ORIGINAL

UNITED STATES
NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF:

METROPOLITAN EDISON COMPANY

(Three Mile Island Nuclear Station,
Unit No. 1)

DOCKET NO: 50-289 SP
(Restart Remand on
Management)

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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In the Matter of:	]	
	]	
METROPOLITAN EDISON COMPANY	]	Docket No. 50-289SP
	]	
(Three Mile Island Nuclear Station, Unit No. 1)	]	(Restart Remand on Management)
	]	

Room 156
Main Capitol Building
Harrisburg, Pennsylvania

Wednesday, November 14, 1984

The hearing in the above-entitled matter was convened, pursuant to notice, at 1:30 p.m.

BEFORE:

JUDGE IVAN W. SMITH
Chairman, Atomic Safety and Licensing Board

JUDGE SHELDON J. WOLFE
Member, Atomic Safety and Licensing Board

JUDGE GUSTAVE A. LINENBERGER, JR.
Member, Atomic Safety and Licensing Board

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C O N T E N T S

E X H I B I T S

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PROCEEDINGS

JUDGE SMITH: Ladies and gentlemen, it is the point in time for the hearing. I believe that all the parties are present and there is no reason not to begin.

My name is Ivan Smith. I am Chairman of the Atomic Safety and Licensing Board of the Nuclear Regulatory Commission.

To my right is Judge Sheldon Wolfe. Judge Wolfe is a lawyer and he is a member of the panel. He serves as Alternative Chairman of the Board.

To my left is Judge Gustave Linenberger. Judge Linenberger is a nuclear physicist and he serves the additional role as a scientist on our licensing board.

We will introduce the parties in a moment. I would like to review again, for those who have just joined the proceeding for the first time, just what we are doing here today.

There have been several issues which have remained pending since this Atomic Safety and Licensing Board issued its last decision.

Today we are beginning an evidentiary hearing on what has been called the Dieckamp mailgram issue. This issue was remanded to this Board by the Appeal Board of the Nuclear Regulatory Commission in its order of May, 1984.

I will read portions of their order remanding this

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because it captures pretty much of the history of this issue.

On May 9, 1979, Herman Dieckamp, President of GPU -- that's General Public Utilities -- sent a mailgram to Congressman Udall in an effort to correct assertively erroneous information about TMI reported in "The New York Times" the day before.

It also happened that he sent a copy of the mailgram to one of the NRC Commissioners, Commissioner Gilinsky, who is no longer a Commissioner.

The story in "The New York Times" concerned a so-called pressure spike that had occurred within the TMI-2 containment at about 1:50 p.m. the day of the accident.

As we had explained it in our initial decision, there was a certain increase in containment pressure from about 3 to 28 pounds per square inch followed by a rapid decrease of 4 pounds per square inch, which was caused by a sudden burning or explosion of hydrogen, which would be symptomatic of core damage.

This is how we described the incident in our initial decision some time ago.

The increased pressure initiated containment spray. There were conflicting statements set out in NUREG 0760, which is a Nuclear Regulatory Commission staff report of investigation, as to how several employees in the TMI-2 control room interpreted this at the time.

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The Licensee did not report the pressure spike to the NRC or to the Commonwealth, however, until a day or so after it occurred.

Again, I'm reading from the Appeal Board order remanding this.

The pertinent part of Mr. Dieckamp's mailgram for our purposes is his statement that, "There is no evidence that anyone interpreted the pressure spike and the spray initiation in terms of reactor core damage at the time of the spike or that anyone withheld any information."

The Staff had investigated the matter to determine whether it was a material false statement within the meaning of the Atomic Energy Act, and they have determined that it was not a material false statement. But for reasons which were not fully satisfactory or complete to this Board, they have stated that in effect it was not a material false statement because it was not a statement that was made that was required by law.

It was our view that whether the statement is required by law or not was not determinant of the issue; that we were concerned about implication of any false statement on the management integrity. And that is the area in which we inquired.

We agree that the Staff witnesses who testified on the issue had resolved the matter satisfactorily and felt

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that their inquiry was complete and equal to or better than any inquiry or investigation that we could make. Therefore, we made no inquiry of our own.

The Appeal Board decided that this was in error. They said that we should have pursued the matter on our own by seeking the testimony from Mr. Dieckamp, those in the control room at the time of the pressure spike, and those from whom Mr. Dieckamp got the information conveyed in the mailgram.

Therefore, they sent the matter back to us and stated that the focus of this hearing should be on, one, whether anyone interpreted the pressure spike and containment spray at the time in terms of core damage, and, two, who or what was the source of information that Mr. Dieckamp conveyed in his mailgram.

Since that time we have modified the issue by describing its scope in the various prehearing conferences. We have had several prehearing conferences which have identified who will be the witnesses.

In these proceedings normally the direct testimony, unlike a court presentation, the direct testimony is provided in advance in written form and the hearing begins immediately upon the cross-examination of those witnesses on their direct written testimony.

In this case the intervenors, who we will introduce in a moment or ask them to introduce themselves, will be relying

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very heavily upon witnesses they are calling from the staff of General Public Utilities Nuclear; those are employees and former employees of Metropolitan Edison and GPU.

The hearing is expected to last, on this phase, all this week and will begin next week in the library of the Capital Center and may extend until the following week.

Now, beginning to our far left is Mr. Goldberg, who is Senior Counsel for the Nuclear Regulatory Commission Staff.

Mr. Goldberg, would you introduce the people that you have with you?

MR. GOLDBERG: Yes, Judge Smith. To my left is Lois Finkelstein, also counsel for NRC Staff.

To my immediate right is John Craig, who was one of the INE investigators into Information Flow and one of the authors of NUREG 0760.

To Mr. Craig's right is Prasad Kadambi, one of the NRC Staff Project Managers for the TMI restart proceeding.

JUDGE SMITH: Mr. Au is Assistant Attorney General representing the Commonwealth of Pennsylvania.

With him I recognize Mr. William Dornsife, who was present virtually every day during the many long weeks of hearings we had in the main hearing.

Welcome back, Mr. Dornsife, Mr. Au.

I particularly want to thank Mr. Au for finding this spot for us to have our hearing. We had a great deal of

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difficulty finding hearing space because it just wasn't possible for those who control the space to assure us such a long occupancy. So we will be required to move around a bit.

We have Ms. Bernabei. I think I see with you Ms. Bradford, who represented TMIA most of the time during the main hearing; and Ms. Doroshow, who is assisting Ms. Bernabei as counsel for the intervenors, Three Mile Island Action, Inc.

We have Mr. Blake, and Mr. Blake, who do you have with you?

MR. BLAKE: Judge Smith, upon my left is David Lewis, also of our law firm, who has entered an appearance on behalf of the Licensee in this proceeding.

JUDGE SMITH: With that ladies and gentlemen, is there any preliminary business before we provide for the opportunity for opening statements?

(No response.)

JUDGE SMITH: Do the parties wish to make opening statements?

MS. BERNABEI: Yes, Judge Smith.

JUDGE SMITH: Do you, Mr. Blake?

MR. BLAKE: I am prepared to make an opening statement. If Ms. Bernabei is -- hearing that she is, I am prepared to follow.

JUDGE SMITH: Perhaps we should review that in the notice calling the hearing, this is entirely optional. We did

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hear a request in our hearing yesterday that they want them to be made, and we are providing the opportunity.

So I would suggest then, Mr. Blake, since you have the burden of proof in this proceeding, that you begin.

MR. BLAKE: Chairman Smith, Judges Wolfe and Linenberger, today we begin additional evidentiary hearings in what is the sixth year of this proceeding to determine whether TMI-1, the reactor undamaged by the accident at TMI-2 in 1979, should operate.

The first issue to be heard by the Licensing Board concerns a mailgram sent by the President of GPU, Herman Dieckamp, to Congressman Morris Udall in May, 1979, some six weeks after the TMI-2 accident.

More particularly, and in plain terms, the issue is whether the mailgram was accurate to Mr. Dieckamp's knowledge, and, if it was not accurate, should Mr. Dieckamp have known better.

The language in the Dieckamp mailgram to be focused upon is, "There is no evidence that anyone interpreted the pressure spike and the spray initiation in terms of reactor core damage at the time of the spike, nor that anyone withheld any information."

The important questions regarding this statement are whether anyone, at the time the spike occurred a little after mid-day on March 28, 1979, understood the significance of an

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indicated abrupt pressure rise observed in TMI-2's containment, and if it was understood, was this information intentionally withheld.

There is no dispute that some people observed the pressure spike on recording equipment in the control room at the time it occurred. The question remains whether the significance of the pressure spike was understood at the time the mailgram to Congressman Udall, six weeks after the accident, expressed Mr. Dieckamp's belief that it was not understood; and, thus, that such understanding could not have been withheld.

This is not the first time that the accuracy of Mr. Dieckamp's mailgram or the information in it have been challenged.

Questions regarding the utility's understanding of the severity of the TMI-2 accident as it unfolded have raged over the past five years.

The statements in the Dieckamp mailgram are but one facet of this controversy, and it is important to realize that the hearings we begin today are exclusively on that one facet.

All that is at issue is Mr. Dieckamp's knowledge as expressed in his statement to Congressman Udall in the May, 9, 1979 mailgram.

The Licensing Board may be called upon frequently to control the scope of this proceeding accordingly.

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I earlier observed that today's hearing is not the first time that this subject and related subjects have been addressed. They have been addressed in investigations and reviews by NRC, the President's Commission, a Special Inquiry Group commissioned by NRC, a United States Senate Committee, a Congressional Committee staff and revisited by an NRC team focused on the subject.

The bulk of these past efforts or their results will be placed in evidence at this hearing by agreement of the parties.

Although the results of these past investigative efforts are important evidence and have been important to Mr. Dieckamp's views on the accuracy of the mailgram, they are not by themselves controlling on the outcome of this hearing.

It is for this Licensing Board now to decide the issue based on the evidence placed before it by the parties over the next several weeks.

Licensee's evidence includes some 150 documents which the parties have agreed to put before the Board, largely past statements of individuals concerning knowledge, awareness and appreciation of the pressure spike on March 28, 1979.

