMISSIONER McPHERSON: Was anybody in NRC that you know of?

MR. GALLINA: I, subsequently, after the order had occurred, volunteered my recommendation, a negative recommendation in that sense , but no, I was never asked personally, "Do you think we should evacuate?"

When I heard that an evacuation order was given on Friday, the initial, what I refer to as accidental order, I personally based on the information that I was seeing offsite and conditions as were being reported to me, saw no reason to evacuate, and I did communicate my feelings to Region and to headqu[illegible]s.

CHAIRMAN KEMENY: Mr. Gallina, would you mind clarifying the phrase "accidental order"?

MR. GALLINA: Well, on Friday morning at approximately 9:00 or 10:00, everything was going pretty smoothly at the plant. Some conditions that they had worried about earlier in the morning with respect to let down flow had been alleviated.

The earlier puff release of radiation that gave the reading of 1200 MR per hour over the vent stack -- that condition had been corrected, and preventive actions were being taken to prevent it from happening again. All of a sudden one of the plant personnel coming on site came into the control room and was rather upset at the NRC. At the best I can remember, he said, "What the hell are you fellows doing? My wife just heard that NRC recommended evacuation."

So I immediately looked at the offsite plot plans and saw that there was no cause for evacuation to the general public. I called over to Unit II and talked to a reactor inspector over there and asked him if conditions had degradated to a point over there where something might happen. And he said no, things were getting better.

I asked them if they saw any reason to evacuate. They said no. So I immediately got on the phone back to Region and to headquarters and tried to stop, or tried to get information to the people that were making this decision, that evacuation was not called for. And I asked them to check out if, in

fact, the NRC had made such a recommendation as this worker had implied. I was informed some 20 minutes later that in fact someone at the headquarters level had unilaterally made some recommendation to the Pennsylvania Civil Defense, and about this time the state phone that I was working with picked up, and the state people were quite upset about this, and we tried our best to call back that evacuation notice, whatever it was, and we thought we were successful --

COMMISSIONER McPHERSON: What is the date or timing of this?

MR. GALLINA: This is approximately 9:00 to 10:00 the morning of the 28th. Excuse me, the morning of the 30th, Friday the 30th.

CHAIRMAN KEMENY: Excuse me. Did you discover, Mr. Gallina, who had called or issued such an order or recommendation?

MR. GALLINA: I was told who made the phone call. I do not have first hand knowledge of who ordered this gentleman to make that phone call.

CHAIRMAN KEMENY: Who were you told made that phone call?

MR. GALLINA: I was informed that Mr. Harold Collins of the Office of State Programs was ordered to make the phone call to the state.

CHAIRMAN KEMENY: Yes. Mr. Davis and Mr. Mosby, are you aware of this?

MR. DAVIS: Yes, sir, I have some recollection of this, and I would like to preface my remarks by saying that this is recollection, and it was somewhat a period of a little it of confusion.

As I recall it, on the morning, on that Friday morning we in EMP heard about this 1200 MR per hour reading which was taken, and we had some discussion about this, and some discussion with staff about this. And there was a fair amount of discussion about should there be an evacuation, should there be a protective action taken and so forth.

Again, as I recally, I believe that the EMP did decide as a corporate body to recommend that the Commissioners consider recommending evacuation.

Now, I am less -- I have been recalling, and I am even less sure with my next recollection -- I believe that Mr. Collins was in the EMP room when this was going on.

CHAIRMAN KEMENY: Excuse me. What is Mr. Collins' position?

MR. DAVIS: I believe he is in State Programs. He is the individual that Mr. Gallina referred to as calling the state Civil Defense.

CHAIRMAN KEMENY: He does not work for NRC?

MR. DAVIS: I'm sorry. Yes, sir. He is within the NRC, the office of State Programs. And I believe that Mr. Collins did make a call to Civil Defense. Now, I am not

certain what the substance of that call was.

COMMISSIONER McPHERSON: Just a few more questions.

MR. DAVIS: May I continue ?

CHAIRMAN KEMENY: I wish you would because you are leaving us in a very uncomfortable position.

MR. DAVIS: Then again, as these things were going on in the EMT room, we were seeking additional information on the 1200 MR reading. I believe there was some, at least opinion, among EMT members that maybe this was a continuing release which is what raised some concerns. As this progressed, as time went by, we heard that the release had stopped, so we began to rethink our recommendation for -- our recommendation for consideration to the Commissioners that there be some level of evacuation.

CHAIRMAN KEMENY: Mr. Davis, I still feel very uncomfortable. Does that mean that an employee of the NRC, your headquarter area, has the authority to call the state government and recommend evacuation?

MR. DAVIS: As I recall, according to the plan, the evacuation plan, the recommendation comes from the licensee to the state.

CHAIRMAN KEMENY: Well, did that employee of the NRC act illegally or -- I don't think that he committed a criminal act necessarily, but did something that was not according to NRC rules and regulations?

MR. DAVIS: Mr. Chairman, I am not certain what he told the state Civil Defense agency. I do not know whether he felt that he would give them a pre-warning alert that perhaps maybe the Commission would be making such a recommendation, you should get ready, this type of thing. I don't know what the conversation entailed.

CHAIRMAN KEMENY: Would that have been a reasonable thing for him to do?

MR. DAVIS: The Office of State Programs in NRC, I believe, has the responsibility for carrying on the operational interface with state-level people. And I would anticipate -- and I am speaking for proper motives of Mr. Collins that he thought he was giving them a little advance information so that they would be -- in other words, a step up, if in fact there was an evacuation.

MR. MOSLEY: Could I add, it is his responsibility and he had been discharging this over a period of time, to communicate with the state.

CHAIRMAN KEMENY: I see.

MR. MOSLEY: I am certain that the staff will interrogate Mr. Collins .

CHAIRMAN KEMENY: Yes, we will certainly want Mr. Collins interrogated.

COMMISSIONER McPHERSON: This was a Friday morning event, right?

MR. DAVIS: Yes, sir.

COMMISSIONER McPHERSON: Do you know if it was related to the venting of gases from the make-up tanks?

MR. DAVIS: Yes, sir.

COMMISSIONER McPHERSON: It was?

MR. DAVIS: Yes, sir.

COMMISSIONER McPHERSON: Mr. Floyd just testified about that, and he said he had talked to state Civil Defense about it. Had he talked to anybody in the NRC? Did he talk to you about it?

MR. DAVIS: No, sir.

COMMISSIONER McPHERSON: Did he talk to Mr. Grier about it?

MR. GRIER: No, sir.

COMMISSIONER McPHERSON: Did he talk to anybody?

MR. GALLINA: Not that I know of. The incidents that Mr. Floyd testified about differ somewhat from my understanding of what was actually happening that morning. True, the make-up tanks were being vented because of over-pressure as he described. The releases associated with that venting were expected to some exten because we knew that there was some minor leakage in the system that would vent in the aux building.

That is one of the primary reasons why the helicopter was put in the air because every time a transfer was made

where we believed that there might be some kind of leak, we would assign a team downwind plus the helicopter in the air, so if we did see an increased level we could terminate that release right away.

To the best of my understanding, it was pressurizer or release valves downstream from that operation that did lift inadvertently. The impression I got in listening to Mr. Floyd's testimony was he expected the 1200 MR per hour when he was doing this transfer.

My understanding of the situation was that we knew a transfer was occurring, but did not expect a 1200 MR per hour release. It was an unexpected release which terminated as soon as we received it. Of course, it takes some time for these release valves to recede, and then we took corrective action to see that it didn't happen again.

The state of Pennsylvania --

COMMISSIONER McPHERSON: Excuse me. He told you that he was going to release, is that correct?

MR. GALLINA: That he was going to be transferring --

COMMISSIONER McPHERSON: Transferring?

MR. GALLINA: Transferring. We knew that --

COMMISSIONER McPHERSON : Did he estimate what the release would be?

MR. GALLINA: No. If the transfer operates normally, you would not expect any high releases to occur. There would

be some minor leaking into an auxiliary building through whatever leakage pass existed, but as he mentioned before, this had been done several times during the night and did not result in any major offsite releases. So in the morning when we did get that puff release, it was an unexpected release as far as --

COMMISSIONER McPHERSON: Are you talking about an inadvertence here?

MR. GALLINA: Well, no one expects a release valve to open up. In other words, the transfer is done on purpose. That a gas tank down the line over pressurizes and a release valve opens up is not expected.

CHAIRMAN KEMENY: Mr. Gallina, I thought Mr. Floyd testified that he intentionally opened something to release the pressure.

MR. GALLINA: He did. But the systems downstream of the valve that he opened up, as I understand it, normally will handle whatever gas is released from that transfer operation, except for any minor leakage that may exist in the piping.

What happened was that some system downstream from that over pressurized and a release valve opened. The conflict I can't resolve for you personally at this time. I am just relating my understanding of what was occurring that morning.

COMMISSIONER McPHERSON: Well, I want to yield to Professor Pigford here because he can ask these questions better than I, but I'm like Chairman Kemeny. I thought Mr. Floyd was testifying to an advertent, knowing release which would vent some radioactivity, not that it would be a matter of leakage, but that it would be a matter of purposeful venting of gas to protect the system, knowing that it would release some down out into the environment, but that the winds would be such that it would not be serious. And you are saying -- that's not how you --

MR. GALLINA: That's not how I understood it at all, no, sir.

CHAIRMAN KEMENY: That's how I understood Mr. Floyd too.

COMMISSIONER McPHERSON: So you were never -- this was about 7:30 in the morning, I think. You were never told, and as far as you know no one else in the NRC was ever told by Mr. Floyd or any other employee of the licensee, "We are going purposefully to vent some radioactive gases but we don't think it is going to be bad"?

MR. GALLINA: That is correct. The understanding that I had at the time is that the licensee stated that, "We are going to be transferring some gas from one point in the system to another."

COMMISSIONER McPHERSON: Under your regulations, and

under the requirements of the licensee, wouldn't he be obliged to tell you if he was going purposefully to vent some gases?

MR. GALLINA: I don't know about obliged, but that had been the practice for the first three days. They were letting us know that they were planning on doing any purposeful release.

That's why I say, at this point in time, we had no knowledge that they intentionally wanted to release gas into the atmosphere.

COMMISSIONER McPHERSON: They were not required to do that? They just do it as a matter of courtesy or something.

MR. GALLINA: Right. Not courtesy, but that's the way we were operating for three days.

COMMISSIONER McPHERSON: Excuse me. Did you have a question?

PROFESSOR PIGFORD: Yes. Maybe to add to that, it's not clear whether you feel, did they intentionally open a valve that released something to the atmosphere or not?

MR. GALLINA: No, sir.

PROFESSOR PIGFORD: Then what caused the material to be released to the atmosphere?

MR. GALLINA: From what I understand, in transferring some of the make-up water, or opening a valve to release some pressure, well now this gas would normally be picked up by compressors, compressed, and put into a waste gas storage tank.

Okay, so that normal operation would not result in any purposeful release of radioactive material other than what you might expect from system leakage; in other words, leaks that you weren't accounting for. It's not a deliberate release to the atmosphere.

Now, as he stated, there is a minor leak into the auxiliary building, so a helicopter is sent up, teams were sent downwind just in case.

PROFESSOR PIGFORD: Mr. Gallina, the question is what caused the release? Do you know?

MR. GALLINA: The release was caused, to the best of my knowledge, by the over pressurization of the vent header and with the resultant opening of a release valve in that system.

PROFESSOR PIGFORD: What is your source of information? Has NRC investigated that?

MR. GALLINA: The source of my information came from one of the people in the Unit II control room that morning, because when I went onsite at about 8:00 and went to the Unit II control room to briefly find out the status, they told me what had happened, and this was the series of events as was related to me at that time.

PROFESSOR PIGFORD: Was there an NRC investigation of this subject?

MR. GALLINA: Yes.

PROFESSOR PIGFORD: Who told you that information?

MR. GALLINA: I believe it was a combination -- I believe it was a Met Ed employee and an NRC inspector together. They were looking over blueprints and --

PROFESSOR PIGFORD: Would you tell me their names, please?

MR. GALLINA: I cannot remember their names.

PROFESSOR PIGFORD: Who is carrying out the investigation now from NRC on what caused this release?

MR. GRIER: I think I can answer that. In this area the supervisor of the investigation is Al Gibson, radiological sequence of events.

CHAIRMAN KEMENY: I am still confused on this, Mr. Gallina, and I am ready to believe there was an honest misunderstanding there, but we have heard what I think is clearly contradictory testimony here .

PROFESSOR PIGFORD. Yes.

CHAIRMAN KEMENY: -- -- was that he had gotten permission for periodically venting these valves even though he knew that that released radiation, they were small in quantity, at the crucial point when he went through the agonizing decision-making process he had to make, he made the decision not to just vent it briefly, but to open up that valve and it stayed open for days, knowing that that would release

some significant amount.

I remember he used the following phrase that, "I had the helicopter up there monitoring it so that if it got too hot --"

I am sure he meant that if there was too much radiation being given off, "Then I would close the valve again."

So he clearly seems to be under the impression then that he was opening a valve which he knew would release radiation, and he would ask the helicopter monitor just how bad it was.

MR. GALLINA: Well, I can only say that the first time I heard what went on in Mr. Floyd's mind when he made -- or when he said what he did that time was when I heard it for the first time some minutes ago.

I know for a fact that whenever a major transfer of gas or liquid was going to be made that monitoring teams were sent downwind, and if possible, weather conditions permitted, a helicopter was sent up, so that if there was some leakage pass that we did not know of, we would spot it and terminate the transfer.

CHAIRMAN KEMENY: Commissioner Lewis.

COMMISSIONER LEWIS: Mr. Gallina, you said that you were sent there to get information. Is that correct?

MR. GALLINA: Yes.

COMMISSIONER LEWIS: Did you take any notes on what was going on when you got there? I mean, shouldn't you have in some written form some notes about how you got this information, who told it to you? Is that a --

MR. GALLINA: Well, at the time, as soon as we get the information, it would be relayed to Regional I and to headquarters, where message forms are filled out as to what the message is and who was delivering it.

COMMISSIONER LEWIS: So it is verbally relayed?

MR. GALLINA: Yes.

COMMISSIONER LEWIS: You don't have notes saying you understood this was the situation and this is the person who told you?

MR. GALLINA: No. This is what I say over the phone, and it is recorded both on tape and in written form.

COMMISSIONER LEWIS: Mr. Davis, what would happen to that information?

MR. DAVIS: It is recorded in our incident center, and these tapes, which we hope will enlighten a lot of us on a lot of things are in the process of being transcribed. There are quite a large number of these.

COMMISSIONER LEWIS: Okay. Would it be possible, Mr. Chairman, for us to get hose tapes?

CHAIRMAN KEMENY: Could we request copies of that when you have them transcribed?

MR. DAVIS: Very well, sir. However, I would

hesitate to promise any type of date. It is a monumental job.

CHAIRMAN KEMENY: I see. Well, in that case, would it be very hard to have copies made of the tape? It might be a simpler process.