Additionally, Licensee will present four witnesses. The first witness who we will hear from today will be Mr. William Lowe, an engineering consultant who arrived at TMI the second day of the accident, March 29, 1979. Mr. Lowe will

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testify that when shown the graph of the pressure spike recorded in the control room late that same evening of his arrival, March 29, he immediately believed he understood its cause and significance.

He will also testify that none of the many individuals at the plant with whom he came in contact on the 29th, or, for that matter, any of the individuals he talked to in the months following the accident, indicated any prior appreciation of the significance of the spike.

Licensee's next two witnesses will be two other gentlemen who were called by the utility in the wake of the accident to assist at TMI.

One of them, Dr. Edwin Zebrowski, Chief Nuclear Scientist at Eppley Energy Study Center in Palo Alto, California, was a leader of an ad hoc industry advisory group comprised of nationwide experts pulled together at TMI right after the accident.

Dr. Zebrowski will describe the rapid learning curve evident in that group's efforts to organize and interpret the large volume of plant data, sorting out different views and speculation in order to come to understand the accident.

He will describe as well Mr. Dieckamp's participation in the group's efforts.

Mr. Thomas VanWitbeck of Energy, Incorporated in Idaho is the second of these two witnesses. Mr. VanWitbeck was

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involved in the utility's efforts to compile a detailed sequence of events of the accident and can describe Mr. Dieckamp's interest and role in the understanding of the events of that day at TMI-2.

The final witness for Licensee will be Mr. Dieckamp himself. He will describe his understanding of the accident at the time he sent the mailgram and provide the basis for the statements in the mailgram.

TMIA's focus will not likely be on whether anyone understood the pressure spike in terms of core damage at the time it occurred as the mailgram itself reads. Rather, I anticipate their focus will be on the introductory phrase of Mr. Dieckamp's statement; that is, "There is no evidence."

Their case, I expect, will largely be a collection of snippets of information from which they will speculate and ask the Board to infer that Mr. Dieckamp knew more or should have known more than is stated in the mailgram.

Today, of course, there are reams of evidence on the TMI-2 accident. This includes evidence on the pressure spike and whether individuals appreciated the meaning of the spike when it occurred.

That evidence has resulted from the many investigations after the fact of what actually occurred at TMI-2 and who knew it and understood it at the time.

Unfortunately, because this accident has received such

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widespread attention, what people subsequently knew and understood has been influenced by all they read and came to understand after the events occurred.

For that reason earlier statements by individuals as to their understanding of what occurred and their appreciation of events during the accident are likely to be more reliable than statements provided years later.

Mr. Dieckamp believes today that the thrust of his mailgram is still accurate despite some individuals' observations now that they more keenly appreciated events at the time than their coincident actions support or than they disclosed at the time, or indeed than they disclosed at their initial round of interviews.

The issue is not whether some individuals' statements today contain key words which may suggest an understanding, but rather these statements reflected true understanding of the spike and its significance when it occurred.

In any event, whatever the present state of evidence by virtue of people's views expressed today concerning the details of their thoughts over six years ago, there is no doubt that these hearings will show that no one had disclosed such appreciation of events to Mr. Dieckamp when he sent his mailgram or that he should have discerned such from any information available to him although he has spent virtually all of his time at TMI after the accident gaining an in-depth

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knowledge of the accident events.

This proceeding remains a high profile case with substantial media and public interest. Witness the media turnout today in the hearing room. But this case, like others, must be decided by the Licensing Board from the evidence before it and not in the media.

Obviously, Three Mile Island is going to receive continued media attention in this proceeding because it concerns TMI will as well.

We strongly urge the parties to resist temptations to try this case other than before this Licensing Board. There have been instances where opposing counsel in this proceeding have been quoted with observations regarding the evidence beyond simply quoting the evidence as the Rules of Professional Conduct demand. That practice should cease. This is particularly important here in a case where an individual's actions and character are being challenged. Keen statements of evidence and propriety is demanded under these circumstances.

I close with one observation on the circumstances surrounding Mr. Dieckamp's mailgram which will be borne out by the evidence.

At the time Mr. Dieckamp sent this mailgram, no information was available to Mr. Dieckamp which would even suggest, much less demonstrate, that anyone -- and I emphasize anyone -- interpreted the pressure spike in terms of core damage when

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it occurred.

Despite interviews which have been promptly conducted of operators and a great deal of data on the accident events which was, by May 1979, already known, and despite Mr. Dieckamp's deep involvement and thus personal awareness of this information, the evidence will show there was indeed no information known to Mr. Dieckamp contrary to the mailgram statements. It was not until after that mailgram was sent, and importantly long after it was sent, that any meaningful information by others as evidence contrary to the mailgram became known to Mr. Dieckamp.

Although we have argued to the NRC Commissioners that there is no need for this hearing at all, the Licensee is prepared to try the issue and looks forward to an adjudicatory determination resting on the evidence presented here that will clear Mr. Dieckamp's name and reputation, which to date has been too easily and unjustifiably questioned.

Thank you, Judge Smith.

JUDGE SMITH: Ms. Bernabei.

MS. BERNABEI: Chairman Smith, Judges Wolfe and Linenberger, as Mr. Blake stated, the issue before this Board is whether Mr. Dieckamp, currently President of GPU and President of General Public Utilities at the time of the accident, knew or should have known that the statements he made in his mailgram were false.

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As Mr. Blake said, he sent a mailgram to Congressman Udall largely to rebut statements in "The New York Times" article which indicated that site personnel on the first day of the accident saw a pressure spike and understood its significance.

In the mailgram Mr. Dieckamp said that no one interpreted the pressure spike which occurred at 1:50 p.m. on March 28 to indicate core damage. No one interpreted the containment sprays which were actuated at that time simultaneously with the pressure spike to indicate core damage; and no one withheld information.

TMIA believes, first of all, that the statements are false. We believe that Mr. Dieckamp may well have known that the statements were false at the time that he made them.

In any event, if he did not know that the statements were false at the time he made them, he should have taken the steps to inform himself that the statements were false at the time he made them.

The mailgram was sent six weeks after the accident.

TMIA will present evidence, largely through company witnesses of the following:

First, contrary to the company's assertion and Mr. Dieckamp's assertions to this date, site personnel understood the significance of the pressure spike to indicate core damage. The significance of the pressure spike, as this

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Board well knows, is that it was caused by the combustion or burning of hydrogen. This hydrogen was produced by oxidation of the cladding surrounding the fuel, which can only occur in substantial amounts at temperatures over 2200 degrees Fahrenheit.

At that point, that is at the point at which hydrogen is produced in those amounts, there is a significant amount of oxidation of the cladding, there is significant core damage, and I don't believe the Licensee witnesses will refute this.

Two shift supervisors, Joseph Chwastyk and Brian Mehler, will testify that they believe the pressure spike indicated a real increase in pressure.

Mr. Chwastyk will testify that he believed -- he attributed it on that day to hydrogen, that is the production of hydrogen.

He will also testify that because of his concern, he convinced the station manager and emergency director, Gary Miller, to change the strategy to bring the reactor to a cold shutdown.

The second shift supervisor, Mr. Mehler, says he believed it was caused by a chemical reaction, but that he understood the pressure spike was real.

Mr. Chwastyk's testimony about the change in strategy for the reactor as a result of the pressure spike is borne out

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by the industry's own study on the accident, which shows that repressurization began a short time after the pressure spike, a portion of which occurred at 3:08 p.m.

The company's position is that this did not occur until much later in the afternoon on the orders of Mr. Arnold and Mr. Herbein.

The industry's own study of the accident and operators' recounting and observations of what occurred on that date will prove that Mr. Chwastyk's description of the events of that date are correct and not the current Licensee's position.

Mr. Chwastyk will testify that he not only informed Gary Miller of the pressure spike, he brought him into the control room, showed him the pressure spike on the console, explained to him how he believed it had occurred, and convinced him at that time to allow him to draw a bubble in the pressurizer and start a repressurization strategy.

Mr. Miller not only denies that this conversation took place, he will say that he was not even aware of the pressure spike.

We don't believe this is credible evidence in light of the plethora of evidence which will indicate that almost everyone in the control room at that time was aware of one or more of the indicators of the pressure spike, either the spike itself, the simultaneous initiation of the containment sprays, a thud which was heard, or any of the numerous alarms

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which were actuated by the engineering safeguard signal received at that time.

Only a half-an-hour after Mr. Chwastyk said he informed Mr. Miller of the pressure spike, and a short half-hour after he convinced Mr. Miller to change the strategy to bring the reactor to a cooldown, Mr. Miller met Mr. Dieckamp on the steps of the State Capital at a meeting to see the Lieutenant Governor.

TMIA believes it is not credible, if one believes that Mr. Chwastyk's testimony is correct that he did inform Gary Miller, Gary Miller authorized the change in strategy for the reactor, that Mr. Miller would not have informed Mr. Dieckamp at that time of what was happening with the reactor.

TMIA also believes that GPU Service Corporation engineers sent to the site on the first day also understood the significance of the pressure spike in this time period, the late-evening of March 28 and the early-morning of March 29.

Mr. Arnold's organization, who was Vice-President of the Service Organization at that time, sent five of its top technical personnel to the site in a late-morning meeting on March 28. Those included Gary Broughton, who was then the chief of the Accident Analysis Section for the Service Corporation.

The Service Corporation engineers arrived at periods

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starting from 2:00 p.m. till 5:30 p.m. on the first day of the accident. At least two of the engineers have testified -- and there are also the notes of one of them -- that they learned of 2500 degree temperatures at 5:00 p.m. on March 28.

Now, these engineers as well as site personnel knew that temperatures in that range indicated an oxidation of the cladding and serious core damage.

We will also present evidence that the GPU Service Corporation engineers who were then stationed in the Observation Center reviewed data from the accident, including hard data from the Unit 2 control room, which would indicate to them that a pressure spike and an explosion in the containment had occurred at 1:50 p.m.

Specifically, we believe they reviewed -- and it was brought to them by one of the engineers, Richard Lentz -- an alarm printout for the period of 1:50 p.m.

The GPU Service Corporation engineers did not report to the Metropolitan Edison management, but instead to their own management, which included Mr. Keaten, who was then, I believe, Manager of Systems Engineering for the Service Corporation.