MR. DAVIS: We have copies of some of the tapes. The problem is that this tape machine that we have had multiple channels, and it tapes something like 20-odd conversations, and it would have to be separated, and you have to sometimes -- to follow a conversation that was on two different phones, it is a little bit complicated to bring back. We are trying to do that presently, but let me point out that this will not identify sources of the information onsite.

What it would identify is who told it on the the telephone to us or to the Regional office.

COMMISSIONER LEWIS: Well, that's what -- I am trying to find out what Mr. Gallina learned, because obviously he can't remember where he got his information and I think it is important.

MR. GALLINA: If it is any help, going back to the evacuation, when the state did contact me on the phone that morning, this is after the initial evacuation order, they informed me that they had received a call from NRC headquarters, that the Civil Defense had received a call. They had also

received two calls from the site, one telling them that there was no need for evacuation, that everything was fine, that they had the puff release and the levels had gone down and the situation was ended; and another phone call from Mr. Floyd saying that he was contemplating evacuation of the site, and they wanted to know which one do we believe?

At that point in time we looked at everything we had and I personally, based on my experience, said that I saw nothing at that point in time that would warrant evacuation.

COMMISSIONER LEWIS: I guess what I would really like to know is, I think we need the piece of information on who told you what there because it is essential to the whole question of triggering evacuation, and we have a difference of opinion about what was understood about that release.

And I think if necessary we should get it unscrambled, but I think if necessary we should subpoena that tape.

MR. DAVIS: We will attempt -- I almost hesitate to promise this because of the mass of those tapes -- but I will see if staff can identify that particular portion.

CHAIRMAN KEMENY: Maybe we could listen to the crucial portion for a couple of hours on Friday morning?

COMMISSIONER LEWIS: Yes. When Mr. Gallina was specifically talking about the releases. That's the particular area.

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CHAIRMAN KEMENY: Yes, and if you have on that same tape the phone call the other gentleman made to Mr. Scofield, to the state office.

MR. MOSLEY: It is liable to be on any one of the channels, but certainly we will do our best and we can make anything available that we have.

CHAIRMAN KEMENY: Okay.

PROFESSOR TAYLOR: Just a point of clarification. In using the word "evacuation", what did that mean in this context of the phone call from NRC headquarters --

MR. GALLINA: Well, the first phone call, the word that we got back from the offsite employee and what we were able to check through the state, the first evacuation order was to evacuate everyone five miles downwind.

If I could back up for a second, my experience in emergency planning realizes that evacuation itself carries a risk. And unless the risk that you are trying to avoid exceeds the risk of evacuation, you really shouldn't be calling for evacuation. You could be doing more harm than good, expecially with respect to radiation when there is a fear aspect that unless you see something that requires evacuation, you don't even talk or mention the word to the public because you start a panic, so personally, I was very upset when this initial evacuation order went through,

and I don't know how it got to the radio,but it got to the media before it was even known to the people onsite.

PROFESSOR TAYLOR: Well, just as a matter of definition, you say five miles downwind. What does that mean? Having a picture that there is a direction --

MR. GALLINA: That's right.

PROFESSOR TAYLOR: But how big is the cone?

MR. GALLINA: At that point in time the wind was just meandering. There was no cone. Most of the release went up and most of it came right straight down on site because the wind was so low at that time, so no matter how I looked at it, no matter what aspect or point of view I wanted to look at it, I could not see any need for evacuation or --

PROFESSOR TAYLOR: I gather that you were thinking about all aspects of an order to evacuate.

MR. GALLINA: Yes.

PROFESSOR TAYLOR: When you were thinking the word evacuation in five miles, were you asking yourself how people would interpret that, or the extent to which anybody in the five mile radius, downwind or not, might accept the recommendation to evacuate?

MR.GALLINA: Why five miles? If I lived six miles, I might say, well if they are evacuating five miles, why not six or seven or ten?

That's why you don't call for an evacuation unless

there is a very definite reason that that release is going to continue for a known period of time, that you are going to expose people in accordance with -- there are guidelines for calling an evacuation, and we weren't even anywhere near that yet.

PROFESSOR TAYLOR: Now, I want to make sure that I understand. These considerations of the pros and cons, in particular some of the hazards of evacuating, were you communicating these in one phone call or several phone calls to headquarters?

MR. GALLINA: At this particular time, I was talking primarily to Region I and I guess that someone, I don't know who the specific individual was, but I guess to headquarters at the same time, telling them basically, "Find out who made the order and if at all possible, pull it back, because it is not called for."

PROFESSOR TAYLOR: Was that in one phone call or several?

MR. GALLINA: That particular one was one long, not long -- it appeared long to me -- but extensive phone call.

PROFESSOR TAYLOR: Was it a number of minutes?

MR. GALLINA: A couple of minutes. Two or three minutes. I was quite angry at the time.

PROFESSOR TAYLOR: Thank you.

CHAIRMAN KEMENY: Professor Marrett?

PROFESSOR MARRETT: Mr. Gallina, I want to go back to the time when you arrived at the Island. I believe you said you went immediately to what must have been the command control center, communications center. Now that center apparently had already established contact with NRC, both the regional office and the headquarters --

MR. GALLINA: Yes.

PROFESSOR MARRETT: Did I understand you to say at one point that you also talked with other persons, state officials for example, while you were there in the room?

MR. GALLINA: Yes, when we entered the Unit I shift supervisor's office, which for all intent and purposes is part -- it's right off the Unit I control room, there were two Met Ed employees sitting at a table, each with a phone off the hook, holding it in their hand, so nobody would hang up the phones. One was to Regional I, NRC. The other was to the Bureau of RAD Health in Harrisburg, and I informed both sources where we stood, that we had arrived and what the plant conditions were, as well as offsite releases at that point.

PROFESSOR MARRETT: Well, what the division of responsibility between you and the Met Ed people who were already there? Did all of you simply answer whatever calls came in? You made calls? What was the difference between

being an NRC representative and being a Met Ed representative in that room?

MR. GALLINA: Well, at the time that we entered the room, the people that were there from Met Ed were merely preventing the phones from being hung up, and once we got there, they departed. So my primary responsibility was informing the region, and eventually headquarters, of what information was being given.

Basically, I was channeling information from the licensee plus our own information that we were getting to the NRC.

PROFESSOR MARRETT: You were totally in charge then of that room after a short time?

MR. GALLINA: I would say for all intent and purposes the NRC took over that shift supervisor's office.

PROFESSOR MARRETT: Could you be a little more explicit about what intents and purposes -- does that mean there were other people who were still assisting or what?

MR. GALLINA: Well, for example, later on in the afternoon when it was discovered -- well, early in the morning it was discovered there was water in the auxiliary building, and the Unit I shift supervisor wanted to get together a party to go down there and cover the water with plastic to prevent or minimize off-gassing.

Now, they needed a place to get together to organize

and plan what they were going to do so they came into this room. It was quite a large room. So with us present they did their planning, and they just used that room for the planning purpose, then they left us alone. In other words, from that point on, we used that office in Unit I as a command post until trailers and other equipment arrived on Friday.

PROFESSOR MARRETT: I guess again I still have the question, what was the difference between your being there operating and what the Met Ed responsibilities had been? Are there to be different channels of information? Apparently you were relying very heavily on the expertise from Met Ed.

MR. GALLINA: Initially. When we first arrive, of course the only information we have is what they provide us. From that point on, we have our inspectors in Unit II that are getting information in addition to Met Ed information. We had our inspectors onsite doing surveys. We had our inspectors offsite doing surveys. And then we were coordinating with the mobil lab the following day when it arrived, getting samples counted.

So it is a combination. Primarily it is our information and the Met Ed information as desired.

PROFESSOR MARRETT: But perhaps I misunderstood earlier. I thought you said there's a sharp disadvantage one faces when walking into a plant, and thus unless you

have really been on the scene, it's almost impossible to know a lot of what's going on. Does that mean --

MR. GALLINA: To operate the plant.

PROFESSOR MARRETT: Does that mean that your inspectors have difficulty on grasping the same way that the Met Ed people know what is going on?

MR. GALLINA: Well, the difference would be something like this, if I can give an example. If a Met Ed employee were to say, "We are losing level in the pressurizer," our inspectors would know what that meant, know the significance, know how to evaluate that event.

If a Met Ed employee were to say the 12 valves are closed, our inspector would not immediately know what the 12 valves meant. In other words, every operator from Met Ed would know what the 12's are. They would probably know exactly where those valves are in the plant.

If they were to say the auxiliary feed-water valves are closed, again, our inspector would know what he is talking about. So as far as operating the plant or being familiar with the plant, the licensee is the best one as far as familiarity where every switch, and valve and panel and meter is. The significance of what is being recorded, or evaluated, in the control room would be understood by an NRC inspector.

PROFESSOR MARRETT: Is there any evidence of any inconsistencies between what your inspector might have thought

and what a Met Ed person in the same position -- that is, in this case -- were there always consistent recommendations?

MR. GALLINA: To the best of my knowledge, yes.

PROFESSOR MARRETT: I have one final question. I understand that the title is Inspector Emergency Planning Officer. Is that --

MR. GALLINA: No. My official title, as far as a job description is concerned, is Investigation Specialist. In the region we have various collateral duties, one of which is the Emergency Planning Officer. The Emergency Planning Officer has alternates, and I was Emergency Planning Officer for several years and then when I became an investigation specialist, I became an alternate Emergency Planning Officer. And it happens that on that day I was it. I was Emergency Planning Officer for the region. So I went there in a dual capacity.

PROFESSOR MARRETT: And it seems to me that is a fairly strange combination, isn't it? Because if on the one hand you are to investigate, how do you make the plans? Isn't part of the evaluating investigating the plans as well? So if you've got one responsibility to investigate and the other responsibility for being in charge of plans --

MR. GALLINA: Well, my primary responsibility that day was Emergency Planning Officer. I happen to be an investigator. I am not directly involved in the Three Mile

Island investigation as part of the team, mainly because I did respond and my actions are subject to investigation as anybody else's who did.. It's just a terminology problem.

PROFESSOR MARRETT: Well, I think it goes back to the larger question about the combination of inspection and advice because I believe that is what we were told early was the combination.

MR. MOSLEY: Pardon me. Could I add that we're making this a little confusing, and in his role in emergency planning, he reviews licensee plans, not makes the plans for them but reviews them and assesses them and tries to determine whether he thinks they are okay or not. He is not really inspecting or investigating his own work.

MR. GALLINA: Right. The reference I made before to having inspected their plan was two years ago when I was a Radiation Specialist in the Environmental Special Project Section. My responsibility was to inspect licensee emergency plans, so I am familiar to some degree with Three Mile Island's Emergency plan, having inspected them before they received a license. I have not done that specific type of inspection for over two years since I have become an investigator.

CHAIRMAN KEMENY: Governor Babbitt.

GOVERNOR BABBITT: Mr. Gallina, are you aware of any documents that describe what it is you should do and what your authority is and who you should communicate with

when you arrive on an emergency site?

MR. GALLINA: Yes. We have an incident response plan. I believe a copy was furnished to the Commission recently.

GOVERNOR BABBITT: Does that plan discuss the issue of who should be communicating with which utility official?

MR. GALLINA: It doesn't get on that specific a level because under emergency conditions you do not want to limit yourself to only communicating with a certain individual because he might not be available. It just states you maintain liaison between the licensee and NRC.

GOVERNOR BABBITT: Does that document, to your knowledge, say anything about the method of communication with state agencies?

MR. GALLINA: I am pretty sure it would state that we provide any information that the state may want, and we keep contact with the state.

GOVERNOR BABBITT: Mr. Mosley, referring to the IRAC Emergency Center, I take it there is a plan that governs your operation of that center?

MR. MOSLEY: Yes, sir.

GOVERNOR BABBITT: Does it discuss the issue of communication from the IRAC Center with both the utility and state officials?

MR. MOSLEY: Yes, sir.

GOVERNOR BABBITT: Designating how and when, presumably?

MR. MOSLEY: Well, it is not a detailed checklist. It is more overall guidance.

GOVERNOR BABBITT: Where does the Office of State Prorams operate from in this kind of emergency?

MR. MOSLEY: In this particular event they were operating out of a small office that is adjacent to the IRAC.

GOVERNOR BABBITT: Is their operation meshed or coordinated with the IRAC operation?

MR. MOSLEY: It is a part of the IRAC in our overall plan, yes, sir.

GOVERNOR BABBITT: And would their communication with either utility or state officials be subject to the IRAC plan?

MR. MOSLEY: They would be guided by the plan. I would rather say it like that than to say directed by the plan, because it is not that specific, as I mentioned.

GOVERNOR BABBITT: Well, then if somebody from the state Office of Programs wanted to call up Met Ed onsite for Bureau of Radiological Protection, they wouldn't necessarily refer to that plan or to their knowledge of that plan to determine how to do that?

MR. MOSLEY: Well, they would have general knowledge

of that plan. They would feel free, however, to communicate with the state. I would not expect them to contact the Met Ed however, the state people to contact Met Ed.

GOVERNOR BABBITT: To contact Met Ed you would expect them to come through the IRAC, is that correct?

MR. MOSLEY: That is correct.

GOVERNOR BABBITT: Okay. Mr. Davis, did you indicate that NRC is doing two entirely separate studies of the accident?

MR. DAVIS: There are two investigations -- I might say at least two investigations. There is the IE investigation which is under my office, and it is basically aimed toward --

GOVERNOR BABBITT: Is that the one you described in some detail?

MR. DAVIS: Yes, sir. Now, it is my understanding -- it is not my understanding -- there is under way a NRC investigation which is looking at broader areas than the IE investigation.

GOVERNOR BABBITT: Thank you.

CHAIRMAN KEMENY: Governor Peterson.

GOVERNOR PETERSON: I would like to ask the Specialist Department when your people became knowledgeable about the nature of the problem? You said you sent two inspectors to Unit II control room shortly after you arrived

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at 10:00 a.m. on Wednesday. When did your people tune in on such problems as the core being uncovered?

MR. GALLINA: The first indication that we had that the core had been uncovered came to myself personally and the other inspector who happened to be the one who was in the control room on day one -- the information came to us on Thursday evening when we returned from the Governor's press conference.

We had been told at that point that a primary coolant sample had been drawn and that it was reading 1000 R on contact, which indicated to us at that point that there was gross fuel damage.

GOVERNOR PETERSON: Well, your people were there Wednesday afternoon when they had the pressure blip at 1:50 p.m., the same time when the sprays in the containment, that building, were turned on. Did your people identify that? Did they realize that had happened?

MR. GALLINA: No, sir. Talking to the people after the fact when this item came to light, the primary concern of our people, as was the primary concern of at Met Ed, was to bring the reactor to a stable condition. During most of the day on Wednesday the 28th, we were encountering a situation which we had not seen before. It was something that we wanted to get the reactor in a stable condition.

During this time, several alarms and trips were

occurring. Make-up pumps were tripping. Some electrical failures had occurred. Things that were not directly related to the reactor operation per se. They were handled and more or less filed away.

For the first couple of days it wasn't our intent to go back and find out what may have initiated the incident. It was to bring the incident under control. It wasn't until late Thursday, early Friday, that we began to look back as to some of the things that occurred early on in the incident. And to the best of my knowledge, that is the first time that our inspectors in Unit II control room were told of the pressure spike and the possibility of a hydrogen burn.

GOVERNOR PETERSON: Could you get that information from the licensee rather than independently determining that?

CHAIRMAN KEMENY: Could I ask Mr. Mosley the same question? When did IRAC become aware of the fact that there had been severe core damage?

MR. MOSLEY: We, of course, believe that there had to be core damage on Wednesday in order to get the radiation levels that we were seeing and the releases that we were seeing. There just had to be core damage.

CHAIRMAN KEMENY: That's what I suspected you would answer. May I ask a question? Why didn't you tell Mr. Gallina who was onsite?

MR. GALLINA: I agree with Mr. Mosley on that. We knew there was core damage on Wednesday. The degree could not

quantitated until -- the severity or the core being uncovered was the question that was asked -- it was not really known by me until Thursday.

GOVERNOR PETERSON: How did you arrive at that? How did you learn that?

MR. GALLINA: Well, the primary indication that triggered it was the primary coolant sample. The dose rate on that sample indicated that there was quite a bit of fission inventory in the coolant.

GOVERNOR PETERSON: That was Thursday?

MR. GALLINA: That is correct.

CHAIRMAN KEMENY: I think we ought to allow Mr. Mosley to tell his side of the story.

MR. MOSLEY: Could I say this? I think that it had to have been that the cover was uncovered partly early on in order to get the core damage. There is no other mechanism which would postulate that would cause such an event. The extent of the core damage was not known until the primary collant samples came in, as Mr. Gallina has said. I think all of us at that time had a much better appreciation for the extent of the core damage.

CHAIRMAN KEMENY: Professor Pigford?

PROFESSOR PIGFORD: Yes. Mr. Mosley and Mr. Gallina, Mr. Stello, who apparently works for the same organization NRC, has testified more than once that he became aware of extensive

core damage on Wednesday, and I think he said that he thought it should have been apparent to everyone. Now, did he discuss this with either of you?

MR. GALLINA: No, sir. Not myself personally, no.

PROFESSOR PIGFORD: Mr. Mosley?

MR. MOSLEY: We, of course, were discussing these things almost continuously. I will have to say I don't recall Mr. Stello specifically discussing it with me. I think that all of generally had a feeling that there was core damage, as I have said. When you start quantitizing it or qualifying it in extensive, I don't believe that I personally was able to do that until the primary coolant samples were obtained.

CHAIRMAN KEMENY: Professor Taylor?

PROFESSOR TAYLOR: Mr. Gallina, when did you first become aware of the fact that there was a large bubble that was considered to be mostly hydrogen in the pressure level?

MR. GALLINA: I became aware of that on Friday morning.

PROFESSOR TAYLOR: Friday morning. Was that after you had come to your conclusions that an evacuation was not a good idea, or was it during that period or before?

MR. GALLINA: Well, the sequence of events -- the first time that I became aware of the hydrogen explosion, or extended burn, or whatever terminology you want to use, was after I learned of the evacuation order. I called to find out if there had been any degrading of the system that would

have called for an evacuation. I was informed by the inspector on the other side -- I am not sure of his name now because I just asked to talk to any inspector. And he said, no, we were in better shape now than we were this morning. As a matter of fact we have just found out that there may have been a hydrogen explosion on Wednesday. The containment pressurized at 29 pounds so we are really not worried about another explosion since the containment can take 60 to 65 pounds continuously, and perhaps could spike to 90 pounds. And he said there is a possibility of a bubble in the core, and that was the first time I had heard of the hydrogen bubble in the core was Friday morning.

PROFESSOR TAYLOR: When did you first get information that there was still a significant concentration, that is, one or two percent of hydrogen still in containment after the explosion?

MR. GALLINA: That was Friday morning, at the same time that I was informed that the explosion occurred on Wednesday.

PROFESSOR TAYLOR: So you were told that there was an explosion, but also that there was still some hydrogen in containment?

MR. GALLINA: I don't believe I was told that there was still more hydrogen. The impression that was given to me was that there was still some in there. I wasn't given

a quantitative number, but that the individual on the other side at least -- the other side of the line -- said, "We are not worried about another one because we have already had one and it appeared the containment took it well and burned up most of the hydrogen that was generated.

PROFESSOR TAYLOR: Well, did the question come up in your mind about whether that assured that there might not be a lot more hydrogen still in containment than accounted for that --

MR. GALLINA: At that point in time the inspector on the other end gave me the feeling that there was no immediate problem with another explosion.

PROFESSOR TAYLOR: Now, how about the hydrogen in the pressure vessel itself? What did people tell you about that in terms of the possibility of an explosion or its burning and rupturing the pressure vessel?

MR. GALLINA: Well, sometime later. It was not during the same phone call. I discussed this matter with some of the reactor operations people who felt that because of the hydrogen overpressure in the bubble -- in other words, the fact that they were at 1000 pounds and the bubble was under significant pressure, that any radiolytic composition would be negligible and that , if anything, the reactor might go the other way where oxygen would be consumed rather than produced. Therefore, they felt that the danger of the hydrogen

exploding inside the pressure vessel was not a real danger at that point.

PROFESSOR TAYLOR: Did they discuss with you at all what might happen if the hydrogen still in the pressure vessel got into containment and then exploded?

MR. GALLINA: If all of it got into containment? We never discussed that specifically other than, as I mentioned before, their feeling that some of it had gotten in on Wednesday and had detonated on Wednesday, and that the containment suffered no ill effects from it so they sort of felt that it was not a major problem at the time.

-- -- --- and had been detonated on Wednesday and that the containment suffered no ill effects of it so they sort of felt it was not a major problem at that time. It was still far away from the explosive limit, as they understood it. I believe the number I got later was 2.6 percent. So there was no immiment danger of an explosion at that point.

PROFESSOR TAYLOR: Did anyone tell you , or did you try to figure out yourself, on the basis of estimates the size of the bubble and the pressure how much hydrogen there was in the pressure vessel?

MR. GALLINA: The number I remember being told me was 1000 cubic feet at that pressure.

PROFESSOR TAYLOR: Well, what I am asking is whether you or anyone you talked to had converted that into pounds

or kilograms of hydrogen?

MR. GALLINA: No.

PROFESSOR TAYLOR: And then -- well, presumably since that wasn't communicated to you, no picture of how much energy might have been involved simply in the combustion of that hydrogen, whether explosively or slowly. Is that correct?

MR. GALLINA: No. No one ever put that --

PROFESSOR TAYLOR: Were you subsequently informed or did your own estimates of how much energy would correspond to the combustion of all the hydrogen that was in 1000 cubic feet of hydrogen at the ambient temperature at that time, and at a pressure of 1000 PSRs.

CHAIRMAN KEMENY: Perhaps Mr. Mosley might be an appropriate person to --

PROFESSOR TAYLOR: Well, I am trying -- I would like to get a picture of what was known at headquarters, but also onsite, and directly, specifically to Mr. Gallina.

MR. GALLINA: Well, one of the impressions I got in all these discussions was that the bubble itself was at that temperature and pressure approximately 1000 cubic feet. There was some feeling that no one could say for sure that it was all hydrogen, that a lot of zenon and other noble gases had been released, so it was a mix of gases.

So nobody ever really discussed, and I never tried

personally to calculate what would happen if that were all hydrogen,or if it all got out, or if it all had been detonated, because the numbers we were getting back were a measurement of what, in effect, had gotten out -- 2.6 percent hydrogen in containment.

So at that point in time we were far enough away from any explosive limit that I never considered it at that time.

PROFESSOR TAYLOR: Well, let me just ask this as a general question. Did at any time during the day on Friday, Saturday or Sunday, or even into Monday when the bubble size decreased sharply, did you find yourself reopening the question about whether evacuation would be advisable on the grounds of any significant possibility of a hydrogen explosion either in the pressure vessel or containment that might reach containment enough to release a substantial amount of activity?

Did you ponder that question, and if so, where did you come out in the answer to that question?

MR. GALLINA: Okay. I pondered that question several times during the course of that weekend. To my mind I had some idea of how the bubble was being reduced. In other words, by keeping under pressure it was being retrained or redissolved in the coolant, and by the pressurizer being vented into containment; in other words, degasified in the pressurizer and vented into containment.

We had indications of that because as the bubble shrunk in size the radiation level inside the containment started to rise, again indicating that a lot of the gas might have been zenon. And even as they were venting it and the bubble was shrinking, containment analyses were showing that hydrogen percent was not increasing dramatically.

And by that time we were planning to hook up a hydrogen recombinder anyway to get rid of whatever hydrogen they had. So at no point during that entire weekend -- as a matter of fact, at no point in time until I left the plant on April 7 did I ever have a fear in my own mind of the hydrogen bubble in the pressure vessel exploding, or a hydrogen explosion in containment that would have ruptured containment and caused a leak.

PROFESSOR TAYLOR: On the second matter, that is, not being worried about explosion in containment and rupturing it, big enough to rupture it, was the main reason that you were not concerned about that particularly, I gather , that there had already been a hydrogen explosion and the peak pressure had only been 28 PSI?

MR. GALLINA: That entered it. That entered it quite a bit.

PROFESSOR TAYLOR: Did you have any basis for knowing how much hydrogen was involved in that explosion that generated an explosion of 28 PSI? In other words, how could you assure

yourself that there wasn't a great deal more hydrogen potentially able to mix with air perhaps in the process of moving from the pressure vessel into containment where at some point it must go through a concentration at the detonation or flammability point?

MR. GALLINA: Well, I was never convinced -- again, based on what I had been told, and as I related earlier -- that it was all hydrogen. I do know, in the back of my mind, I had read the Rasmussen report and some other reports, I believe, that in your worst case accident, with all of the cladding involved, and all of the hydrogen involved, the possibility of a hydrogen detonation is considered, and that pressures that are expected to occur in containment normally do not reach a point where they would, by themselves, rupture containment.

So here I was looking at a situation where we had not even approached the DBA. There was core damage and hydrogen was formed, but in my own mind I never thought it would be enough hydrogen to reach a point where if it had all detonated at one time in containment, that containment would be ruptured.

PROFESSOR: Okay, so far as quantity of hydrogen is concerned, am I correct in that your recollection of the Rasmussen report put a kind of a limit on that? It said if all the zeconium had reacted, and all the hydrogen had

mixed with air and detonated or burned rapidly, that even under those conditions the pressure would not be enough to reach containment. Did that --

MR. GALLINA: That's my recollection, yes.

PROFESSOR TAYLOR: Thank you. Now, I am sorry, I interrupted.

CHAIRMAN KEMENY: I think, Mr. Mosley, you have been dying to join in the discussion.

MR. MOSLEY: I was hoping maybe to save you some time. I think that there has been a change in our chronology here -- there has been a change in responsibilities that you didn't understand. Earlier, about Thursday, a group of people from our licensing group was dispatched from headquarters and they were onsite. And it was their responsibility to assess the operation and the operational considerations that are not now covered by the operating license. So what we knew, what the NRC knew onsite, and the conclusions that were being reached by the NRC in headquarters is now in another group.

The people that you will be talking to later are the ones who are responsible for these things.

PROFESSOR TAYLOR: Now, it was when? It was on Friday, but what time did that shift --

MR. MOSLEY: Well, it shifted when the people arrived onsite. I don't have an exact time, but Thursday, it strikes

me Thursday afternoon, the first contingent arrived onsite, I believe Mr. Denton, and then a larger group arrived on Friday. He will be able to clarify those times for you.

But I wanted you to understand that there had been this shift. And at this point now, once they had arrived, the IE function became more one of assuring that the licensee was doing those things that the licensing people had agreed to rather than being the principle evaluator of what was going on onsite.

PROFESSOR TAYLOR: Now, we will be talking to Mr. Denton and Mr. Stello tomorrow. However, I --

CHAIRMAN KEMENY: Mr. Denton I hope today and Mr. Stello tomorrow.

PROFESSOR TAYLOR: Oh, I see. You are planning --

CHAIRMAN KEMENY: Yes.

PROFESSOR TAYLOR: I think I will stop this line of questioning.

CHAIRMAN KEMENY: I wonder what I said that brought that.

Let's see. Mr. Lundin asked the privilege of one more question.

MR. LUNDIN: Just one more thing, Mr. Chairman.

Mr. Davis and Mr. Mosley, to your knowledge has NRC ever informed Met Ed management of the fact that the liquid level in the pressurizer is a good measure of inventory, liquid

inventory in the plant, only when the temperature is below saturation?

MR. MOSLEY: As far as I know, the first time we informed Met Ed of that was when we sent out the 05 bulletin.

MR. LUNDIN: Thank you.

GOVERNOR PETERSON: May I ask a question about the emergency center before they leave?

CHAIRMAN KEMENY: If you make is short.

GOVERNOR PETERSON: You have an emergency center for this region. Are there other emergency centers around the country?

MR. MOSLEY: Each of the regional offices has their own center.

GOVERNOR PETERSON: And are they set up like the emergency centers around the country for natural disasters like floods and hurricanes?

MR. MOSLEY: I think Mr. Grier could maybe -- they are not -- they are more communications centers than these other things, but maybe Mr. Grier could talk to you.

MR. GRIER: Our emergency center in the regional office is simply a set-up that we have in the back part of a conference room with telephone communications, extra phone communications, and that is the extent of our emergency center.

CHAIRMAN KEMENY: Professor Pigford, last question.

PROFESSOR PIGFORD: I'll try to be brief, Mr.

Chairman.

Mr. Mosley, is Mr. Creswell or Mr. Streeker in your office?

MR. MOSLEY: Mr. Creswell is in the Region III office. He is an inspector in the operations group for which I have some responsibility.

PROFESSOR PIGFORD: I am inquiring about a memorandum which was offered by Crewswell and Streeker entitled "Conveying New Information for Licensing Boards" about the Davis, Bissey and Midland experience on the problem of pressurizer level indication, and on the issue of pressure release valves.

Now, why did this information go to the licensing boards without also going to the licensees?

MR. MOSLEY: The information went to the licensing board. It also at that time goes into the public document room. It is my understanding, however, that it is not normal practice for everything that goes to the licensing board to automatically go through all licensees.

PROFESSOR PIGFORD: I know, but this particular information which apparently contained experience which was relevant to a similar problem that happened in this accident would have seemed appropriate to send to all B&W licensees. Why was it not sent?

MR. MOSLEY: Well, the information was not new

information. It was a collection of licensee event reports that Mr. Creswell had reviewed and had come to some conclusions about.

PROFESSOR PIGFORD: Is it possible that an earlier report which is an inspection and enforcement report, 5346-06 was sent to the licensees earlier on this same subject?

MR. MOSLEY: I'm sorry. I don't recognize that number. Can you tell me what facility we are talking about?

PROFESSOR PIGFORD: David Bessy Units II and III.