Mr. Keaten wrote in his notes for March 29 that he was informed by Mr. Broughton of an explosion in the Unit 2 containment. There are two dates on the notes, but the only date that was written at the same time as the notes is the March 29

j20

date.

We believe Mr. Keaten at some point may well have informed Mr. Dieckamp of what he learned on March 29; that is, that the GPU Service Corporation engineers sent to the site had learned about the explosion in the containment on the prior day.

In any case, if Mr. Keaten did not inform Mr. Dieckamp, it was certainly information which was available to him and which he should have availed himself of during this period six weeks prior to sending the mailgram.

TMIA will also present evidence that there was general knowledge on the site on the first day of the accident of a hydrogen burn or a hydrogen explosion.

In response to a GPU questionnaire submitted in the discovery portion of this proceeding, 20 individuals, some at the TMI site, some across the river at the Observation Center, and one individual in Mountain Lakes, the Parsippany Corporate Headquarters, stated that they had learned or become aware of the hydrogen burn on the first day of the accident.

Many of these individuals, after speaking to corporate counsel, have retracted their statements and said they misread the questionnaire.

We will present testimony that at least some of these individuals -- we believe that the testimony they gave, the answers they gave to the original questionnaire are more

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credible than the testimony now; that they, in fact, did know about the hydrogen burn on the first day of the accident.

Finally, TMIA will present the testimony of David Gamble, a former NRC investigator who participated in the NRC investigation into Information Flow during the accident.

His prefiled testimony with this Board states that there were serious deficiencies in the investigation as well as in the conclusions reached in that investigation.

Some of the conclusions he specifically addressed have to do with site personnel's knowledge of hydrogen and pressure spike on the first day of the accident.

TMIA shares the company's concern that this issue is being litigated five-and-a-half years after the accident. But lest that lead this Board to discount the importance of this hearing, we would refer you to a recent Department of Energy study which came out, I believe, last week, which indicated that TMI-2, during the accident, reached temperatures up to 4800 degrees which they estimated was 280 degrees away from the meltdown.

If, as TMIA believes, information was withheld from the NRC, from the Commonwealth of Pennsylvania and from the public about the seriousness of this accident, the risk to which the public was exposed was much greater than previously believed

We would urge the Board to listen to the evidence,

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understanding that most of the witnesses that we will call will be company witnesses, many of whom who continue to work for the company. However, we believe the only credible explanation, given the objective evidence of the events of March 28, given the credibility of the witnesses who will appear before you, is that site personnel not only understood the significance of the pressure spike to indicate the production of hydrogen, to indicate core damage, that it took serious steps to bring the reactor under control as a result of their understanding.

We also believe that there is no other conclusion the Board can find; that if Mr. Dieckamp did not know, he certainly had available to him the information to inform himself prior to sending the mailgram.

JUDGE SMITH: Mr. Au, does the Commonwealth have an opening statement?

MR. AU: The Commonwealth has no opening statement.

JUDGE SMITH: Can you give us some idea of how you intend to participate in this phase?

MR. AU: The Commonwealth will participate to the extent of cross-examination to clarify some facts if necessary. Other than that, the Commonwealth will not be an advocate in this part of the proceeding.

JUDGE SMITH: We should call upon you then in order for an opportunity to cross-examine?

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MR. AU: Yes.

JUDGE SMITH: Mr. Goldberg.

MR. GOLDBERG: Thank you, Judge Smith, Judge Wolfe and Judge Linenberger.

The NRC Staff will present the testimony of Mr. Norman C. Mosely. Mr. Mosely is no longer employed by the Nuclear Regulatory Commission, but was previously employed by the NRC in a variety of positions up to and including Regional Director and Division Director.

Mr. Mosely led the team that performed the inspection and enforcement investigation entitled Investigation Into Information Flow during the accident at Three Mile Island.

The report of this investigation was issued by the Nuclear Regulatory Commission as NUREG 0760.

The team was asked to include in its investigation an assessment of whether the Dieckamp mailgram constituted a material false statement.

This matter was pursued in an interview with Mr. Dieckamp on September 12, 1980, in which Mr. Mosely was the principal questioner of Mr. Dieckamp.

As the investigation team leader, Mr. Mosely supervised the preparation of NUREG 0760. Mr. Mosely previously testified in this proceeding for the NRC Staff.

As part of that testimony Mr. Mosely was questioned about his conclusions regarding the Dieckamp mailgram.

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Mr. Mosely explained that prior to his testimony he had interviewed Mr. Dieckamp on his stated knowledge at the time he sent the mailgram to Congressman Udall.

This interview was conducted on September 12, 1980, in Parsippany, New Jersey. Mr. Dieckamp answered questions under oath, and a transcript was made by a court reporter.

The interview of Mr. Dieckamp, including Mr. Mosely's questions and Mr. Dieckamp's answers under oath, will be entered into evidence in this proceeding.

Mr. Mosely testified that as far as Mr. Dieckamp's state of mind was concerned, Mr. Mosely believed that Mr. Dieckamp believed the message he was trying to convey in the mailgram was true.

During Mr. Mosely's interview of Mr. Dieckamp, Mr. Mosely gained an impression that Mr. Dieckamp was sincere. This conclusion of Mr. Mosely is supported by his extensive questioning of Mr. Dieckamp on Mr. Dieckamp's state of mind and the knowledge which Mr. Dieckamp gained as to the accident. And it is also supported by the fact that the answers Mr. Dieckamp gave to Mr. Mosely's questions are consistent with the findings and conclusions reached by the Staff's investigation, which are reported in NUREG 0760. That is that no one present in the control room at the TMI Unit 2 concluded on March 28, 1979, that hydrogen was the cause of the pressure spike.

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As explained in NUREG 0760, the investigators concluded that on March 28, 1979, it was beyond the range of credible operator knowledge to infer that amounts of hydrogen sufficient to reach a flammable concentration in the 2 million cubic foot containment might exist at ten hours after the initiation of the event.

Therefore, Mr. Mosely concluded that the message Mr. Dieckamp was trying to convey in his mailgram was true.

To the extent that the Board wishes to hear testimony on the adequacy of the Investigation Into Information Flow as it relates to the Dieckamp mailgram statement and Staff's investigative report, NUREG 0760, insofar as it relates to the Dieckamp mailgram, the Staff will introduce evidence which will show that the criticism by Mr. Gamble of the adequacy of the investigation and the report are not supported by the facts.

JUDGE SMITH: Have you concluded?

MR. GOLDBERG: Yes.

JUDGE SMITH: Are you ready for your first witness, Mr. Lowe? I suggest that you do whatever you wish as far as where you sit. When you have a witness you can take a place at the well or wherever you are, but the parties should make themselves comfortable wherever you feel you have the best position for your cross-examination and examination.

MS. BERNABEI: May I just suggest we handle one

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preliminary matter? Mr. Blake and I had spoken about the documents the parties had stipulated on the mailgram stipulation. I think we both thought that it might perhaps be better to present and introduce those documents at the beginning since they may be used for questioning of witnesses.

JUDGE SMITH: All right.

MR. BLAKE: Judge Smith, that's fine with me. We can do it now, because I don't think much time is involved.

The parties have agreed on a stipulation of our quantity of documents. Those documents have been copied. Copies of what amounts to a 13-volume set of stipulated exhibits have been delivered to the Board's offices in Bethesda and one copy brought here for the Board. Three copies have been provided to the court reporting service in Washington. And yesterday we provided a copy to Ms. Bernabei's office and to Mr. Goldberg's office.

I learned today from Ms. Bernabei that she didn't receive it in her office, and we will just have to check as to why she didn't. But there is indeed another set which we will provide her, and we have a copy here of our own which the parties may utilize if it is necessary throughout the hearing.

The document which I propose that the Board accept in evidence is comprised of, one, a ten-page document dated November 8, 1984, and entitled "Modified Stipulation of

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Parties on Mailgram Evidence." That ten-page document has been signed by three counsel in this proceeding, Mr. Goldberg, Ms. Bernabei and myself.

The second item which comprises the stipulated exhibit is a seven-page document bearing the title "Index of Joint Mailgram Exhibits," and it is in fact an index to the 144 items which are included in the third element of this package, and that is a collection of 13 volumes of documents which have been copied and distributed in the manner that I have already indicated.

Unless there is some clarification -- I'm sorry, I'm incorrect. It is 14 volumes rather than 13.

I provided to the court reporter today copies of both the document entitled "Modified Stipulation of Parties on Mailgram Evidence" and the "Index of Joint Mailgram Exhibits."

As I had earlier indicated, three copies for the court reporter were provided directly to their offices in Washington.

So unless there are other clarifications, I would propose, on behalf of all three parties, that the Board accept this as a joint stipulated exhibit by the parties.

JUDGE SMITH: Mr. Blake, the Board previously approved a stipulation which would allow the introduction of a large group of documents. We also indicated, however, that we had reservations about receiving into evidence such a large bulk

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of information when we don't know in advance exactly how it is going to be used in the parties proposed findings, how we propose that it be used in our decision, and we don't know in advance that all these documents satisfy our own feelings for being a test of reliable and probative and substantial evidence.

As we begin the hearing, nothing has been worked out as far as I know as to any ground rules as to how the documents are to be used, nor how you are to identify what portions of them will be available to the parties and to the Board for use in the Commission decision.

I don't know what the parties have in mind. It is not our intention to run the case for you. But I just wanted to start the hearing off by telling you that although we approved the stipulation, and we will mechanically, if you wish, receive these four large boxes of exhibits into evidence, the parties have a lot of work to do before they can expect the Board just to go ahead and make a decision. They're going to have to come up with some guidelines.

MR. BLAKE: Judge Smith, it is an observation which the Board has made before. I think all the parties are aware of your October 3 order which earlier reminds the parties of this.

I should say that one of our reasons for trying to do this was to avoid the necessity for a large number of witnesses to appear. There are a lot of past statements by individuals

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on this subject, and it was the parties desire to try to avoid the necessity of calling all of those people to come and support them.