MR. MOSLEY: The inspection report that you refer to was written about an inspection at David Bessy, is that correct?

PROFESSOR PIGFORD: Well, it's in this document which is your document. I don't have that report. I want to ask you about it. It is referred to in this document.

MR. MOSLEY: Well, I don't want to be argumentative. We don't send copies of inspection reports to all licensees. They go into public document rooms and the individual licensee who owns the facility that was inspected gets a copy of it.

CHAIRMAN KEMENY: Perhaps I could help you, Mr. Mosley, if you could answer the following question, or Mr. Davis. Who makes the decision which documents should go to all licensees?

MR. MOSLEY: Well, there is not a conscious decision made on each and every document. There are, by types, we have distribution lists. I am not sure that

answers your question, but that's the way we arrive at it.

CHAIRMAN KEMENY: I mean, would it be at Bureau level or at NRC headquarters level that a decision is made that certain documents should go to all licensees?

MR. MOSLEY: It is made at NRC headquarters level.

CHAIRMAN KEMENY: Then perhaps we might ask that question of later witnesses, Professor Pigford.

PROFESSOR PIGFORD: If I -- just one follow up. It says there are some indications that other B&W plants may have problems maintaining pressure level indications.

And my question is, apparently this inspection report was not sent to the B&W licensee. Is that right?

MR. MOSLEY: To the best of my knowledge, it was not. No,sir.

PROFESSOR PIGFORD: Okay. Thank you.

CHAIRMAN KEMENY: Thank you. The witnesses are excused. We will call one more witness today. We have informed Mr. Stello that he will be on first thing tomorrow morning.

Will Chief Counsel please call the next witness?

MR. NATALIE: Will you please come forward, Mr. Denton?

Whereupon,

HAROLD DENTON,

having been called as a witness and having been first duly

sworn, was examined and testified, as follows:

CHAIRMAN KEMENY: Mr. Denton, just a little introduction. We know you played a major role at some point. We have studied the chronology, so perhaps you could tell us very briefly when you first heard about the accident and what lead you to go onsite the minute you arrived there.

MR. DENTON: Certainly. I was informed by John Davis at about 8:00 Wednesday morning that the incident center was being activated because of the site emergency at Three Mile Island.

I elected to send my deputy to the emergency center. I had planned to leave town that afternoon. During the day I was continually informed about the developments. I went to the emergency center about 5:00 that evening. I spent the night there. I went down to testify to a system, testifying before Congressman Udall Thursday morning. When I returned, I went home and went to bed.

Friday morning I came in again to the incident center. I was involved in -- in fact, I should take responsibility for that recommendation to evacuate that was made in the emergency center that morning.

During the morning I received a call from the Chairman who had talked to the President. The Chairman directed me to get to the site and to take charge of the NRC operations to recover the plant. I stayed at the site for

approximately --

CHAIRMAN KEMENY: When did you actually arrive on the site?

MR. DENTON: I arrived at the site about 2:00 Friday afternoon, and I arrived with a selective cadre of about 12 or 13 NRC experts in the various disciplines that we knew we would be facing.

CHAIRMAN KEMENY: Mr. Denton, I didn't quite understand what you said about your responsibility in the evacuation order .

MR. DENTON: That morning when I arrived at the emergency center and was briefed on the developments during the night --

CHAIRMAN KEMENY: Was this still in Washington?

MR. DENTON: This was still in Washington. There was an increasing concern over the extent of core damage. By this time, we had some thermocuplar (ph.sp.) data.

At some time before I left on Friday morning, a report came in about inadvertent release of radioactivity at the site, that a helicopter in the plume was reporting a dose rate of 1200 MR per hour. There didn't seem to be any reports coming in as to the cause of the release, when it would be terminated.

I knew that the EPA guidelines for evacuation were evacuate when you could anticipate an exposure of 5000 realm

and that actions should be considered when the range exceeded 1000 milo-realm.

Based on the dose rate in the plume that was reported originally, we calculated that there could have been doses of 300 or 400 MR at the site, and perhaps 100 MR's at a mile distance.

Based on this information, and based on the EPA guidelines, the senior team in the incident... center, including myself, recommended that the Governor be told that the NRC recommendation was to evacuate. We were not able at that time to establish contact with the Commission. We, in effect, directed Mr. Collins to call the state, so he did not do it on his own initiative. It was with the recommendation of senior management, and largely my own.

He called the state that morning. We were also attempting to get in touch with the Commissioners themselves. Additional information kept coming in from the site, and within about an hour we realized that the source had been terminated, that the offsite doses were not as high as we had projected, and the Commission did make a different recommendation to the Governor, and the Governor, as you know, proposed a protective evacuation for pregnant women and children that morning.

CHAIRMAN KEMENY: Mr. Denton, during this period did you have an open line to the site? You refer to communication

problems.

MR. DENTON: My own memory of that is very poor communications. I had sent a team of people up Thursday, and as I said before, they fell into an Einsteinian black hole. It was practically impossible to get good information from the site.

I guess one of the lessons I learned is we need to establish at sites a senior spokesman, not only for NRC, but with management, with utility management. Someone who could tell us what they were planning to do next so that we weren't in a reactive mode.

My recollection of those first few days is we would get information after the fact, and then in the course of trying to figure it out, something else would have happened. And we were always sort of chasing the problem rather than being in front of it.

CHAIRMAN KEMENY: Were you in touch with the Commissioners that Friday morning? I wasn't quite sure what you said on that subject.

MR. DENTON: Yes, we did get in touch with the Commissioners that morning. We did discuss what we knew. The Commission asked for a lot more information than we actually had, such as wind direction, speed, how far offsite, what the dose rates would be, and in the course of discussion with the Commission, we were getting more and more information

from individuals such as Mr. Gallina, that indicated the problem wasn't perhaps as serious as the first flash had indicated. And so the Commission and the Governor spoke later that morning and I --essentially, I don't think we ever rescinded our original recommendation, but from the technical discussions we had we all concluded we had over-reacted about an hour after we had made the original one.

CHAIRMAN KEMENY: Commissioner McPherson?

COMMISSIONER McPHERSON: I will pass.

CHAIRMAN KEMENY: Commissioner Lewis?

COMMISSIONER LEWIS: I wonder -- was this around the time that you were talking in that famous or infamous tape of all your goings on when you said it was better to evacuate than to sit here and die? When did you say that? And I understand you tried to change that last word, but would you explain the circumstances under which you said that?

MR. DENTON : Yes. There was a continuous tape recording of about 20 telephones in the incident center. I understand there are 13,000 cassettes to be transcribed and reported. Some that have been released was the one that you have mentioned. My own recollection of that is, I don't think I would have said sitting here waiting to die. I think I said sitting here waiting to decide. My concern was that

if there had been a puff release of a cloud that read on the order of an R an hour, that we should evacuate promptly and get the people out before the plume reached there, and so I think I said rather than sitting here and waiting to decide.

And my concern was that every minute that went by was a lost opportunity and we could have reduced the exposure to the public in the downwind direction. So I tried to correct that to decide, although I guess I have not personally reheard the tapes to be sure that's what I said.

COMMISSIONER LEWIS: Okay. I just wondered.

CHAIRMAN KEMENY: Mr. McPherson.

COMMISSIONER McPHERSON: Mr. Denton, going back in your testimony, you have given in other forums, and you have been giving a good deal of it now. I think you could consider yourself a professional witness, but you testified that within a day after you arrived, an agreement had been made with Metropolitan Edison that NRC folk would review and approve all procedures of substance that affected either the nature of the cooling of the core, or had the potential of changing offsite doses. NRC would be made aware of any changes in advance that the licensee wanted to make in their plans.

That was in response, I take it, to that highly confused situation where you were playing catch-up ball?

MR. DENTON: Yes, sir. I felt that we had to get in the chain of command, so to speak, and know about the

proposed changes in advance. I had sufficient number of people in my own office at the site by Friday night. It was over 20 people, and they were experts in the various areas of reactor systems, emergency cooling systems, affluent treatment systems, and offsite doses.

I was able to staff the plant around the clock with very knowledgeable senior NRC officials so that any action that was contemplated by the licensee came to our attention and we reviewed the procedure, the contingency plans all in advance, and the ones with more serious implications were flushed off the chain for myself or Vic Stello, who was my relief on the midnight shift, to approve.

COMMISSIONER McPHERSON: Did you bring all those specia experts up because you lacked confidence in the Met Ed people?

MR. DENTON: I brought them up because I wanted my own source of information. These are the people I rely on normally during a review of applications. I knew that they were able to make the kinds of judgments I wanted in each of these areas. I guess I had felt by that time that the utility was operating in sort of firefighting mode. I was concerned that they were not contemplating the contingencies that might occur such as loss of all offsite power, what would happen if the research pump they were depending on failed, so I was very concerned that contingency plans be developed, and the "what if" game be played so that we would have a clear

agreed upon action rather than waiting for an unexpected event to happen and then have to cope with it afterwards.

COMMISSIONER McPHERSON: How would you rate the engineering strength of the Metropolitan Edison? That is, how would you rate their defense in depth against these possible contingencies?

MR. DENTON: I said to someone they were very thin. I went through I guess two phases of attempting to beef up the capabilities of the utility.

COMMISSIONER McPHERSON: This was after the --

MR. DENTON: After I arrived. I think I spoke with Mr. Dieckamp either Friday night or Saturday morning about the need to involve the industry who were -- industry experts in the kinds of subjects that we were looking into so they were operating in a mode different than a responding sort of mode. And I ended up speaking with the President Saturday morning suggesting this. I gave some of his assistants names of the principal U. S. companies involved in the nuclear business and by Saturday afternoon --

COMMISSIONER McPHERSON: I'm sorry. You gave the President's --

MR. DENTON: Gave his assistants --

COMMISSIONER McPHERSON: Is that President Dieckamp or President Carter?

MR. DENTON: President Carter. The names of the

companies that I felt should be more involved and by that afternoon we had a considerable contingent of industry experts beginning to arrive at the site.

Later on, I have forgotten exactly what time in the sequence, I became concerned about the utility's ability to carry out the procedures and plan that the utility group was beginning to develop, and I made a series of phone calls myself and so did some of --

COMMISSIONER McPHERSON: Could you be more specific about that?

MR. DENTON: I felt like all the employees at the site were putting out 150 percent effort, but they had gone around the clock for a number of days and were just really exhausted, and were not able to do the job with the care and quality I thought should be. And I called a number of individuals in the utility business including Mr. Lee, who is President of Duke Power Company, who owned three B&W reactors, and some other people, and there was considerable positive response from the utility industry. They began to show up, some that same day, in large numbers, and were integrated into the GPU organization, and in effect worked the opposite shift and so forth, and began to relieve the GPU organization for some much needed rest.

COMMISSIONER McPHERSON: They literally worked the shifts?

MR. DENTON: Yes,sir.

COMMISSIONER McPHERSON: People from Duke Power and elsewhere?

MR. DENTON: Yes. Both of these groups were really working for the utility, not for NRC. We instigated the effort, but they came to report to the utility and I guess by Monday or so we had established formal meetings with GPU every four hours in which their senior staff and my senior staff would get together and go over the plans for the next eight hours and go over a schedule and decide what was to be done, and set priorities and those sorts of things.

COMMISSIONER McPHERSON: Was this the Industry Advisory Group?

MR. DENTON: That was the group that showed up first, the people more from the B&W, GE, Westinghouse --

COMMISSIONER McPHERSON: Did they arrive -- was that your suggestion that they be convened?

MR. DENTON: Well, they may have done it on their own, but we certainly helped.

COMMISSIONER McPHERSON: I see. How did Metropolitan Edison regard this effort of Westinghouse and GE and other people coming in to assist?

MR. DENTON: Well, I think they were not adverse to it when I raised it, but I felt it was so imperative to do it, I didn't want to waste another day to see how

successful they would be, and I decided to use the leverage that was available to be sure that they would respond.

COMMISSIONER McPHERSON: Right. Now, many of us who heard about this accident before we were Commissioners of the Three Mile Island Commission had the impression that when you went up there, you were sent up to take charge of the plant; in effect, to make all decisions about the plant, and as well as about information that was put out about it.

The nature of the agreement, though, that you described is that you would review and approve all procedures that affected either the nature of the cooling of the core or have the potential of changing offsite doses, so in effect others, the Metropolitan Edison was still running the plant and making the decisions, but those decisions where they would have any --- -- -- -- with you and your people, is that correct?

MR. DENTON: Yes, sir. In the dark of night, sitting in the trailer, my staff and I occasionally discussed whether or not a takeover by the NRC, in effect, an attempt to operate the plant directly would be feasible or practical, but it was never a real consideration. We never came to that.

CHAIRMAN KEMENY: Mr. Denton, could I ask would you have had the power to do that? I mean, legal power is what I meant.

MR. DENTON: I understand that buried in the

Atomic Energy Act is a clause that gives the Commission authority to take possession of plants. Now, actually it was a rather unique democratic exercise between the state and the Federal Government and the utility. I don't think we ever contemplated that this would actually come to pass, and the arrangements were sort of worked out between the state and myself and the utility --

COMMISSIONER McPHERSON: Excuse me. You never considered that what would come to pass?

MR. DENTON: That we would get in this situation where it would be an ongoing, long-term problem to protect the public health and safety, and whether or not the NRC should ever have the operational capability to actually take posession of an operative plant. We never contemplated actually doing that.

COMMISSIONER McPHERSON: Do you mean you never contemplated an event of this magnitude occurring?

MR. DENTON: No, sir. I meant never contemplating the need to have my own operators in a plant in order to adequately protect the public.

COMMISSIONER McPHERSON: Would it be a good idea if NRC had a kind of nuclear SWAT team that it would send in to plants that were in trouble?

MR. DENTON: This has been suggested in several quarters. I think it is a good idea to have a team who is

now focused on the kinds of thinking that should be done in emergencies. My own preference is that we would never have people as familiar with the details of the plant operation as the actual operators in the plant, so in terms of our participation, I would prefer that it be in terms of approving plans and procedures and next step rather than the actual execution of the plans themselves.

COMMISSIONER McPHERSON: I understand. You have testified that while you never had to assume control of the plant, there were some serious arguments between the NRC team and Met Ed. Could you elaborate on that? Were they arguments about significant matters?

MR. DENTON: I think what I had in mind at the time was trying to accurately reflect. There were a lot of technical disputes between my staff members and utility staff members over the right means to accomplish objectives.

CHAIRMAN KEMENY: Mr. Denton, it would help me if you would give one example of that.

MR. DENTON: Well, let's just take, for example, the efficacy of flame arrestors in the line that we had had the utility to install in order to pump back waste gases from the waste gas storage tank into the containment, and the utility had installed some flame arrestors in that line in case there was an unexpected ignition when the system was activated.

Well, we had on the staff experts in this area and people who had spent a lot of -- part of their lives worrying about flame arrestors and so forth, and the utility had advice from certain outside people on flame arrestors, and they argued quite a bit. And I think there were a lot of --

CHAIRMAN KEMENY: Is this whether to have flame arrestors or what kind to have?

MR. DENTON: What kind of flame arrestors and how good they were, so there were a lot of technical disagreements in the sense that anytime you get a lot of technical staff together over the right way to accomplish missions, but there was never any serious arguments between the management of GPU and myself. It may be that I won them all, and therefore I don't perceive that they were serious arguments, but I wanted to say accurately that the staff did occasionally run into the trailer all upset over some technical detail, but by the time it came up to GPU's management and my own management, it was always resolved, and I never personally had to threaten Commission intercession in order to obtain our desires.

COMMISSIONER McPHERSON: Mr. Denton, I will ask you one last question. I suppose if anyone was aware of a single great contribution you made during that time, he was aware of what you did as far as restoring public confidence in

the integrity and candor of the statements that were being made. I'm not suggesting that earlier statements lacked either, but the sense was a great confusion of people being quite reluctant to spell out the whole story. I think Ms. Trunk could have a good deal to say about this since she was on the receiving end of a good deal of that information at Middletown.

What was the principle -- what principle did you carry up there so far as public information was concerned, what was the policy you were going to follow with respect to telling the public what was going on?

MR. DENTON: Well, I have been in the job long enough to realize I can only tell it like it was. I once told someone that if he knew what I know, you would think like I think. And the rebuttal was, so what do you know?

And when I arrived up there, I met in some lady's house who lived right across from the plant. She allowed me to meet in her living room, and I received a call from the President on her kitchen phone there, and one of the first things he asked that I do was attempt to fully and accurately inform the public about what was going on.

So I briefed the Governor Friday night, and then we went out to make a press release. He read a press release and I had never been much involved in press releases before, and then someone asked a question, and he said, "Well, Denton

will answer those." And so from that time on, it became sort of a regular ritual, and so I tried as best I could just to let people know what I knew. And I was briefed several times a day by my staff so I could go out and brief the public.

So I guess I tried to tell it like it was. I didn't go with any message to provide assurance or not assurance. It was just --

COMMISSIONER McPHERSON: I asked the question, even though it seemed a softball pitch across the plate, because it seems to me for the senior public official on the scene, the federal official on the scene, it's not an altogether easy question to answer when you have great fears and concerns and you know a whole lot about the specifics of those fears and concerns, the technical matters involved, it's -- I would think -- taking a very substantial risk for you to lay that out before the public and talk about things that might be because you very likely could stimulate a tremendous fear where it wasn't entirely justified. On the other hand, if you dissemble and evade and cover over, you will soon lose your credibility one way or the other.

The question of when to talk seriously about evacuation is, I would imagine, generally predicated on what you have already said about the gravity of the situation.

So when I asked the question what philosophy did you bring, I was certain that you would bring candor and wish

to tell it like it was, but also recognize that in the responsible position you were in, you had to gauge that to some degree the explicitness with which you talked about matters. Would that be a fair statement?

MR. DENTON: Yes. I didn't have any hesitancy talking explicitly about the status of the plant. The Governor and I did have an arrangement whereby I would provide him all the technical advice about the probabilities and consequences and risks, and he would make those social decisions involving the state of Pennsylvania. He felt he was the person to make an evacuation decision. I agreed with that. So I would be explicit about the status of the plant, but questions on balancing social costs in Pennsylvania was strictly his decision.

CHAIRMAN KEMENY: Governor Babbitt.

GOVERNOR BABBITT: Mr. Denton, there appears to be some chronology problems, Saturday the 31st. Now, you and Mr. Creitz appear to be divergent quite a bit in your estimate of the facts at the plant. Did you have any discussions with Mr. Creitz either on Saturday or prior to that time about how you might harmonize your views or whether or not there ought to be a designated spokesman, or whether or not you might refer disagreements to the Governor, or any other mechanism?

MR. DENTON: Well, I think the day that I arrived

on Friday, the company had prepared a press release that -- I have forgotten the substance of the press release, but it said the NRC and GPU say something. And I said, "I don't think that's the way we want to operate. You know, you can make those statements as you like, but I think we will reserve and we will say one ourselves."

Then I think Saturday it did work -- we did not attempt to harmonize our press releases on Saturday and I think the differences is what at least partially led the company to terminate their press conferences and I became, in effect, the spokesman for all that was going on.

GOVERNOR BABBITT: Prior to the time that Mr. Creitz retired from the field, was there no discussion between you and Mr. Creitz on parameters of the problem and what the conceivable solutions were?

MR. DENTON: Not between Mr. Creitz and I. As I mentioned, by that time I did have staff around the clock in all the principal operations that were going on in the plant and we had our own knowledge of the status and potential development, so there were at the staff level, but Mr. Creitz and I, I don't think spoke on Saturday.

GOVERNOR BABBITT: Do you have any idea what the discussions at the staff level were about how the problem might be -- conceding as you would, I suppose, that it was a serious problem?

MR. DENTON: I don't think that Saturday there was any discussion between what they might say in a press release and what we might say. I think there were discussions technically over the issues that were current on Saturday, but I don't remember any attempt to coordinate our press releases.

GOVERNOR BABBITT: I am not suggesting, incidentally, that anybody was trying to blend the facts. My concern is a very difficult problem in terms of public psychology and public information appears on the face of this to have been resolved by one party unilaterally heading for the hills, and I am just wondering as a matter of procedure whether or not there was any discussion of how to solve the problem other than simply one party picking up his ball and going home?

MR. DENTON: Well, I sort of blundered into that problem. I had never given it any thought before and certainly at the press conference that I had Saturday a lot of the original questions were on why do you differ with the previous press conference, and in some areas the differences were rather minor, over numbers, and we might actually agree over range, and others they may have been more substantial.

But I think there was concern in Washington by that time over the need for one spokesman, and there were various pressures other than just my own that led the company to terminate its practices.

GOVERNOR BABBITT: Did you have any occasion to

discuss that issue with either Governor Thornburg or President Carter?

MR. DENTON: I'm sure I discussed it with the offices of both those individuals. I don't remember whether the Governor or the President himself were involved, but I did have discussions with Mr. Powell and Mr. Critchlow, the Governor's press secretary over the confusion that was resulting from more than one spokesman for a single fact.

GOVERNOR BABBITT: Did you advance any suggestions as to what they might do about it?

MR. DENTON: No, I didn't. I think it was more or less forced upon me the other way, that I should be the spokesman, and I accepted that role.

GOVERNOR BABBITT: Now, if I might just drop back to the general working relationship between yourself and Met Ed from the time you arrived on the scene. Who was the Met Ed official that you made decisions with to the extent that it was necessary?

MR. DENTON: I think on the first day, on Friday, I met briefly with Mr. Herbein, who was operating out of the visitor's center, a very small room in the visitor's center, a rather chaotic situation I thought.

I met Mr. Creitz, I believe, out in the yard. It was the only place to meet. And I went over to the lady's house right across from the plant and met Mr. Arnold. And it

was at that time that I met with the press briefly saying I would get back to you, and described to the company my plans, the groups I had formed, what my intentions were, and sent the staff out into the plant.

From that time on I met principally with Mr. Dieckamp when he arrived, Mr. Arnold, and Mr. Herbein, and members of their staff. In other words, I would visit their location which became trailers when we initiated a problem. When they had problems they would come to see me. And we did have our staff in several staff meetings a day to discuss the various issues that were going on.

GOVERNOR BABBITT: Now, if I understand your previous testimony, you seem to suggest that your respective staffs managed to work out all disagreements in your favor without the necessity of your going across to Herbein, or Creitz, or Arnold to fight it out with them. Is that in fact correct?

MR. DENTON: Not all, but most. I think this is an area that maybe isn't entirely clear, and when I talk about the disagreements between staff, I just wanted to be factual that tenacle staffs do argue back and forth over a lot of --

GOVERNOR BABBITT: You don't profess for a minute that there was a lack of a good faith and games which you might play. The disagreements are indeed inevitable.

MR. DENTON: But as they worked up, we would either

send them back to the drawing board to do more studies and do it our way and so forth. There were very few instances I think that required serious discussion between the company and I over how to do things.

For example, one issue I remember being involved in that was important was the beginning of the NRC investigation and the need for our investigators to talk to operators. The company was very concerned that the investigators not talk to operators while they were on the job, and I was concerned about the same thing of diverting their attention from the very job that we hoped they were doing that day.

And so Mr. Grier and myself did meet with the company and worked out an arrangement whereby our investigators would talk to those operators as they came off shift and would have, in effect, a day off so that investigations could begin and that there would be a certain number of operators that would have a day off each day. And these would be the operators that our investigators would talk to.

So that kind of thing did elevate up to my level and we'd work out how it was to go.

GOVERNOR BABBITT: Do you recall who you met with to negotiate that agreement?

MR. DENTON: I think that was Mr. Arnold.

GOVERNOR BABBITT: Was that reduced to writing, to your knowledge?

MR. DENTON: I didn't reduce it to writing. It just went into effect. It was one of those--in those early days, we didn't document a lot except to call back to Washington, all of which was recorded.

GOVERNOR BABBITT: Could you recall any incident where you negotiated with Arnold, Herbein, or Creitz, or anybody at that level over operational decisions in terms of controlling the incident?

MR. DENTON: Well, we were--we operated in two modes. One was we thought a lot more action should result to cope with contingencies, that the recombiners should be put in the containment, they should be made inoperable, you know, right away; we should get the pumpback system; we should make changes in the heat transfer system, so if we lost the condensers, we'd have cooling modes and so forth, so we were constantly pushing the utility to do more faster. And then occasionally there were things which they had actually done or accomplished, and it would turn out we weren't quite ready to approve its operation because we didn't think the leak type test had been performed adequately, or we would disagree with a procedure at the end.

So we were rather heavily involved technically, I think, from Friday and Saturday on, but I really don't recall specific instances where there were major, major differences. Either they convinced us that it was the prudent thing to do, or they just went and did what we suggested. Maybe while we're combing back through all these phone calls, I could find some examples for you.

COMMISSIONER BABBITT: What you seem to be suggesting is that there wasn't any formal two-step process by which staff disagreement was surfaced.

MR. DENTON: No, it was dealt with just when it occurred. Things were on a round-the-clock basis, and we

didn't have the luxury of a formal decision making process.

COMMISSIONER BABBITT: (Inaudible) testimony--

CHAIRMAN KEMENY: Governor Babbitt, could I just ask one thing on that? I'm wondering if Mr. Denton is being very polite here. That kind of decision reminds me of things I get involved in occasionally. Was it clearly understood during this process that if the disagreement could not be resolved at the staff level, if it rose to your level and it still was not resolved, that your decision was final?

MR. DENTON: I don't know when the utility came to that view, but I think they would agree that it was an unequivocal understanding after a few days.

COMMISSIONER BABBITT: Mr. Denton, the original agreement that you referred to by which you would review and approve all of these certain category of action--that was an oral understanding, was it?

MR. DENTON: Yes, sir.

COMMISSIONER BABBITT: Okay. We've heard testimony that I believe on Thursday prior to your arrival at Three Mile Island, that there was a mandatory NRC order to cease dumping waste water that came from Washington. Were you a party to that order?

MR. DENTON: I think that was after I had retired from the scene on Thursday, but I do remember that kind of discussion.

COMMISSIONER BABBITT: Do you recall whether or not there was discussion between Washington and the Met Ed officials at Three Mile Island?

MR. DENTON: I think it was prompted as much by concerns of the state and discussions between the state and perhaps the Commissioners that led to that decision.

COMMISSIONER HAGGERTY: Mr. Denton, are you acquainted with the letter from Thomas Novak of January tenth, 1978, on loop seals and pressurizer surge line?

MR. DENTON: Yes, I am.

COMMISSIONER HAGGERTY: Were you acquainted with it at that time, in January 1978?

MR. DENTON: No, sir, I wasn't acquainted until recently.

COMMISSIONER HAGGERTY: Until when?

MR. DENTON: Just recently in the past--

COMMISSIONER HAGGERTY: I see. Who would be responsible at NRC for making a decision on whether information that seems--I'm sorry, at least to be as vital as this, should be more broadly disseminated?

MR. DENTON: Yes, I would be responsible, and the officials who supervise Mr. Israel--I talked to him today, and to Mr. Novak, and to Mr. Ross. All three people were involved in writing it. Mr. Israel indicates that he became concerned about this after the Davis-Besse event,

and perhaps in connection with a review of Pebble Springs, led him to be concerned about the manometer, but he didn't see it as a great big problem, but just as something that should be documented, so he wrote the memo; it was signed by Mr. Novak. Mr. Novak didn't think at the time it had lots of significance, but was something to do better. Mr. Ross apparently gave it less time than Mr. Novak did. Ordinarily in our process, the staff, if they think changes need to be made in our standard review plan, they forward it up the line to what we call the Regulatory Requirements Review Committee, which is a senior management group. They meet on changes being proposed by the staff, decide, does the change go far enough, or does it go too far, and these changes are put in a formal chain. So I think the situation at the time was that the individual responsible didn't see it as a quantum improvement, but as a relatively minor thing, and they wrote a branch reminder to the reviewers to look at in the future.

COMMISSIONER HAGGERTY: This is addressed to RSB members. What is RSB?

MR. DENTON: That's a branch of people who review reactor systems, and I--about 14 people who worry about thermal and hydraulic--

COMMISSIONER HAGGERTY: It would be his own people, then.

MR. DENTON: Yes, sir.

COMMISSIONER HAGGERTY: It's quite (inaudible) in its description of difficulties that actually evolved, and it's quite clear that if this information had been in the minds of operators or certainly of engineering personnel, they would have looked with a completely different view at the signals they were getting. Is that right?

MR. DENTON: I think my own view is that it is significant, but probably not as significant as the Michaelson report would have been if that had been widely understood.

CHAIRMAN KEMENY: Yes. When did you become aware of the Michaelson report?

MR. DENTON: After the accident.

CHAIRMAN KEMENY: After the accident. I see.

Let's see, there was Commissioner Marrett and then Commissioner Lewis.

COMMISSIONER MARRETT: As I recall, at our first meeting, we had a statement from the Executive Assistant to Governor Thornburgh that said the Governor had considered declaring a disaster, because of course that would include--involve then a number of Federal agencies--but that the White House advised against the declaration of a disaster. Do you have any information on that?

MR. DENTON: No, I don't. I think those discussions probably took place before I arrived.

COMMISSIONER MARRETT: Do you--was there anything other--you indicated the constant communication you had with the White House in terms of your informing, at least, people there what was going on. Was there anything coming the other way, that is, advice to you in terms of not simply your role, but what possibly should be done in the area?

MR. DENTON: No, I really didn't get advice in the technical sense, either way.

COMMISSIONER MARRETT: But what with reference to your earlier comment about the--I guess the way to put it is, expressed preference, if there could be a single voice speaking. Did I understand you to say that that was in a sense suggested?

MR. DENTON: Yes, it was. And there were discussions along that line and I think during the first few days, and once a pattern got established, everyone was satisfied with it. But I think on Saturday both the White House and the Governor's office were concerned over the differing sources of information.