Within those statements I recognize, as do the other parties, that there are items of interest which none of us could argue as a fact of interest in this limited scope proceeding, and there are other items in here which none of us I'm sure would argue are beyond the scope. And it does require the good faith on the parties, taking into account the Board's rulings on the scope of this hearing. They will argue in an appropriate fashion from those documents.

JUDGE SMITH: I would advise any party that wishes to rely on any document or any document in the bound exhibits to bring it to the attention of the Board and the parties that you intend to rely upon those documents in your proposed findings to the Board. Otherwise, in your proposed findings if you allude to a document and it has never been discussed during the hearing, never been referred to by a witness, never been identified, you may find that we will disregard the document.

So until you come up with better ground rules, we are going to have to bear in mind that we won't accept your proposed findings on documents that were not alluded to or referred to by a witness, although counsel needs to make some other preparation. There are going to be depositions here by

j30

people who do not appear. And if we should see just naked proposed findings on a person who hasn't appeared, absent something, I don't know if we can assure you that we will give it the weight that you want.

In effect, I'm saying the burden still remains upon the parties to bring to our attention, as the hearing unfolds, exactly what you want us to make a decision on. We don't want any surprises at the time it comes to make a decision.

I think that your effort to stipulate is commendable and perhaps even necessary, and I'm not criticizing the parties for not going further. I don't know what else exactly you can do right now.

I just want us all to begin the hearing with an understanding that we are just not going to reach into a grab-bag and pull out a document and make an important decision in this case. So the burden will still be upon the parties to make sure, if you wish to rely upon a particular document in your proposed findings, that we know about it. Otherwise, you take your chances.

With that, then, would you give your documents whatever type of designation you think that it requires, and we will receive them?

MR. BLAKE: My statement initially, Judge Smith, was an attempt to identify the three component parts, the modified stipulation document dated November 8, the index and the

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14 volumes of documents which I had asked be admitted.

JUDGE SMITH: Right. Do they have a number or anything, or just by that name; will they be admitted by title?

MR. BLAKE: I think the record will reflect that they were sufficiently identified. When you look at the second document, the one that has the index, there is in fact a descriptive index to all documents which appear, the 14 volumes.

JUDGE WOLFE: One question I have: is this to be marked as Joint Exhibit 1, for example? Because I don't know. The parties may stipulate as to the documents with respect to another issue. Mechanistically I just want to know.

MR. BLAKE: I propose the terminology "Joint Mailgram Exhibit," just not to be confused with what previously have been made exhibits in the record of this proceeding.

JUDGE SMITH: That makes sense. Okay, let's repeat now, Joint Mailgram Exhibit 1, and give its title; Joint Mailgram Exhibit 2; Joint Mailgram Exhibit 3, and give its title, if that is your --

MR. BLAKE: No. My proposal is that this be overall Joint Mailgram Exhibit 1; that it be comprised of those three documents; and that within that third document, that is, the boxes you hold, there are Item numbers 1 through 144. Just so there will be no confusion in the terminology or reference to them.

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JUDGE SMITH: My concern is not so much confusion, because I think you described it quite accurately. I was hoping somehow for a shorter term, but I'm sure that will evolve.

All right, if there are no objections then --

JUDGE LINENBERGER: I have a question. One point of clarification, Mr. Blake, before the Board decides on this matter.

Have I understood correctly that the makeup of the 14 volumes comprises precisely the list of items in the November 8 modified stipulation, no more, no less?

MR. BLAKE: Yes, sir.

JUDGE LINENBERGER: Thank you.

JUDGE SMITH: Then if there are no objections, the Board receives into evidence Joint Mailgram Issue Exhibit 1.

(Whereupon, the documents referred to were marked as Joint Mailgram Issue Exhibit 1 for identification, and were received in evidence.)

JUDGE SMITH: Now are you ready for Mr. Lowe?

MR. BLAKE: Yes.

JUDGE SMITH: The witnesses will take the seat at the far end of the bench.

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Whereupon,

WILLIAM W. LOWE

was called as a witness and, having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. BLAKE:

Q. Mr. Lowe, would you please state your name and business address?

A. My name is William W. Lowe. My business address is 1200 Eighteenth Street, Northwest, Washington, D.C.

Q. Mr. Lowe, do yc have before you a document dated November 1, 1984, and entitled "Testimony of William W. Lowe"?

A. I do.

Q. Was this document prepared by you?

A. It was.

Q. Do you have any corrections, amendments, additions or deletions that you would make to it?

A. There is one typographical error on page 12; at approximately the tenth line there is a time listed there in military time which, in the testimony as typed, reads "0235." It should be "0245."

JUDGE SMITH: Is that marked on the reporter's copy?

MS. TOBERMAN: I will make the necessary changes.

JUDGE SMITH: After this, provide in advance the corrections on the reporter's copy. Normally, corrections such

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as this will not be made on the record. The most important thing is that the reporter's copy be correct. There is no use taking hearing time to correct these things on the record, so as long as the reporter's copy is accurate, that's all we need because that will be in the transcript.

BY MR. BLAKE:

Q. Mr. Lowe, with that correction, do you adopt this 15-page document as your testimony in this proceeding?

A. I do.

Q. Mr. Lowe, do you have before you a one-page document, undated, having the title "William W. Lowe," the first entry on which reads: "March, April 1979," "TMI Accident Control: On-Site Night Leader for Technical Support"?

A. I do.

Q. Was this document prepared by you?

A. Yes, it was.

Q. Are there any corrections which you would make to this document?

A. No.

Q. Do you adopt this one-page document as your testimony on your past work experience and educational qualifications?

A. I do.

MR. BLAKE: Judge Smith, I ask that the 15-page document dated November 1, 1984, entitled the "Testimony of William W. Lowe" and the one-page statement of qualifications

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of Mr. Lowe be physically incorporated in the record as though read.

I have provided copies to the court reporter, and I believe all the parties and the Board have copies.

JUDGE SMITH: Any objections?

MS. BERNABEI: Yes, there are. I am going to object to the introduction of any part of Mr. Lowe's testimony on the ground that it is not relevant to the issue before the Board.

Mr. Lowe was not at the TMI site on March 28 at the time of the pressure spike or shortly thereafter. There is no basis for his knowledge that individuals did not interpret the pressure spike on that day in terms of core damage.

I think it is clear from the testimony itself that he does not have a basis to make the conclusions he does reach in his testimony.

Therefore, I believe he is not a competent witness on the issue before the Board.

JUDGE SMITH: Mr. Blake.

MR. BLAKE: Judge Smith, I am hard put to -- I need to respond that Mr. Lowe is the individual identified in past reports. He himself has testified that he believes that he was the first to appreciate the significance of the chart which recorded the pressure spike. His actions that night have been recounted by others, and I think it is important

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that the Board understand and the reviewing bodies as well understand what Licensee's position is about how the pressure spike did come to be understood.

JUDGE SMITH: Your observation is a fair observation for purposes of cross-examination, but it certainly does not go to the relevance of this testimony. His testimony is relevant and the objection is overruled.

MS. BERNABEI: I did have an objection to specific portions.

JUDGE SMITH: All right, now, just a moment. Let's begin very early in this proceeding to correct a habit that we have all fallen into during the prehearing conferences. That is, after this, when you have an argument to make on a particular motion, the entire argument shall be made, and then when the Board rules, that will be the end of it, unless you perceive a very rare situation where you think that we have made a mistake in fact and there is something we didn't understand.

You have to make all of your argument in the first instance.

Now, do you have additional motions to make, or are you going to argue more on your relevancy motion?

MS. BERNABEI: It is another motion on specific portions of the load testimony. It is specific paragraphs.

JUDGE SMITH: All right.

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JUDGE WOLFE: At what page?

MS. BERNABEI: Page 2, first paragraph. I don't believe that is competent testimony. What it essentially states is Mr. Lowe's lack of knowledge of certain events.

JUDGE SMITH: We can't hear. We can't hear what you said.

MS. BERNABEI: The first paragraph on page 2, there is no basis for the testimony. Mr. Lowe is essentially testifying that he had no knowledge on March -- well, he said that there was no knowledge about the significance of the pressure spike.

I believe that that is not competent testimony but lack of knowledge.

Several of these are similar arguments. I will continue down.

JUDGE SMITH: Wait a minute. I don't know if we can do it that way. Let's take up the first one and explore it in context.

You say the first paragraph on page 2 --

MS. BERNABEI: Mr. Lowe's testimony -- essentially, he says the basis for believing he was the first one to understand the significance is based on -- I think he says it is important to know when it was not understood or recognized.

Basically, he is basing his opinion on a lack of knowledge in a previous time. I don't think that is a

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competent foundation for the testimony.

JUDGE SMITH: I just don't understand your reading of the paragraph. He says simply that a part of his testimony is what was not known, and that is absolutely correct. That is a material part of his testimony and it is relevant. That is the central issue.

MS. BERNABEI: Mr. Lowe was not on site. In fact, I think it is clear from his testimony that his firm performed a limited function on March 28. He was not in a position to know what site personnel knew on March 28.

Therefore, his knowledge or lack of knowledge about what was going on at TMI-2 is not an adequate foundation for the statement that there was no knowledge about the significance of the pressure spike.

JUDGE SMITH: What point in time do you say there is no basis for his testimony? He begins his next paragraph saying, "At 0830 on 28 March 1979 our office in Washington was notified..." Are you asserting that he doesn't know that; he has no basis for that statement? I don't really understand. Was it prior to 0830 on 28 March?

MS. BERNABEI: Mr. Lowe was not at the site and he was not providing or in a position to know what site personnel knew on March 28.

JUDGE SMITH: What do you say about the following paragraph, "...our office in Washington was notified by GPU

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personnel of potential radioactive releases...and we were requested to provide weather date"? Are you saying he has to be on site to know that?

MS. BERNABEI: No, but I don't think that is relevant to this Board.

JUDGE SMITH: If that is the basis for your objection, overruled. You are ignoring all data that can be obtained by other means.

MS. BERNABEI: On page 9, the first full paragraph which begins, "The third factor is stress." Mr. Lowe has no expertise, as he states in his testimony, to render this opinion. He is not a psychologist or psychiatrist. I think he indicates in his testimony that he does not have a foundation for rendering the opinion he renders.