CHAIRMAN KEMENY: Commissioner Lewis.

COMMISSIONER LEWIS: Mr. Denton, you emerged from this as the man in the white hat, and that's fine. But I'm rather concerned about your normal role at the NRC. You're the Director of the Nuclear Regulatory Commission's Office of Nuclear Reactor Regulation.

Let me ask you first, what does it say about your licensing and the efficacy of the job that you normally do, when we would have an incident like this? Does it trouble you? Does it make you have second thoughts about the job you've been doing up to this point?

MR. DENTON: Yes, it does. And I think the fact that when I got back in town, I recommended shutdown of all the other B&W plants; then we expect to make a number of changes in plants as a result of this. It has--I actually think that we had become somewhat complacent in the number of--we'd had 400 reactor years without a major accident, and maybe there had gotten to be a mind set, all the parties involved, that the framework of regulations and review and ACRS resulted in a plant which was very unlikely to have these kinds of accidents. And now we're going back and looking at the whole situation again.

COMMISSIONER LEWIS: What I'm really referring to is the public perception of agencies like the NRC, is that here is our marvellous Federal government. The watchdog is looking after the people's interests. And people like Anne Trunk who live in Middletown have discovered that it really wasn't worth very much in a crunch.

You say there's complacency. Is it possible also that the NRC is so--I'll use the word chummy-- with the nuclear industry that you really haven't been able to do an

adequate job of regulation?

MR. DENTON: No, that was a concern over chumminess, if that's a word--was one of the reasons, I think, that the AEC was broken into two parts, the NRC and ERDA, at the time. I think my own view is that industry had become so reliant on NRC that they weren't doing a proper job of worrying about safety in their own plants. I think they had gotten in the mode where we asked for another valve or another pump, it would be put in. And there was somehow the feeling that the Commission had this omnipotent view of reactor safety. And I'd like to see a move back toward making the utilities more responsible in the first instance for their own safety, and get us in an auditing role so that we don't have to identify every change in every plant out of Washington.

COMMISSIONER LEWIS: Are you saying then that the utilities tend to see the NRC regulations as a base, a minimum; they don't really do any more than that?

MR. DENTON: I don't want to make a blanket accusation on that line, but I don't think they do enough, and I think we're looking for mechanisms to be sure they do more. There has been concern, for example, over the fact that GPU did not react to the Davis-Besse incident more strongly. We get 3000 LER's a year from plants; a wide spectrum of malfunctions are reported to us. We do

send out computer listings of these to all the utilities, and I know that we sent four to Met Ed and four to GPU in December of '78. We also sent out a description of the Davis-Besse accident to all utilities. But we don't require the utilities to look at each one that happens in a sister plant and propose back to us what should be done differently. It's more that they wait for us to analyze all these LER's and then send out directives to what should be done differently.

CHAIRMAN KEMENY: Let's see, that's an interesting line which was suggested to us before, that one effect of having a great deal of regulation is that the companies respond more to regulation than worry about safety. I gather from your comments you would share that concern.

MR. DENTON: Yes, I do, and I'd like to look toward the FAA system a little bit, whereby there are employees in the companies paid by the company perhaps, but whose job it is to look at licensee event reports and tell us, the Commission, what should be done differently in that plant, to avoid the Davis-Besse kind of problem.

CHAIRMAN KEMENY: Yes, that's an interesting suggestion. You said that after you got back, you made the recommendation that the B&W plants should be closed. I would be very much interested if you could just touch the highlights of what you have learned from this incident that led you to make that recommendation.

MR. DENTON: Well, I think originally I felt like the cause of the accident was largely operator error. And at one time I had parsed the pie to be, of the six things that had gone wrong, maybe four and a half were operator error and one was an equipment malfunction and a half was a design error. As we began to look back and find that this pressurizer relief valve had opened 150 times in B&W plants in the past and had in fact stuck open on a number of occasions, I think three occasions in the past, it caused us to look very hard at what the difference was between this design and others. Westinghouse plants have sufficient steam generator capacity such that they don't boil dry for about 30 minutes. Another manufacturer perhaps takes 15 minutes. In these plants, the steam generator boils dry in one to two minutes. So you don't have a time frame in which to operate.

I also found that in none of these other plants had this pressurizer relief valve ever been called upon to open in the event of a loss of feedwater, at least in the U.S.

And so we made a number of changes. We ordered the B&W plants in this country to make a number of changes as a condition of further operation.

CHAIRMAN KEMENY: What is your current feeling on the role of operator training as it may have contributed to the incident?

MR. DENTON: Operator training is something we want to improve, and you've talked about simulators while I was here today. I think we're thinking simulation can be improved in two respects. Usually the simulators model normal operations and mayte what we call design basis accidents in the jargon of the NRC. These are things that we--the plant is designed to accomodate. But we don't put in a simulator the kinds of occurrences that happened at Three Mile, and these could easily be introduced into the simulator by just having the system fail this valve and this one and this one, many more failures than the operators are normally trained to cope with. Or we could actually model what we call Class Nine accidents. These are ones beyond the design scope. We could take the reactor safety study and design simulator models which would go through things leading to core meltdown or in the partial core meltdown.

I guess getting away a bit, though, from the operators, a number of people have pointed out that our regulations permit the plant to be operated only with high school graduates. We do not require to have a college degree to be a senior operator if you can pass the exam. So I'm concerned a bit about the availability of technical talent for off-normal conditions in these stations on a round-the-clock basis. And we're considering requirements

which would assure that there are people trained at the college level in the plant who could be called upon in the event the situation degraded outside the envelope for which the operators had been trained.

CHAIRMAN KEMENY: Yes, because, as we heard from the operators yesterday who were on site during the crucial period, they all said that they met a combination of circumstances that none of their training had prepared them for, and I think as some of our Commissioners asked questions, there was some impression that the kind of expertise you are now talking about was not present. Would you agree with that?

MR. DENTON: I am sure Mr. Taylor remembers, there were a lot of reactors operated early on in the atomic energy program who didn't have nearly the safeguards built into them that we require today, but they did very careful care and feeding by a large staff of technical experts.

CHAIRMAN KEMENY: Yes. Let's see. Commissioner Trunk.

COMMISSIONER TRUNK: I just want to ask a question on the training. From a previous statement that the Commission (inaudible), a person said that the NRC, the fellows would train and would take the test, and in this one group, all of them failed. And when they rechecked it, they found out that the NRC man did not know the answers,

that they were all right, but the NRC man didn't know it. Could you comment on that?

MR. DENTON: I haven't--I don't know the details of that particular one. Let me tell you how we do license operators. There are about 2500 licensed operators in the country. We have an operator licensing branch who are mainly people out of the utility business who know how to operate plants, and we retain a large number of consultants from universities and the national labs just to help us in operator licensing.

So it's up to the utility to train the operators in the first instance. So they pay for the training program. They write their own test. And once they think the operator is trained, and this takes about a period of a year, and we do have certain requirements for what constitutes an adequate training program, we give these operators both a written test and a walkthrough test of hands on. So maybe we couldn't pass the utility test in some areas. But our inspection is not based on the grade that the utility gives the operator, but rather on their taking our test and an oral exam and then demonstrating proficiency in actually manipulating controls.

COMMISSIONER TRUNK: But isn't that like having the utility company walk the student through and you come along and just give them another test that's similar to the

company's, and just passing them?

MR. DENTON: I think the failure rate is--I forget what the failure rate really is. But it's not an automatic passing, and many utilities do have initial problems getting the operators trained. I could provide you with statistics on that sort of thing, if you'd like more detail.

CHAIRMAN KEMENY: Mr. Denton, we saw some descriptions of how the utility prepares people for passing these exams. I guess I share Commissioner Trunk's concern. It reminds me very much of the performance of a very well known preparatory school in the United States. I once said to an official of that school that I always subtract 50 points from the SAT scores gotten by students from that particular school because they are so well coached. I mean, there it doesn't matter so much, but here is it possible that utilities coach peopl to the point where they are able to pass these licensing tests when in some absolute sense their knowledge is not sufficient?

MR. DENTON: We intend to relook at this area. If it's that prevalent, I didn't realize it. I did visit Oconee in connection with the review of a restart of their plants and talked to a number of operators, and based on our discussions, we decided that 70 wasn't a proper passing grade for those operators, and we required that there not be anyone on the controls who had not scored 90 on the type

of test they were giving, so I don't think in the future it will be business as usual in the operator licensing arrangement.

COMMISSIONER TRUNK: I do want to ask one more question. A lot of people in Middletown are worried about the containment building. I would like to know how safe that building is having the spikes and the water and the radiation confined. I mean, is it safe from cracks, ruptures, anything like that?

MR. DENTON: I think that building is one example of a structure performing its intended function. There's every indication it's doing exactly what it should do. I know of no reason to suspect its integrity.

COMMISSIONER TRUNK: Well, it hasn't--

MR. DENTON: We were concerned, you know, for a while about rising water level and the fact that certain instruments might be drowned that were relied upon originally to operate the recirculation pumps.

COMMISSIONER TRUNK: But in your opinion, nothing's going to come out into the atmosphere to hurt the public.

MR. DENTON: I==yes, that's my opinion.

COMMISSIONER TRUNK: Okay.

CHAIRMAN KEMENY: Professor Taylor.

COMMISSIONER TAYLOR: Mr. Denton, I'd like to establish a few head points briefly. Your perception of the state of the core materials and of possible ways of

breaching containment as you perceived them during the course of the few days after Wednesday morning. First of all, when did you first come to believe that a significant number of fission products had been released from the fuel and were in the cooling water?

MR. DENTON: I think we became aware on the first day that there was an unusual amount of fission products. There was speculation that this was either an iodine spike, which was commonly seen on a plant shutdown, or perhaps cladding preparations. And in fact at one time we thought we could explain the activity being seen by assuming that one per cent of the fail had cladding preparations.

COMMISSIONER TAYLOR: At the time, what were you saying to yourself was the cause of that release of fission products? That is, what had happened to the fuel to cause that the fission products to appear in the water?

MR. DENTON: I presume that this is Wednesday--

COMMISSIONER TAYLOR: Some time Wednesday.

MR. DENTON: It was a pressure transient, perhaps the possibility that the core had been partially--

COMMISSIONER TAYLOR: So were you visualizing then split cladding, some of the fuel was up--

MR. DENTON: I think Wednesday I visualized more cladding damage, but--

COMMISSIONER TAYLOR: Of what sort?

MR. DENTON: Preparations, maybe splitting near the top. Perhaps--

COMMISSIONER TAYLOR: Did you have any suspicion that the temperatures might have been high enough so that there had been some zirconium-water reaction? At that time on Wednesday.

MR. DENTON: No, I didn't think that on Wednesday.

COMMISSIONER TAYLOR: When did you first start believing that that had been happening, that substantial fractions of the zirconium had reacted with the hydrogen? With the water and released hydrogen?

MR. DENTON: There were a number of indicators that became clear later on, and I think one of them was the thermocouples above the core were found to be indicating superheated steam, indicate core that's at least partially (coughs) I think everyone involved in this accident's got a respiratory problem.

COMMISSIONER TAYLOR: I imagine we will too before long.

MR. DENTON: So the thermocouples were an early tip-off that the core had been uncovered and the fact that you had such high temperatures indicate things weren't normal in the core.

COMMISSIONER TAYLOR: You've mentioned temperatures that suggested that you were generating superheated steam--

MR. DENTON: Well, some of the fuel--

COMMISSIONER TAYLOR: Yes, now--

MR. DENTON: This would indicate flow blockage, which would go back and indicate extensive cladding damage.

COMMISSIONER TAYLOR: I understand. Did you at any time during those few days hear the report that there had been a millivoltmeter put on to one of the thermocouples and that it had recorded a voltage that corresponded to some 2400 or 2500 degrees? Was that reported to you by anyone?

MR. DENTON: I think I first heard it after arriving at the site. We've asked ourselves, where did we first hear it? And I think my recollection is, it was only after we arrived up there.

COMMISSIONER TAYLOR: Do you think that the first direct indication, direct measurement that gave a temperature as its output that was in this high region of several thousand degrees; was that particular thermocouple reading, do you think that was it?

MR. DENTON: I think the thermocouple readings began to come in or at least be recognized on Thursday, and maybe through Thursday night. A primary coolant sample was obtained, and that result I think became available Friday. We heard about the containment spike Friday.

COMMISSIONER TAYLOR: Now is it fair to say that

by Thursday night some time, you had become convinced that a lot of the fuel, a substantial fraction of the fuel, had lost its cladding or its cladding integrity to such an extent that the fuel inside had been exposed to the water? Was that some time Thursday evening while you were still in Washington?

MR. DENTON: I wasn't actually in the Center that Thursday night. I had gone home by that time, but certainly when I got to the Center Friday morning, I had learned that these developments had taken place. And I think by Friday we did have a much different perception of the extent of core damage than we'd had since Wednesday afternoon.

COMMISSIONER TAYLOR: Now when did you first come to believe that substantial amounts of hydrogen had been formed?

MR. DENTON: I guess my own--I think the question may have been talked about, but I was informed Friday of the hydrogen spike in the containment, and of course that left it unequivocal about the amount of water reaction.

COMMISSIONER TAYLOR: Was that really the indicator to you that you were dealing with fairly large quantities of hydrogen, as opposed to the data that were being reported on the fission product content of the water? I'm trying to--

MR. DENTON: They all came in--

COMMISSIONER TAYLOR: Which was the first indication

that you really should worry about hydrogen?

MR. DENTON: I guess it was the containment spike, pressure spike.

COMMISSIONER TAYLOR: Now just a brief question about that. You may not be able to answer this, but if you had known of that spike, which occurred about two o'clock Wednesday afternoon, have you asked yourself whether if you had been told that and knew that, that you would then have begun to focus on hydrogen?

MR. DENTON: I guess the answer must be yes. Once we knew about it, we did focus, we mounted a considerable effort back here in town to try to calculate and answer the kinds of questions you were asking earlier today: the volumes, the resultant forces that would be produced by an explosion--

CHAIRMAN KEMENY: Mr. Denton, could I step in for a moment because Professor Taylor asks these fascinating questions and we never find out what the answers are. What did your calculations show?

MR. DENTON: I'd be happy to provide them. I don't recall now the--

CHAIRMAN KEMENY: Just the punch line. Did you think there was enough hydrogen that there was a danger of--

MR. DENTON: I don't think we were concerned about hydrogen affecting the integrity of the containment, and we were pressing full steam ahead to get the recombiners going

and keep it below flammable levels. We did do some calculations for forces inside the reactor vessel.

CHAIRMAN KEMENY: Were you worried about a possible hydrogen explosion inside the reactor vessel?

MR. DENTON: I think it was not as much a concern about explosive rupturing of the vessel as what it would do to this damaged fuel and whether it would result in additional flow blockage. But Dr. Mattson, who is scheduled to be on tomorrow, can be prepared to go into this in detail with you.