JUDGE SMITH: I'm sorry, your voice trailed off.

MS. BERNABEI: On page 9, the first full paragraph, Mr. Lowe gives an opinion on stress and states in support of that opinion that he is not an expert in this area. I don't think that is competent expert testimony for the Board to hear.

JUDGE SMITH: You say in the first paragraph?

MS. BERNABEI: It's the first full paragraph beginning, "The third factor is stress."

JUDGE SMITH: Then go on. What does he say? "Although I am not an expert" -- what does he say then?

MS. BERNABEI: -- "I know from experience..." I

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believe he is rendering an expert opinion for which he does not have adequate qualifications.

JUDGE SMITH: Is that the sole basis of your objection?

MS. BERNABEI: Yes.

JUDGE SMITH: Overruled. You may, however -- of course, when we overrule it we are not ruling that you may not cross-examine on the quality of the point that you are making. You understand that?

MS. BERNABEI: I understand.

JUDGE SMITH: It is just whether he is absolutely not competent to give any testimony on that issue is the only thing that we are ruling rather than the threshold point.

MS. BERNABEI: At page 14, the first full paragraph which states, "I find it inconceivable...", and the second full paragraph, as well as the third paragraph which continues on to page 15 up to the sentence which begins "He, for example..." I don't believe there is any basis for Mr. Lowe to render the opinions he renders in these three paragraphs. It appears on the basis of speculation.

JUDGE SMITH: On page 14, the first paragraph to which you object begins, "I find it inconceivable that if anyone had known hydrogen was present...they would have concealed that knowledge." You object to that paragraph?

MS. BERNABEI: Yes; all three.

JUDGE SMITH: All three.

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MS. BERNABEI: That's correct, up to the point where he describes his personal knowledge of Mr. Dieckamp's activities, which I think is relevant.

JUDGE SMITH: The paragraph that begins on the bottom of page 14, "In the course of working with Mr. Dieckamp during the accident, my high regard for his honesty..," you do not object to that?

MS. BERNABEI: I do. I don't think Mr. Lowe should be offering integrity testimony to this Board. His expertise is a technical consultant. He is basically offering his opinion as to Mr. Dieckamp's honesty, managerial ability and patience.

JUDGE SMITH: I think we are going to take it a paragraph at a time. The first paragraph to which you object is "I find it inconceivable that if anyone had known hydrogen was present in containment and had ignited, they would have concealed that knowledge from peers or managers and that the on-site technical support team would not have been told of it."

I think we will hear from Mr. Blake.

MS. BERNABEI: If I could just state, I think that is in the same nature as opinion testimony of former Commissioners Bradford and Gilinski, which this Board felt was not appropriate. That is, it is testimony which goes to legal analysis or conclusions of the Board.

JUDGE SMITH: I don't see that as a legal analysis as

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well. That is his own observation as to what he would have expected of the people at that plant. Whether he has expertise or not, I don't know; we will hear it. I don't know how we'll come up. I think we have to hear arguments on it, but it is not nearly anything like offering two former Commissioners to explain the regulations.

Mr. Blake.

MR. BLAKE: Chairman Smith, I don't understand Ms. Bernabei's argument to support at this juncture a motion to strike or exclude this paragraph. It may be that by virtue of cross-examination of Mr. Lowe on this paragraph or other portions, Ms. Bernabei will be in a position to argue that this paragraph or others should be given little weight by the Board, but certainly an individual who was at Three Mile Island, who worked with the people, whose testimony held up elsewhere, supports that he has been a consultant to this organization and who worked with the people in it literally for years, is not deserving of being struck at this point.

I think at most what we are talking about is following cross-examination and the motion to strike being renewed at that point; or, in fact, argument about the weight which should be afforded Mr. Lowe's testimony by Ms. Bernabei, but not to exclude it now.

JUDGE SMITH: The difficulty that I am having with it is that we cannot keep in mind at all times everything in his

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testimony. So I don't know, taking the paragraph out of context, whether he is expressing his views as to his own personal experiences working with his peers and those managers based upon his own experience in the field or whether he is offering a technical expertise opinion that persons, in his opinion, persons so situated would have acted in that manner.

I think as it stands now that some voir dire might be necessary. I think that the second sentence, "No motive for concealment by those involved existed since too much was at stake including, perhaps, their lives," tends to be a factual statement that would be within his area of competence as a chemical engineer experienced in nuclear.

The other I think we will defer until we have had an opportunity to explore the basis for the statement.

MR. BLAKE: As I observed, I think it may be that Ms. Bernabei could renew a motion to strike following cross-examination. But I don't think that at this juncture it is a basis for excluding.

JUDGE SMITH: In this instance the ruling is deferred. However, it will be your responsibility to bring it up again. It is up to you to remember.

MS. BERNABEI: Let me just state again our objection on the record. As I understood it, former Commissioners Bradford and Gilinski, both of whom made observations or observed Mr. Dieckamp at a Commissioners' Meeting, one of whom

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had a conversation with Mr. Dieckamp two days before this --

JUDGE SMITH: Wait a minute. You were denied the right to bring Commissioner Gilinski to the hearing; although we expressly told you that that was an area where he may have relevant testimony, you were denied that right because, one, you refused to tell us what he would testify about, and, two, you said he did not know what he would testify about. Now you are just digressing.

JUDGE WOLFE: I would also suggest, Ms. Bernabei, that you are confusing our rulings and you are confusing this proceeding by bringing up how this Board or its Chairman has ruled on other matters. In that circumstance you bring up not only our ruling under the facts of the present issue as against what the facts were with the prior issue as to which this Board ruled. This serves to confuse not only the Board but anyone that is listening.

So I would suggest to you that you argue each issue or each objection on the merits of that particular issue, and don't go back to prior rulings of this Board that don't serve to clarify what the ruling of this Board is on this particular issue.

MS. BERNABEI: I would just like to state my understanding and our objection for the record, and I am doing it in order to clarify our position.

My understanding was that we represented that

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Commissioner Gilinski had information about -- former Commissioner Gilinski had information on a conversation in which the subject of the Dieckamp mailgram was discussed. He was not allowed to present that information.

It seems to me that that is information of equivalent status to what Mr. Lowe has.

JUDGE SMITH: You are wrong.

MS. BERNABEI: That's fine.

JUDGE SMITH: Again, I want you to make your full argument when you make your motion and not after we rule.

Moving on to the next paragraph, "Also, I find it inconceivable on other grounds that the real significance of the pressure spike was deliberately concealed by an exercise of duplicity or dishonesty. I know many of the people involved and have for years. They simply would not have done such a thing. And when I say that I include Mr. Kuhns, Mr. Dieckamp, Mr. Arnold and all of those managers and engineers with whom I worked during the accident."

That seems to me to be a factual statement, an opinion based upon his own personal experience with these people, and not based upon his expertise as a chemical engineer.

Do you wish to argue this point? You made a generic argument. Do you have any particular argument to make as to this paragraph?

MS. BERNABEI: The same argument. I believe he is

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offering an opinion on the ultimate issue before this Board, the integrity of Mr. Dieckamp and the corporate management.

I think if other testimony of a similar nature was excluded, Mr. Lowe's should be as well.

JUDGE SMITH: Again, with the observation that no other testimony of a similar nature was ever excluded, and the irrelevancy of your statement, your objection is overruled.

Anything further?

MS. BERNABEI: The second-to-the-last sentence on page 15 starts, "Furthermore, the people I know and dealt with would not have deliberately concealed such knowledge." That is not supported in the testimony.

JUDGE SMITH: Overruled.

Any further objections?

MS. BERNABEI: No.

JUDGE SMITH: Is Mr. Lowe available for cross-examination?

MR. BLAKE: Yes, sir. I would ask first that the prepared testimony and the one-page statement of qualifications be physically incorporated into the record.

JUDGE SMITH: The testimony and the attachment of his qualifications are received.

(The documents follow:)

November 1, 1984

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
METROPOLITAN EDISON COMPANY	)	Docket No. 50-289 SP
	)	(Restart-Management Remand)
(Three Mile Island Nuclear Station, Unit No. 1)	)	
	)	

TESTIMONY OF WILLIAM W. LOWE

My name is William W. Lowe. I am a founder and Chairman of the Board of the engineering and consulting firm of Pickard, Lowe and Garrick, Inc., as I was at the time of the TMI-2 accident. And I am now, as I was then, a consultant to the General Public Utilities Corporation concerning nuclear power matters.

The account which follows is about the containment pressure spike referred to in the mailgram from Mr. H. Dieckamp to Congressman Udall of 9 May 1979. I will describe my direct personal knowledge of how and when the spike was first recognized to be evidence of major core damage and how and when this view was verified.

I have been careful to reconstruct events as they were, not as they may now be perceived, and have consulted colleagues in the interest of accuracy. The clock times given for some events may be in error but not, I believe, by more than a few hours.

In judging when the significance of the containment pressure spike was first recognized, it is important to know when it was not. So I will start by summarizing my knowledge of prior events and will end by saying that this knowledge, based as it is on intimate personal involvement in the matters described by the mailgram, leads me to the clear conclusion that the statements in the mailgram are accurate concerning the spike.

At 0830 on 28 March 1979 our office in Washington was notified by GPU personnel of potential radioactive releases from TMI-2 and we were requested to provide weather data. At 0930 the request was repeated. We were asked because we have computers in Washington which can read, correlate, and double check weather data being measured by instruments on the weather tower at the TMI site. These computers can also compute radiation doses using such data. At 1025 we were informed that an accident had occurred and a general emergency declared. At 1140 Mr. Jack Thorpe, a senior manager for GPU, called and asked me to stand by to come to TMI-2. He was then Chairman of the TMI-2 General Office Review Board of which I was and am a member. At 1150 I called several of our engineers in from around the country so they would also be available. At 1620 I called Mr. Thorpe requesting status and learned that there had been a steam bubble in A and B loops of the primary system preventing operation of the reactor coolant pumps but the steam in one loop had been condensed and cooling was by feed and bleed.

He reported the plant thinks core cooling is recovered. There were more than ten, probably as many as twenty, phone calls between our Washington office and GPU during the day and evening and some of them were extensive. No mention was made of the pressure spike or hydrogen.

The next morning, the 29th of March, at 0830, Robert Arnold, then Vice President for Generation of GPU Service Corporation, called me regarding the formation of an Events Analysis and Recovery Planning Team. He asked me to be a member and to come to the TMI Observation Center by early afternoon. I called Bob Keaten at GPU about 0930 and recommended primary coolant be sampled and measured for the isotope silver-110 which, if present, would have implied damage to control rods. I arrived at the Observation Center about 1400. A briefing for several U.S. Senators was underway in which Mr. Herbein, Mr. Dieckamp and others were involved.

After this was over, the Analysis and Recovery Team members, comprised of senior technical people from GPU and myself, assembled at 1530 in the TMI-1 supervisors conference room and were divided into two groups: one for Events Analysis and one for Recovery Planning. I was assigned to the latter. There was considerable discussion of the division of work between the two groups and a briefing about plant status. A decision was made to debrief all operators coming on or off shift and record their accounts of what happened.

I believe we were told during the meeting, which started at 1530, and/or during a discussion with Mr. Kunder immediately thereafter, that the waste gas decay tanks were near their relief pressure. A large part of the gas in them would normally be hydrogen. No one mentioned or implied, however, that there had been hydrogen produced by a reaction between zircalloy fuel cladding and water or that there had been an ignition or explosion of hydrogen in containment or anywhere else. Knowledge of the accident was no where near that complete.

The meeting began to break between 1700 and 1800 to get food and so that each group could work separately. At this point Mr. George Kunder took me aside for a short but intensive explanation of what he perceived to be the urgent needs of the plant. After about ten minutes of it, several of us decided we should go to the control room forthwith and get first-hand information. Consequently, two GPU engineering managers and I suited up, and did so.

In the control room we talked with some operators and engineers and observed what was going on. There seemed to be unresolved problems relating to plant stabilization and damage control. The operators were having trouble holding the pressurizer level steady.

After half an hour or so, we left the control room and went to eat with several others. We discussed what we knew of plant status and accident sequence and how to proceed with recovery planning. We tried to contact Gary Broughton to get

more information about accident sequence. Earlier he had shown some of us a preliminary analysis of the first minutes of the primary system pressure and temperature transient. When we found him, he confirmed the system had reached saturated conditions within the first few minutes after the reactor trip.

After dinner, the Recovery Planning group to which I had been assigned met in a hotel room to discuss approaches to recovery planning. These discussions focused on how to identify equipment requiring repair and replacement and how to clean up liquid, gaseous and solid radioactive wastes. Several of us were uncomfortable during these discussions because we sensed we should go to the plant to get more information and to assess some of the problems operations was having. Consequently, the group went back to the TMI-1 supervisors conference room at the site.

Shortly after we had reassembled at TMI, I followed Mr. Herbein, the site leader, as he left the conference room and told him the basic problem was stabilization, not recovery, and that several senior people should be assigned forthwith to the control room to help with stabilization and damage control. Mr. Herbein immediately re-entered the conference room, reiterated this position, and asked for volunteers. Tom Crimmins, who at the time was Manager of Generation Engineering for Jersey Central Power and Light Company, and I volunteered, suited up and went to the control room at about 2200 hours.

Our first priority was to connect the two waste gas decay tanks back to the containment. These tanks contained radioactive gas and were near relief pressure. We assumed a primary constituent of the gas was hydrogen as it would be in normal operation and we planned carefully to avoid its ignition in situ or as it entered containment. I insisted there be a flame arrestor in the line of tubing which was to connect the tanks with the containment. We requested an investigation to find any potential ignition sources within twelve feet of the exit point. After the plan was outlined, execution was turned over to Ron Toole who had reviewed the pertinent drawings with us.

We then sought further information about plant status. We were told that the primary system was still "mushy," that is, it was hard to control pressurizer level. The operators were concerned about this problem but still had no explanation which made sense. They thought there might still be a steam bubble outside the pressurizer but none of the many temperature readings were high enough for that.

At about 2300 the operators lost control of pressurizer level and Joseph Logan, Unit 2 superintendent, who with several others was conferring with Crimmins and me in the supervisor's office at the back of the control room, left to take direct charge of the operating crew. I followed to observe. At that point, a young engineer assigned to collect data approached me and said, "Have you seen this?" He held out the containment building pressure recorder chart trace showing a pressure spike

of 28 psig at 1350 hours on 28 March, the previous day. I concluded instantly without further discussion that the spike was caused by hydrogen ignition in the containment, that therefore the mushiness in the primary system had to be due to the presence of hydrogen gas loose in the primary system, that the hydrogen was from a zircalloy-water reaction and that we had to get the hydrogen out. The spike looked like those we used to calculate for hypothetical hydrogen ignition in containment except it came down faster. Containment pressure was subatmospheric which could be due to having used up oxygen by burning hydrogen. I asked the young engineer for another pressure reading and he pointed to the wide range trace at the bottom of the same chart. I asked for building temperature traces. They were confirmatory.

I asked for xerox copies and stepped back into the shift supervisor's office where Tom Crimmins was with several others and told him that there had been hydrogen ignition in containment, that there was a hydrogen bubble in the primary system, that we had to measure it and that we had a fighting chance to get it out because hydrogen "diffuses like a shot." The great sense of urgency to measure the size of the bubble derived not only from wanting to confirm or refute its presence but also to find out whether it was growing, to find out whether it was then large enough to interfere with reactor coolant pump operation on which core cooling then depended, and to estimate whether the core could be uncovered by bubble growth if

depressurization occurred by failure of pressurizer heaters or a critical seal or valve. While the term bubble was used then, as it is now, we knew it could be several or many bubbles in a number of places.

One aspect of the events just described may need explanation at this point before resuming the account of what happened next. Sardonic doubt was once exhibited in my presence as to how the meaning of the spike could be rapidly apparent among the many things going on. I think the question of why I recognized it whereas others apparently hadn't deserves consideration, and the answer, I believe, is at least three-fold.

First, on the 29th, puzzles had been accumulating all evening. The primary system acted as though steam was in it outside the pressurizer but temperatures were too low. The waste gas tanks were full but we did not know why. Lots of radiation was loose in containment, but we did not know what the fuel damage was like. And we felt a great urgency to get answers. The visual image of the recorder trace resembled graphs of calculated hydrogen pressure spikes I had seen before and that image was the trigger which made all the then-known pieces of the puzzle fall in place. This kind of thinking is intuitive, not analytical in the pedestrian sense. But, I believe it is a well recognized psychological process.

The second factor is background. Although I am a licensed nuclear engineer, my degree is in chemical engineering and I worked in that field and chemistry for five years during which

I had personal experience with both the potential for and the actuality of fires and explosions. During the early years of nuclear reactor design we were especially sensitive to the possibility that metals such as aluminum, stainless steel and zircalloy used as fuel cladding could react with water at high temperatures to produce hydrogen and destroy the cladding. Later on, accident analyses such as those for TMI, included consideration of these reactions as well as hydrogen production in containment by radiolysis and by reaction of spray water with aluminum and zinc. Those familiar with these analyses knew the aluminum source was over-estimated and radiolysis was slow. Most operators and many engineers did not have this kind of background then and so probably were not as sensitive to the possible meaning of a pressure spike.

The third factor is stress. Although I am not an expert in this area, I know from experience that except for those who freeze, acute stress makes one especially alert to start with but dulls analytical and physical capabilities fast. Stress is especially high if one can't figure out what is going on. The operators and most others present upon my arrival in the control room had been under high stress for long periods. Some of them had not slept much, if at all, in about two days. We, on the other hand, while under high stress, were relatively fresh, better able to interpret the more obscure clues such as the spike.

Given these three factors, I do not find it surprising at all that the situation developed the way it did. I don't find it surprising in such a complex, confusing, unprecedented and on-going situation that it took a combination of circumstances and a fresh look to recognize the significance of what may at first have appeared to be a spurious instrument reading among hundreds of other readings and alarms and plant control problems. I say this because I have a recollection, imprecise as to time, that mention was made among many other things in my presence at some point on March 29 of a containment pressure recorder spike said to be a spurious indication: e.g., caused by a voltage anomaly in instrumentation. I recall being skeptical of that explanation. In all the discussions, however, no one had exhibited or implied in my presence any recognition of the significance of the containment pressure spike. Nor did I pause to reflect on my skepticism at the time and, indeed, until the graph of the spike was shown to me which prompted the reaction described above.

And this leads back to the story. I knew from personal experience that under high stress one tends to lock-on to a perception of reality which, even if the best available, may be wrong. I had been trained to recognize and handle such situations. So even though we felt great pressure to act, Tom Crimmins and I forced ourselves to take the time to review the facts and test the logic of the hypothesis about the spike and related matters. When the hypothesis held up, I called someone

and asked for the best man available to help us. Shortly afterward at about 2330 Mr. Jim Moore, an experienced GPU engineer arrived.

The three of us sat in the shift supervisor's office trying to figure out how to measure bubble size. Finally, after what seemed a long time but probably was not, Jim Moore said, "Boyle's law ought to work" and I recall thinking, perhaps saying almost before he had finished, "And the pressurizer is the piston." Boyle's Law states that, other things being equal, the volume of a perfect gas is inversely proportional to absolute pressure. Although other things were not equal and hydrogen is not quite a perfect gas, it was obvious that the volume of a bubble, if there was one in the primary system, could be measured approximately by measuring the difference in system pressure caused by a given difference in pressurizer level. I asked Joe Logan, the TMI-2 Superintendent, to change level to get about a 100 psi pressure differential. Operations said they had some data like that from the previous day. I asked that it be "QA'd," that is, verified before we used it and then commandeered the open telephone line to Lynchburg from a B&W engineer and made two urgent, highest priority requests of Don Nitti and Jim Taylor whom I found at the other end:

First: What is the free volume under the head of the reactor pressure vessel down to the top of the nozzles?

Second: Make refined calculations of bubble size, using pressure, temperature and pressurizer liquid volume change information we would give them, taking account of gas solubility and anything else pertinent assuming the gas is hydrogen.