COMMISSIONER TAYLOR: Well, one connection I'd like to ask about is, when did you form the connection, or when did someone that talked to you form the connection between hydrogen and zirconium quantitatively? That is, let me ask another question first, and that is, when did you become convinced that there was a lot of hydrogen in the so-called hydrogen bubble? When was that?

MR. DENTON: I think when I effectively left around noon time the Incident Center, we had not yet started focusing on the sponginess of the primary coolant. I don't remember that we had many discussions or much data showing that as you varied the pressure, the volume changed a lot, and it wasn't until I came back in to work that Friday morning were we able to--something hit us that there was a great deal of free volume in the primary system somewhere.

I don't think we ever necessarily thought it was all in one big bubble hiding out in the control rod drives or in the various other, the collective free volume in there was on the order of 1500 cubic feet.

COMMISSIONER TAYLOR: Well, what I'm trying to get at is, when following the time at which there was a fairly good idea of what the volume of the bubble was and a basis for conviction that most of it at least was hydrogen, when after that did someone in NRC do the arithmetic of relating that mass of hydrogen to some mass of zirconium and therefore trying to derive some sense quantitatively of how much of the cladding might have turned into zirconium oxide.

MR. DENTON: Could I be sure to have someone supply that tomorrow? I just don't know whether it was Friday evening or night or Saturday morning, but some time in that time period was when those kinds of calculations were begun in earnest.

COMMISSIONER TAYLOR: So is it fair to say, then, that so far as the picture of the core damage is concerned, that by the end of Friday you had a picture of a substantial fraction of the cladding having been lost and did you have yet any, or had you asked yourselves or yourself what the result might have been so far as the integrity and the character of the fuel inside the rods that had lost their cladding? I mean, did you begin to have a picture of what

that core might actually look like by Friday?

MR. DENTON: Yes. Well, we tried to back calculate from the thermocouples what sort of flow paths did exist, and I think we calculated numbers like in some thermocouples indicated flow blockage on the order of 97 per cent, indicating that there must have been extensive cladding fragmentation, pellet fragmentation, you know, a rather disrupted picture in the center of the core.

COMMISSIONER TAYLOR: When was this--

MR. DENTON: We've now continued that sort of thing and have gotten a somewhat better--

COMMISSIONER TAYLOR: When was this semiquantitative estimated picture of the core state described to the media?

MR. DENTON: I guess by Friday we were talking about the damaged core, because by that time we had the primary coolant sample back and the amount of iodine in the coolant. We were not able to visualize and draw the kinds of pictures we are today, but I think by Friday we were describing it.

COMMISSIONER TAYLOR: Well, were you describing it in terms that said the temperatures were in the thousands of degrees range, and fractions of the core that were severely damaged were not one per cent or two per cent but more like a quarter or a half?

MR. DENTON: I don't think we were describing that

2000 degree or 2400 degree thermocouple. I just don't remember where I first heard that, but it wasn't early on, I don't think, in the process.

COMMISSIONER TAYLOR: I see. Well, did you have a picture in your mind, say, by Friday afternoon, that there really had been very high temperatures, much higher temperatures than were indicated by the thermocouples that were measuring water temperature?

MR. DENTON: Well, we certainly had, I knew that it had gotten sufficient for the metal-water reactions to take place.

COMMISSIONER TAYLOR: Well, that, at least my own reading of the newspapers and looking occasionally at television didn't suggest until about two weeks after the accident that there had been, that the source of hydrogen in the bubble had been the zirconium-water reaction, and that the temperatures had in fact in a large part of the core--by large, I mean more than 10 per cent--had probably reached temperatures significantly above 2000 degrees. I don't remember hearing that from any source at all. Now was that because that information was not given to the media? I would think they would have picked it up and done quite a bit with it.

MR. DENTON: Well, starting from Saturday night around midnight on, there was a lot of discussion of the

hydrogen bubble and the metal-water reaction. I don't recall the temperatures that--whether they were talked about.

COMMISSIONER TAYLOR: But there wasn't an attempt to try to present to the public a picture of some shape, some fraction of the top of the core, several feet presumably at that tim:--

MR. DENTON: We did--

COMMISSIONER TAYLOR: What it might look like--

MR. DENTON: We went along. I'm not sure at what point we were able to describe it very accurately, but I think we started talking about the upper third and those kinds of, that the top must be damaged, and a lot of those thermocouples were showing, out of the 52, a number of them were showing very high temperatures. So my recollection is, we were talking about extensive core damage in a qualitative sense rather than in a quantitative sense.

COMMISSIONER TAYLOR: By talking you mean to the media, at press conferences?

MR. DENTON: Yes. Yes.

COMMISSIONER TAYLOR: Now just a couple of questions on this matter of the possible dangers of breach of containment due to ignition or detonation or something of the hydrogen. At what time or when roughly had some kind of estimate of the total inventory of hydrogen in the pressure vessel, in the water, and in containment been sort of put together to get

some idea of whether one was talking of small amounts of hydrogen or very large, from an energy point of view.

MR. DENTON: I think this went on all day Saturday and had probably all been accomplished by noontime Sunday, but I can have someone tomorrow be sure to address it in detail.

COMMISSIONER TAYLOR: Do you recall roughly what total weight of hydrogen you were talking about and some measure of the total amount of energy that that corresponded to in some--

MR. DENTON: I just don't recall--we didn't do those calculations at the site. We had them done by our people back here in Washington, and that's why I'd prefer to just defer to Roger Mattson, who was in charge of those and who will be a witness, I understand, tomorrow.

COMMISSIONER TAYLOR: Let me just very briefly get to the question of possible consequences of that hydrogen mixing with enough oxygen to detonate. As I understand your perceptions of the situation then, there was known to be a thousand cubic feet or so of hydrogen in the bubble at about a thousand psi. There was also known to be simultaneously one and a half or so per cent of hydrogen in containment. And is it correct that there was some unknown amount of water,

of hydrogen accounted for by the water in the primary system. Is that a fair picture of your perception of the numbers, then?

MR. DENTON: Yes, and we had done the calculations to show that what would the containment concentration be if we were effective in getting all the hydrogen in the reactor vessel into the containment and had assured ourselves that was way below the flammable limit, and it turned out that most of the hydrogen probably went the route of the makeup tank and the waste storage tanks rather than the pressurizer--

COMMISSIONER TAYLOR: That was some time later that you deduced that. Now on Saturday, you were by then aware of the pressure spike and knew that there had been an explosion.

MR. DENTON: Yes, sir.

COMMISSIONER TAYLOR: My question then is, how concerned were you about that sort of thing happening again, but with a larger amount of hydrogen; if that hydrogen in the bubble then somehow got into containment, into the containment atmosphere, by, for example, the same mechanism that it did ten hours after the explosion?

MR. DENTON: We were concerned and we did attempt to look at the possibility of pocketing. We looked at what fans were running in the containment, what kind of mixing was going on; and before we pumped back the waste gas in the

K tanks, for example, we traced down where the line would go, actually, in the containment, and whether any possible ignition source was nearby. So we did look into those kinds of areas to be sure it was well mixed in containment and that the flame arresters and--it was a concern, but I think our thought at the time was that the amount of hydrogen involved was well below the flammable limit, if we could guarantee it wasn't pocketed somewhere.

COMMISSIONER TAYLOR: Well, that was my question, because at least you currently had a picture of almost all hydrogen in one place under pressure, almost all air in another place at much lower pressure, that is, roughly one atmosphere. But in the process of any kind of movement of the hydrogen at high concentration with respect to hydrogen into the air, there must be some kind of transition through the front flammability point. When we began to pump back the waste gas decay tanks, which I think were like 56 per cent hydrogen, as I recall--that's why we'd gotten concerned over the need for flame arresters, where it would enter the containment, what would happen if it did ignite due to physical kinds of forces at the time you--and we wanted to be very sure that there wasn't something that would ignite while pumping. So we did have people in this specialty worrying about these things in those days.

COMMISSIONER TAYLOR: Well, is it fair to say, then,

that your main concern about the possibility of explosion was not the buildup of oxygen from some source in the pressure vessel, but rather the flow of hydrogen into, from the pressure vessel into containment?

MR. DENTON: They were both. I think we were concerned about the containment, but originally we had calculated that radiolysis would produce about one per cent oxygen in a free state, and we locked up the flammability limits of oxygen in hydrogen, and on my first inspection, if you took no credit for any of the laws of physical chemistry that really do operate, we were concerned that in a matter of five to 10 days, you would build up sufficient oxygen concentration in the hydrogen in the reactor vessel to have a flammable or detonable mixture. It turned out it took us about 24 hours to realize the error of our conservative assumption that we really couldn't build up that kind of oxygen in a system.

COMMISSIONER TAYLOR: Among your experts there, did you have someone who professionally was an expert in hydrogen-oxygen mixtures and flammability limits and so on? In other words, a combustion person.

MR. DENTON: I think we had, we relied on, well, we went back to the national labs and DOE for a lot of this expertise. I think we got good answers on combustible mixtures. Where we went astray was the calculation of the

rate at which oxygen might be added, and that it was more a lack of appreciation of physical chemistry.

CHAIRMAN KEMENY: I'm sure Mr. Taylor knows the answer to this, but I suspect the rest of us don't know. Which direction was the error in? Were you estimating too much or too little oxygen?

MR. DENTON: Too much. It turned out, we found out about a day later that it would be impossible to add oxygen to this hydrogen bubble. It would suppress and recombination would in fact go on in the water. And so by Sunday evening we had begun to---

CHAIRMAN KEMENY: So therefore if I understand it, you were unnecessarily worried about that.

MR. DENTON: Yes, sir.

COMMISSIONER TAYLOR: Now on Saturday particularly when you had the bubble in there, but I guess you had clear evidence that the core was covered with solid water, were you concerned about any possibility of a loss of pressure such that you would uncover the core, present the hydrogen to very hot fuel, which would--because it would then heat up--and in the course of that, develop other routes to forming oxygen, in particular the routes like the catalytic decomposition, not radiolytic, not due to gamma rays or neutrons, but the catalytic splitting of water by raising it to temperatures of perhaps several thousand degrees and then releasing

oxygen in sufficient quantities to make a detonable mixture? I guess the key word in my question is catalysis. Do you know whether anyone trying to figure out what things might happen was looking at catalytic decomposition of water into hydrogen and oxygen?

MR. DENTON: We were very concerned about a loss of pressure and the growth and the size of the bubble. I don't recall hearing discussions about particular effect. We were more concerned about the hydraulic effect of a loss of pressure expansion, the bubble blocking the normal flow paths, and the possible need to depressurize the system and have this huge bubble interfering with the kinds of flow patterns we'd like to see.

COMMISSIONER TAYLOR: I'd like to just ask one more question that has to do with the possible effects of an explosion. We've got a lot of information and we'll be getting a lot more about the implications of what might happen to the containment in general and so on. I don't want to explore that. What I do want to ask is whether on that weekend when you were considering possible results of a hydrogen explosion in the containment, not in the pressure vessel, was there any consideration given to the effects of a blast on any of the heavy equipment inside the containment that then might lead to a big rupture of any part of the primary system and give you not a small break loca, but a big

break loca? In other words, sort of indirect mechanism, not for rupturing containment per se, but rupturing penetrations into the pressure vessel as a result of the application of sort of a big leverage onto some big pieces of equipment? And let me ask specifically whether in the course of that you considered possible breakage of any of the pipes at the bottom of the pressure vessel through which the neutron monitoring samples, I guess go through what we used to call a rabbit machine. I understand there's some 50 inch or so diameter, they may be half an inch, I'm not sure, penetrations of the bottom of the core. The questions is, was there consideration of the effects of an explosion on the internal equipment that might lead to a large loss of coolant below the core level and a major core melt and a breach of containment then by the China syndrome?

MR. DENTON: I don't know. I'll have to be sure we have that answer tomorrow. The word that I remember at that time was that the issue had been looked at, and there was not a great deal of concern on this--

COMMISSIONER TAYLOR: The issue of internal equipment damage.

MR. DENTON: Well, no, the whole issue of hydrogen explosions in the containment apparently was not a major concern to the staff, but exactly the scope of their investigation I can't speak to, but I can have people be

prepared tomorrow.

COMMISSIONER TAYLOR: Fine. Thank you very much.

CHAIRMAN KEMENY: Governor Babbitt.

COMMISSIONER BABBITT: I just have a couple of questions. During the time you were at Three Mile Island, who was your immediate superior?

MR. DENTON: My immediate superior would have been the Commissioners.

COMMISSIONER BABBITT: All five of them?

MR. DENTON: Yes, sir.

COMMISSIONER BABBITT: When you were looking for advice, did you have occasion to seek advice from the Commission, or direction?

MR. DENTON: Yes. For example, with regard to the question of evacuation, we did develop during that first week after the accident an action plan that said if certain equipment fails, there should be an alert called, and if certain other pieces of equipment failed, there should be an evacuation recommended; and it tried to spell out that if I had time, if there were no time, I would recommend on my own authority to the Governor an evacuation; that if it were in certain time frames, I would attempt to contact the Chairman and get him to call the Governor; and if he had certain time frames, he would gather the whole Commission together. So we did eventually formalize and put in writing and gave

copies to the Governor and to the other Federal agencies involved the kind of procedure under which we'd operate. We didn't have it available the first few days.

COMMISSIONER BABBITT: Okay, but that would have been generally true for any advice you needed. That document would govern your going to the Chairman, the Chairman dealing with the Commission, and coming back to you.

MR. DENTON: Yes, sir.

COMMISSIONER BABBITT: Thank you.

CHAIRMAN KEMENY: Professor Pigford.

COMMISSIONER PIGFORD: Mr. Denton, Governor Babbitt asked you earlier about areas of disagreement between the industry team and your team, and the testimony appears to indicate that this issue of the hydrogen bubble and its possible explosibility due to the oxygen is an example of such disagreement. The testimony has been that the industry concluded that it never was explosive within the primary system, within the reactor vessel, and had no chance of becoming explosive; and you've mentioned that your team concluded it was.

Now is the major--first, did you rely upon the industry data to estimate the amount of hydrogen there?

MR. DENTON: We relied upon the same instrumentation that the utility did, namely, there were a series of tests run involving changing the primary system pressure and

observing the change in level.

COMMISSIONER PIGFORD: Who ran the test?

MR. DENTON: The utility conducted the test. We reviewed the procedure to make these tests and the data collection, so we had the same data they did and we sent the data back here for analysis and the utility I think sent it to B&W for analysis.

COMMISSIONER PIGFORD: Thank you. And did you rely upon different sources of information to estimate the amount of oxygen?

MR. DENTON: Yes, we did.

COMMISSIONER PIGFORD: And is this what then led Dr. Mattson to conclude that the bubble would soon become within explosive range?

MR. DENTON: I'd prefer to let him answer that one.

COMMISSIONER PIGFORD: Well, did you evaluate his conclusion?

MR. DENTON: I relied on his conclusion in those areas.

COMMISSIONER PIGFORD: Did he recommend to the Commissioners as a result of this that an evacuation be carried out?

MR. DENTON: I think from reading the transcripts that he was advocating that position.