Jim Moore and I then made calculations of bubble size independently and got approximately the same answer. When we corrected each other we had a bubble size of 1568 cubic feet at 875 psia from data taken at 1245 on 29 March. My calculations are time marked 0235 (0245) on 30 March. Subsequent estimates from data taken about 0330 on 30 March gave a bubble volume of about 1100 cubic feet at 875 psia. We had not yet gotten proof of the interpretation of the pressure spike but the hypothesis had been greatly strengthened.

At about 0325 hours B&W called back to report the free volume in the reactor vessel down to the outlet nozzles was 1129 cubic feet. Even though the first bubble volume calculated of 1568 cubic feet was larger than this, and the second about equal, it was clear the core wasn't uncovered. Questions to Operations indicated amperage and vibration were normal for the one primary pump which was running. So there wasn't enough hydrogen to interfere with main pump operation at then current system pressure. But there was enough so that depressurization could uncover the core and defeat core cooling by methods then being used.

Shortly before 0400 after talking to B&W, I started to calculate the amount of zirconium cladding in the core which must have burned to produce enough hydrogen for global ignition in containment and for a hydrogen bubble of the size measured. I stopped before completion because of the press of urgent matters and since rough numbers and mental corrections indicated a large part or all the zirconium had burned. I didn't necessarily believe all of it had, but it was clear now that the core was very seriously damaged. That was what we needed to know at that time.

At about 0400 after discussions with Crimmins and Moore, I recommended to Joe Logan that he start venting the pressurizer to containment while holding the pressure at the then current level of about 970 psig with pressurizer sprays and heaters on as much as possible. I also asked that analyses of the hydrogen and oxygen content of the containment atmosphere be obtained as soon as possible. The venting was aimed at removing hydrogen from the primary system by steam stripping dissolved hydrogen from the hydrogen rich water brought to the pressurizer by the sprays on the assumption that the hydrogen in the bubble would "diffuse like a shot" and replace that stripped and so the bubble would gradually disappear. Venting from the pressurizer was started later on 30 March.

Containment atmosphere sampling done between 0518 and 0638 of 31 March showed residual hydrogen of 1.7% and oxygen of 16.3% by volume clearly supporting the hypothesis of a hydrogen

ignition. The normal concentration of oxygen in air is about 21% and hydrogen is essentially absent. At 2338 of 1 April B&W reported by telephone that at 1550 that day the bubble in the primary system had disappeared according to volume calculations and noise measurements. This was confirmed by a graph sent to me and received at 0044 of 2 April. The disappearance of the bubble was consistent with the initial interpretation of the spike. As more information was accumulated over the next days and weeks, the initial interpretation was demonstrated without doubt to be correct.

I find it inconceivable that if anyone had known hydrogen was present in containment and had ignited, they would have concealed that knowledge from peers or managers and that the on-site technical support team would not have been told of it. No motive for concealment by those involved existed since too much was at stake including, perhaps, their lives.

Also, I find it inconceivable on other grounds that the real significance of the pressure spike was deliberately concealed by an exercise of duplicity or dishonesty. I know many of the people involved and have for years. They simply would not have done such a thing. And when I say that I include Mr. Kuhns, Mr. Dieckamp, Mr. Arnold and all of those managers and engineers with whom I worked during the accident.

In the course of working with Mr. Dieckamp during the accident, my high regard for his honesty, managerial ability and patience, which has certainly been tested under very

difficult circumstances during the past five years, was reconfirmed. I might add that Mr. Dieckamp gave a great deal of personal attention to what was going on during the TMI-2 accident. He, for example, called me directly several times near midnight of Friday, 30 March when he was concerned, as we all were, about the potential for another buildup of hydrogen concentration in the containment due to venting the primary system and due to the slow radiolytic decomposition of water in the bottom of the containment building.

To recapitulate, no recognition of or even speculation about the significance of the pressure spike was expressed or implied in all of the extensive and intensive communications I heard or was party to from early morning of 28 March until the spike's significance was recognized at about 2300 on 29 March as I have described. These communications were with both senior and junior engineers, operators and managers, probably more than 50 in all. Nor did I hear about any such prior recognition from the hundreds of people I dealt with subsequently while on duty at TMI for nearly a month. Furthermore, the people I know and dealt with would not have deliberately concealed such knowledge. And I state that judgement with emphasis and without qualification.

WILLIAM W. LOWE

March, April 1979	TMI Accident Control: On-Site Night Leader for Technical Support.
1956 - Present	Pickard, Lowe & Garrick, Inc.
1954 - 1956	Bath Iron Works, Chief Nuclear Engineer.
1948 - 1954	USAEC/Hanford, Washington. Engineer - Chief of Nuclear Engineering Section.
1944 - 1948	Los Alamos Scientific Laboratory - Staff Member.

Education

B.S., ChE., Purdue, 1947

Registered Nuclear Engineer, District of Columbia
American Nuclear Society, Member
American Chemical Society, Member
American Institute of Chemists, Fellow

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MR. BLAKE: I have no further questions for Mr. Lowe. He is available for cross-examination.

JUDGE SMITH: The Board has just become aware that we have not followed the traditional practice or what has recently beer traditional requiring the parties to present cross-examination plans in advance of cross-examination. Of course, it is too late to make that requirement now of you, Ms. Bernabei. But having done that we may find it necessary from time to time to ask you to interrupt your cross-examination.

What we will do is expect you to explain to us, unless you feel that there is a genuine need to keep that confidential -- on rare occasions, if we believe it is necessary, we will have you explain that confidential reason to us in a memorandum or something if we believe that that is necessary. But the pattern has been throughout this hearing and in our previous orders prior to going to hearing to have the parties present cross-examination plans at the beginning of the cross-examination.

I know you weren't present during the other hearings, so we will excuse you from it, and we should have brought it up again and make it clear.

Beginning the next round, however, the next phase where there is written testimony, we will require cross-examination plans.

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You seem confused, Mr. Blake.

MR. BLAKE: Only by your reference to the next phase.

JUDGE SMITH: I don't want to leave anything open. We'll be going into the training phase, and we will have them then. The rest of the hearing will require cross-examination plans when there has been advance opportunity to prepare.

I might also invite you, if you are able, so that we can better follow your cross-examination, to provide us with a copy of your cross-examination plan; but that can only be done with the understanding that after the examination, what you provided us is made available to other parties.

Do you have questions about that?

MS. BERNABEI: I know the procedure has worked in other proceedings I've been involved with. The plan has not been made available to the other parties, however.

JUDGE SMITH: Ultimately, it is, not before the cross-examination but afterwards it has to be; otherwise, it is an ex parte communication.

However, proceed.

MR. GOLDBERG: Judge Smith, please excuse me. I want to make sure I understand what you just said about cross-examination. Are you requiring cross-examination plans for other witnesses on the Dieckamp mailgram issue, or just beginning with the training phase of the remainder of this proceeding?

JUDGE SMITH: If it should turn out that there is a hiatus in this hearing or some opportunity for the parties without undue burden upon them to prepare cross-examination plans, we would require it. It does not seem to me possible now.

It will be possible with respect to the training phase.

MR. GOLDBERG: Thank you.

JUDGE SMITH: Miss Bernabei, you may proceed. Make yourself comfortable. If you would rather sit down there with your notes and papers, I think there is room; wherever you feel that you can perform the most efficiently.

MS. BERNABEI: We have a few exhibits. I would just like to move those up here as well.

CROSS-EXAMINATION

BY MS. BERNABEI:

Q. Mr. Lowe, am I correct that you believe you were the first one to understand the significance of the pressure spike; is that correct?

A. Yes.

Q. Mr. Lowe, it is true, is it not, that you believe that you were the first to understand the pressure spike that is interpreted in terms of core damage or production of significant amounts of hydrogen?

A. Yes.

Q. Have you testified at any previous times, or have you been interviewed in the course of any NRC investigation at which you indicated you did not know if you were the first one to so interpret it?

A. There was a call from a member of the Kemeny Commission; I believe his name was Lewis Battist. He asked me if I had identified it and asked for information. I told him that I didn't remember the details. He asked me if I considered it to be significant and my answer was yes.

Q. Isn't it true that there was a report of that interview prepared -- and Mr. Battist, if I could inform you, was a member of the Special Inquiry Group, not the Kemeny Commission. But is it true that he prepared a report of that interview in which he said you responded that you did not know if you were the first one to understand that the spike indicated an explosion?

A. If that's what Lew Battist reported, that's no doubt what I said.

Q. Do you have any doubt about that?

A. Well, subsequently on --

Q. Do you have any doubt that that was what Mr. Battist reported of your interview?

A. It certainly would resolve any doubt if someone would show me a copy of what he wrote.

Q. I am going to show you what I believe has been marked as Joint Exhibit 114.

JUDGE SMITH: Already there is confusion about the exhibit references.

MS. BERNABEI: This is a Special Inquiry Group memorandum of a conversation with Mr. Lowe. I believe it is number 114.

JUDGE WOLFE: We are talking about how you identified it. Should it not be identified as Joint Mailgram Exhibit 1, Item 114? Would that be a correct identification?

MS. BERNABEI: I don't think so.

MR. BLAKE: I think we had more problems with that.

MS. BERNABEI: I think it is Joint --

MR. BLAKE: I'm sorry, very sorry, to say that maybe we had better take a break, but Item Number 114 on the index of Joint Mailgram Exhibits is D. Berry Notes.

Maybe we should take a break and sort this out between Ms. Bernabei and I.

MS. BERNABEI: If we had an index of the exhibits we could determine that.

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JUDGE SMITH: Also while you are on a break, let's come up with a uniform method of referring to the various items in the exhibit, or various exhibits. Right now I understand there is one exhibit with many items. Let's agree on some kind of uniformity.

MR. BLAKE: Mr. Chairman, what I think Ms. Bernabei is referring to is Item 104 on the index, not 114; and I think we should take a break.

MS. BERNABEI: I am ready to go on. I think the Joint Exhibits are Exhibit 2; is that correct, Mr. Blake?

JUDGE SMITH: Where we stand now we have only one exhibit, and that is the Joint Exhibit on the Dieckamp issue; one exhibit with three sub-parts, and one sub-part has 100-and-some items.