COMMISSIONER PIGFORD: And was it due to this

estimate of the explosive potential of the hydrogen bubble?

MR. DENTON: I'm sure it was, yes. But I don't want to speak for Dr. Mattson. I'd prefer that--

COMMISSIONER PIGFORD: Did the Commissioners ask you for your recommendation on that subject?

MR. DENTON: This--we had our hands full with other areas other than hydrogen at the time, and it was an area that I deliberately delegated back to Washington for analysis. We did not attempt to do these kinds of calculations there. By Sunday night we were getting concerned about the same issue, and we began calling a number of people around the country that we knew had expertise in this area. It's fair to say by Sunday morning we were more optimistic than was Washington about the ultimate outcome, and Dr. Mattson and Chairman Hendrie came up Sunday. We and they were able to get together briefly and exchange sources of information by that time, and I think when I briefed the President Sunday, I was able to indicate that the direction of the concern was downward rather than upward.

COMMISSIONER PIGFORD: You mentioned earlier that there was a mistake made by someone on the NRC staff or your sources in the estimate of the amount of oxygen. Is that correct?

MR. DENTON: Yes, sir.

COMMISSIONER PIGFORD. Can you tell us where, who

made that estimate?

MR. DENTON: I'll defer to Roger again for that.

COMMISSIONER PIGFORD: And when the mistake was learned, what was the source of the new information?

MR. DENTON: The source of the new information was that we had contacted a number of experts at (Beddes, ph.sp.), at G.E., at (Cappel, ph. sp.), people we knew had firsthand knowledge of the operation of reactors with hydrogen overpressure. All the individuals we contacted then began to call us back with data that had been taken in other reactors and sources of information, so it was kind of a collective input back in, people telling us it couldn't happen, and then a call from another expert saying, "You got it wrong, it doesn't go like this," so some time during that day we discovered the error of our ways.

COMMISSIONER PIGFORD: Had you contacted those people to provide data for your first estimate?

MR. DENTON: I'd have to defer. I don't know the--

COMMISSIONER PIGFORD: You mentioned (Cappel, ph.sp.). You mentioned G.E., (Beddes, ph.sp.). Had you contacted people at those places?

MR. DENTON: I really have never gone back to look in detail at how that number was arrived at or how it changed.

COMMISSIONER PIGFORD: On what day did you discover

that there was an error in the oxygen estimate and therefore that the hydrogen bubble was not in the explosive range?

MR. DENTON: My own perception was Sunday.

PROFESSOR PIGFORD: Yes. Can you--Chairman Kemeny asked us, asked you about the Michaelson report. Now you mentioned that, I think, your own personal knowledge occurred after the accident. But what about the NRC staff? Can you tell us on what date that report first appeared at the NRC staff, either informally or formally?

MR. DENTON: Yes, sir. Some handwritten notes were provided by Jesse Ebersall of the ACRS to a member of my staff, Sandy Israel, apparently around the winter of 1977, perhaps December or so. Apparently we kept them for a while and sent them back. They were notes concerning small break locas, and Mr. Ebersall had raised several questions, and I think Sandy felt he had answered those questions, and he returned the notes. Mr. Michaelson was persistent. I think later on in January of '78 he formalized his concerns in a memo that he gave to his boss, Mr. Ebersall of TVA. The report was sent to B&W, and during 1978 they attempted to get answers back from B&W about this concern. I think it's fair to say our staff wasn't formally informed, didn't formally get this report other than the Israel contact until after the accident, at which time it was made available through the ACRS.

COMMISSIONER PIGFORD: Was Mr. Ebersall a member of the ACRS at that time?

MR. DENTON: Yes, sir.

COMMISSIONER PIGFORD: And the ACRS is an advisory group to NRC?

MR. DENTON: Yes.

COMMISSIONER PIGFORD: Did the ACRS not transmit any information about that to the NRC?

MR. DENTON: It was never transmitted formally other than the informal notes that were passed between Mr. Israel and Mr. Ebersall.

COMMISSIONER PIGFORD: No, I'm speaking now of 1978, when this report had become a reality, and he had then given it to Mr. Ebersall. Had he also given it to ACRS?

MR. DENTON: I don't know. I think we first obtained it from Mr. Michaelson in connection with a briefing he was giving at ACRS.

COMMISSIONER PIGFORD: And what date was that?

MR. DENTON: It was after the accident.

COMMISSIONER PIGFORD: Do you know what date he first gave it to the ACRS?

MR. DENTON: No, sir, I don't.

COMMISSIONER PIGFORD: Is there someone on your staff who has liaison with ACRS to be sure for the transfer

of information?

MR. DENTON: Yes, sir.

COMMISSIONER PIGFORD: Who is that?

MR. DENTON: Mr. Crocker.

COMMISSIONER PIGFORD: Now is there someone on your staff who has recently made an analysis of the whole history of that report through your division?

MR. DENTON: We've made a technical analysis of the report. This is published in several documents. We're also conducting an investigation pursuant to Part 21. As to whether or not we should have been informed of this report by either TVA or B&W as a result of their having knowledge of the potential safety problem--

COMMISSIONER PIGFORD: Let me rephrase my question, then. Is there someone on your staff who has made a search to identify when that report came in either informally or formally, through what procedures and what line in your management it was transmitted, and who read it?

MR. DENTON: This is under investigation by our Office of Inspection and Audit.

COMMISSIONER PIGFORD: There's no such report at this time?

MR. DENTON: Not that I'm aware of. Now we have provided Congress our perception, our being my office's perception of the ways it came to us, but we have requested

that our auditor's office look into it, because it is in dispute between the parties as to how it came to our attention.

COMMISSIONER PIGFORD: Then let me rephrase my question. Maybe it's not a report. Is there a piece of paper containing the sequence, the results of this analysis, showing the progress of the Michaelson report through your division?

MR. DENTON: Yes, sir. We've supplied such a piece of paper from our perspective to individuals, but recognizing that there are others who don't agree with that. And that's why it's the subject of an investigation.

COMMISSIONER PIGFORD: Your perspective. You mean the technical merit of the analysis or the history of who looked at it?

MR. DENTON: The history of who looked at it according to the people in NRR who were involved.

COMMISSIONER PIGFORD: Who's the author of this paper?

MR. DENTON: Roger Mattson is the author, I believe, and can speak to that.

COMMISSIONER PIGFORD: Could we get a copy of it?

MR. DENTON: Yes, sir.

COMMISSIONER PIGFORD: Thank you.

COMMISSIONER MCPHERSON: One question about this, Mr. Chairman. Mr. Denton, if that report, that Michaelson

report, had just landed smack on your desk and somebody had put a note on it saying, "Here, you'd better look into this," and that was, say, early 1978, what would you have done?

MR. DENTON: It certainly contains--Mr. Michaelson showed a great deal of prescience, I guess, in writing that report. While the scenario and the sequence is not exactly the same, he has sure hit upon the problems that went here. Now we've asked ourselves the question what we have done; would we have given it priority 99, you know, and still not have worked on it, or would we have recognized it? I think the staff involved in that area thinks they would have turned to it and it would have had a fairly high priority for us to look into the adequacy of small break analyses, the potential of board formation; but certainly I can't guarantee you that the priority would have been sufficiently high that we would have changed regulations or changed requirements in time to have prevented the accident.

COMMISSIONER MCPHERSON: Are you satisfied that there is an adequate ability in the NRC to evaluate and respond and take action when matters of this kind are brought to its attention? Do you think, is it good enough, or does it need a whole lot of--

MR. DENTON: No, it's not good enough, and we hope to improve it.

COMMISSIONER MCPHERSON: How are you going to go

about doing that?

MR. DENTON: Well, with regard to the licensee event reports, for example, the 3000 occurrences that we get, we had categorized them and we had passed them out to the individual technical specialists, branch by branch, and some branches did a much better job than other branches in following up on what was happening. The Commission has under consideration and I have myself in my own office, of creating a group of people whose sole job it is to look at all the events that go on, to plot trends among B&W plants, Westinghouse plants, as well as discipline by discipline, and farm these out to the specialist branches to be sure they are getting proper attention. It's always been, in the office I'm in, a question of priorities. So I think if we can pull out more attention on these and also get the licensee perhaps to evaluate them all that apply to this plant, we'll be far less likely in the future to have a major precursor such as the Davis-Besse event slip through without us acting on it.

Now questions such as the Michaelson report: I would say that if the accident had involved any other aspect of the plant--suppose it had been the result of (inaudible) missiles or small locas--I would not be surprised to find in our files memos where the staff called to do better because after all, that's what we get paid to do, is to think up ways

to make plants safer. So it doesn't surprise me that in our files in this case are a few memos suggesting things that could be done better, because I think you'll find in every branch that is in NRR, there are ways to improve the plant. I think we just have to be more sensitive to pick out the ones that are worthwhile to work on.

CHAIRMAN KEMENY: Could I ask the Commissioners how many more Commissioners wish to ask Mr. Denton questions? I'm just trying to determine whether we complete this expeditiously before we melt down.

(Laughter)

So whether we ought to adjourn till tomorrow. How many of you--

COMMISSIONER TAYLOR: I have a very brief question.

CHAIRMAN KEMENY: By brief you mean brief?

(Laughter)

And you have. Very good. Just two more questions.

COMMISSIONER PETERSON: I have two questions. One is a follow-up of what Professor Taylor was asking in connection with the potential energy that would be available if all the hydrogen that could be produced by all of the zircoloid reacting with water, all of it getting in the containment building before it was triggered off. Now you commented earlier that the amount of hydrogen there was inadequate to reach the detonation point, but from that

which was in the reactor at the time you got there, you mean that amount of hydrogen, don't you?

In other words, I'd like to go back and ask this question: if all the zircaloid reacted with water to form hydrogen, and all the hydrogen got in the containment vessel, and then if it detonated, would the energy developed be sufficient to rupture the containment vessel?

MR. DENTON: I don't know the answer to that. I can have it ready, I think, tomorrow.

COMMISSIONER PETERSON: Great. Now the other question is: you were a principal in recommending that the area be evacuated on Friday, and Dr. Mattson, according to the transcript you read, had recommended a later date because of the theoretical way that hydrogen might have exploded in the reactor vessel, recommended evacuation. You were consulting regularly with the Governor. As you said, you would tell him the story as it was, and that you were giving him pictures of possible things that could happen and leaving it up to him to make the decision about evacuation.

What was the most serious potential incident you described to the Governor?

MR. DENTON: Every night we would discuss what might happen, okay, and we would walk through the Watch 1400 or Rasmussen type scenarios, how much time would be available if you lost all cooling? How long would it take for the core

to melt down, penetrate the vessel, result in containment failure; and of course, as time went by, it was a longer and longer time period, so that if something had gone wrong, you could call up the Civil Defense system and have more time to get people out.

So we went through those scenarios every night. I never felt an imminent danger after arriving at the site and having the confidence that my own staff could give me about the certainty with which which things would go on. And I had changed my recommendation that Friday morning even after additional information had come in that the sewers had been stopped, that the offsite doses were small, and after I arrived there and found that it really could be controlled; my staff felt comfortable with the situation; so I never recommended evacuation after arriving at the site.

We did discuss the scenario that suppose we can't get rid of the bubble. Suppose all means don't do it and we have to somehow bring the core down to a lower pressure state. I did recommend that we do that hydraulically in the daytime at a pre-selected hour with the full Civil Defense panoply of resources standing by so that if something didn't go wrong, everybody would know it right at that time and the whole system could go.

So it was a nightly ritual to go back through all the scenarios.

COMMISSIONER PETERSON: But you never did buy the theoretical position of Dr. Mattson that the hydrogen in the reactor could explode.

MR. DENTON: I acted on that premise, but it, even accepting that, we had time on the order of five to 10 days or so, depending on those kinds of calculations, before you'd reach a flammable mixture in the reactor vessel. So I was getting concerned as to how many days I could tolerate such a situation without having to resort to some means to disperse the bubble before it reached an explosion. And that's when I was discussing with the Governor that if we couldn't make the bubble go away, and if the possibility of a detonation continued, we ought to put in place a standby evacuation for the time that we might try it.

COMMISSIONER PETERSON: Did you describe the various things that could happen in the whole community if that explosion did occur in the reactor?

MR. DENTON: We didn't try to particularize the consequences. I sort of relied on the consequence models out of the reactor safety study to describe the types of health effects that would result from core meltdowns. And we would walk through the potential for early fatalities and latent cancers and genetic defects, using the reactor safety study as a consequence model, and then talk about the time

element based on the fraction of core heat that was actually available to melt down each day.

CHAIRMAN KEMENY: Professor Taylor. Last question.

COMMISSIONER TAYLOR: (Inaudible)

CHAIRMAN KEMENY: I thought there was only one.

COMMISSIONER TAYLOR: I'm sorry. I'll ask just one. During those several days after you got there, did you ask yourself what would be the worst thing that anybody might do in the Control Room, let's say, as a single operation, or perhaps two? The worst thing that might happen, might be done in the Control Room, either accidentally or on purpose, in terms of the subsequent possibility for release of a lot of fission products out of containment? Did you ask yourself what that might be?

MR. DENTON: We tried to, and we tried to have from early on after we got there contingency plans developed for those even if they were very crude, and I think as time went on, we got better and better at contingency plans, but we were very concerned about loss of off site power, for example. We'd lose power to the recirc pumps; wouldn't natural circulation be established, and this sort of thing, and we'd try to think out those ahead of time, and that's what I didn't think the applicant had the resources to do on that Friday night and Saturday after getting there, as he was in no position to think that far ahead to do contingency

COMMISSIONER TAYLOR: Well, did you somehow alert people in the Control Room along the lines of saying, "Whatever you do, for God's sake, don't do certain things," like open the pressurizer relief valve, or whatever you were concerned about leading to a much more serious situation and a release of containment. Did you inform people to make sure that they don't do any of these things?

MR. DENTON: We tried to do it by concurring in procedures that said those things. I don't recall a specific directive--

COMMISSIONER TAYLOR: Not to the extent of blocking out something and saying, "Don't anybody touch this particular control."

CHAIRMAN KEMENY: I think, Mr. Denton, that's an interesting question. I think that's a little bit like telling a child not to put a peanut in his ear.

COMMISSIONER TAYLOR (?): But some children do.

CHAIRMAN KEMENY: Yes, that's why I'm saying it.

(Laughter)

It's, I mean, under those circumstances, you said you did it indirectly by pooling procedures. Were you concerned at any point psychologically about the problem that if you pointed out to somebody what is the worst thing to do, that you might actually cause it to happen?

MR. DENTON: No, I don't think I was concerned

about that. I did reflect on the fact that the people in the Control Room taking these actions were the same ones who'd been in the Control Room on Wednesday; that the plane was still in the air, sort of thing, and that's one reason I wanted people there all the time whenever any action was being taken.

CHAIRMAN KEMENY: I understand. May we excuse the witness?

Thank you very much, Mr. Denton.

The Commission is recessed till nine o'clock tomorrow morning.

(Proceedings adjourned.)