MS. BERNABEI: Then this will be Joint Exhibit 1, Sub-part 104.

JUDGE SMITH: That would be a shorthand way. I think it is harmless, but to be complete it is the third category of designation, the third sub-part to the exhibit, Item 104.

If it is acceptable to the parties, let's call this Joint Exhibit 1-C-104. Is that consistent with your numbering code?

MR. BLAKE: Yes.

JUDGE SMITH: So this is Joint Exhibit 1-C-104.

MS. BERNABEI: We do have single copies of that

exhibit which we could distribute.

JUDGE SMITH: That would be helpful.

BY MS. BERNABEI:

Q. Mr. Lowe, doesn't Mr. Battist's record of this interview indicate that you did in fact state you did not know if you were the first to recognize the pressure spike indicating the explosion?

A. Excuse me; I am a slow reader. I am reading.

(Witness perusing document.)

I think that Mr. Battist has characterized my statement at that time correctly. However, there may be other notes on this particular subject.

Q. Let me just make sure I understand. The question to you, according to this memo, was -- and I'm quoting now. Question two was: was he the first to recognize the significance of the containment pressure spike? Is that correct?

A. That's what he says it was, and that's what I remember it to be.

Q. And Mr. Battist's answer is that you do not know -- that is, you, Mr. Lowe, do not know if you were the first; is that correct?

A. That's what he said.

Q. The first information you received in your offices on March 28 about the accident was received at what time?

A. I'm sorry; I didn't hear the first part.

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Q. The first information you received about the accident was received at what time?

A. About 8:30 in the morning.

Q. During this morning period your firm was requested to provide certain weather data; is that correct?

A. They were requested to provide weather data, and also a double-checking of weather data, yes.

Q. And I understand your testimony to indicate that you believe you were being informed about the condition of the reactor on that morning, the first day of the accident?

A. The condition of the reactor, you say?

Q. Yes.

A. No, I don't think so except in a very general way. We were informed that a general emergency had been declared, and what the time was was 0745.

Q. So it is fair to say you were not being informed of the conditions, that is the parameters at the reactor that morning?

A. Not in the morning, except in that general way.

Q. At any time during the day were you, yourself, informed?

A. Yes.

Q. When was that? Now just sticking to March 28th, the first day.

A. I'm going to have to try to recollect. There was

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a discussion with Mr. Jack Thorpe, and I believe that was in the afternoon.

Q. I believe you stated in your testimony that Mr. Thorpe told you in that conversation that the plant thinks that core cooling is recovered; is that correct?

A. Yes.

Q. Isn't it true that what Mr. Thorpe told you at that point was not that core cooling was recovered, but in fact the core was now covered where previously it had not been covered?

A. I'm not sure -- in fact, I would not draw that inference because I don't think it was until much later that I understood that the core, in fact, had been uncovered.

Q. So your testimony is that Mr. Thorpe did not indicate to you that the core was covered, but had not previously been covered earlier in the afternoon?

A. Recovered, I suppose, if one wants to take the semantic point of view; it can be read in several different ways.

Q. I am asking you now --

A. One could recover the thermal cooling in the core from a derated condition.

Q. But I am asking you: did Mr. Thorpe in this 4-30 conversation tell you that the core was now covered where previously it had not been covered?

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A. I do not remember him saying the last three words.

Q. Did he indicate to you that it was now covered, but imply, if not express, that it had been previously uncovered?

A. Well, he may have implied it, but if he did I didn't pick it up because I do recall much later finding that the core had probably been uncovered, and that was a rather shocking discovery.

Q. When did you have this shocking discovery?

A. It was apparent in the understanding of the pressure spike, but the specific calculations about the water level were not available until after that.

So I suspect, although I don't know, that it was on the evening of Friday the 31st.

Q. So that was the first time you were aware that the TMI core had been uncovered; is that correct?

A. By evidence from hydraulic calculations, yes.

Q. How about by any other evidence, including assessment by site personnel?

A. At that time I am not sure it was through personnel. It was after the identification of the meaning of the spike, to which I testified.

MS. BERNABEI: I would like to mark a TMIA exhibit. Would that be TMIA Exhibit 1?

JUDGE SMITH: Yes. Is it an exhibit that is not

involved in the stipulation?

MS. BERNABEI: That is correct.

JUDGE SMITH: A new exhibit?

MS. BERNABEI: Yes, a new exhibit.

MR. BLAKE: Judge Smith, do you think in order to avoid a conflict with the past exhibit numbers in the proceeding we could refer to this exhibit as TMIA Mailgram Exhibit 1? It is a little more awkward, but just so we don't get goofed up with prior exhibit numbers.

JUDGE SMITH: Yes. All exhibits will be by the offering party and designated as Mailgram Exhibit and then the number. This will be TMIA Mailgram Exhibit 1.

Will you provide copies to the other parties?

MS. DOROSHOW: Yes.

MS. BERNABEI: I believe the parties have copies.

(Whereupon, the document referred to was marked as TMAI Mailgram Exhibit No. 1 for identification.)

BY MS. BERNABEI:

Q. Mr. Lowe, have you had an opportunity to review TMIA Mailgram Exhibit Number 1? That is the document that was just handed to you.

A. Yes.

Q. Can you identify this for us?

A. It is a memorandum that I dictated on the 28th

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of March, 1979.

Q. And the memorandum concerns your conversation with Mr. Thorpe at about 4:30 p.m. on March 28th; is that correct?

A. Yes, that is correct.

Q. Referring you now to the last sentence of this memorandum, doesn't that sentence indicate that Mr. Thorpe told you that the core -- not core cooling, but that the core was covered?

A. No.

Q. That's not the way you read that sentence?

A. No. If you lose core coolant or lose the normal situation, the temperatures and flows are not normal. The core is in an abnormal state, and if you get it back to some understandable state -- or think you have it -- it is quite common in the industry to use the term "recovered."

Q. Wouldn't you say, as you stated in your testimony, if he had meant to tell you the core cooling was recovered, wouldn't he say core cooling is recovered or reinitiated? Wouldn't those be the words you would use?

A. I wouldn't speculate about what words he would use.

Q. How about the words you would use, Mr. Lowe?

A. I don't think I would have said that.

JUDGE SMITH: May I interrupt you just a moment?

When we have rather bulky pieces of paper like this, I would prefer that they be, if possible, bound in the

transcript at the very point at which the witness is discussing it. This is a particularly important one because it is a memorandum from Mr. Lowe. If you have an extra copy we will mark it TMIA Mailgram Exhibit Number 1 and it will be bound into the transcript at this point. It is in the three official copies that we will need it.

BY MS. BERNABEI:

Q. Mr. Lowe, you were part of what was called the Analysis and Recovery Team; is that correct?

A. I think they called it the Events Analysis and Recovery Planning Team.

Q. And that was formed or constituted on March 29th; is that correct?

A. That is correct.

Q. And essentially it was composed of two sections, an Events Analysis section and a Recovery Planning section; is that correct?

A. Correct.

Q. And you were part of the Recovery Planning section; is that right?

A. Yes.

Q. Now, Mr. Crimmins, Tom Crimmins, was also part of that section; is that correct?

A. Yes.

Q. The first meeting of that Events Analysis and

TMIA Madgram Exh 1 11-14-80 HG

ME-2 - GORB
3-28-79
WWL

IV 2.4

6

Jack Thorpe reports at 4:20 p.m., this date the following Unit 2 status:

1. Radiation monitor at containment top inside has dropped from 6,000 R/hr to 80 R/hr in the past three hours;

2. Exterior radiation readings are 7 MR/hr at the fence, 3 MR/hr at the guard house and 2 MR/hr at the north bridge. Tom Jeruski reports reading of 0.2 MR/hr in Harrisburg.

Steam bubbles existed in ~~#1~~ A and ~~#2~~ B MC loops. One ~~has been collapsed and they are working on the other.~~ bubble Earlier attempts to start main coolant pump indicated that they were running in steam. All power is available and all pumps are available. They are cooling by feed and bleed. Plant thinks core is recovered, but proof not yet established.

W. W. Lowe
WWL

:bb

WWL,
THIS IS THE ONLY MEMO DICTATED BY YOU 3/28/79 WITH JACK THORPE'S NAME MENTIONED THAT I CAN FIND. I CHECKED ALL FILES ON YOUR DESK AND BEHIND (BUT NOT ON TABLE). IS THIS IT--I HOPE! LOLA

pl2

Recovery Planning Group was at 3:30 p.m. on March 29th; is that correct?

A. Approximately, yes.

Q. And this group was briefed by George Kunder, the Superintendent of Technical Support for Unit 2; is that right?

A. Frankly, I don't remember who gave the initial briefing. My recollection is that at the end of it, at the end of the meeting, or at a separate meeting afterwards Mr. Kunder did make a statement, yes.

Q. In any case, you were briefed by site personnel; that is Metropolitan Edison personnel about the status of the reactor; is that fair to say?

A. Yes, that is correct.

Q. And this meeting, I think, according to your testimony, lasted until about 5:00 or 6:00 that evening?

A. Yes.

Q. And the meeting was conducted with both sections of the group; is that correct?

A. Yes, that is correct.

Q. Therefore, Mr. Crimmins was present at that meeting as well as yourself?

A. Yes, he was.

Q. And he was present with you during the entire meeting, if you remember?

A. I believe he was.

Q. Now, I believe it is your testimony that the first time you saw the pressure by chart report was at 11:00 p.m. on March 29th; is that correct?

A. That's correct.

Q. And it was shown to you by an engineer; is that correct?

A. Yes.

Q. And I believe it has been testified at previous times that it was Richard Bensel, an electrical engineer?

A. Would you repeat the end of that?

Q. Richard Bensel, an electrical engineer?

A. I found out later he was the person, yes; Richard William Bensel.

Q. Now at the time Mr. Bensel showed you the pressure spike, you testified that you concluded instantaneously that the spike -- or instantly that the spike was caused by a hydrogen emission; is that correct?

A. Yes.

Q. Did Mr. Bensel indicate to you at that time his assessment or evaluation of the spike?

A. Not that I recall.

Q. Did he give you any other technical data, raw data other than the chart recorder?

A. I asked for confirmation, and he pointed to a

second pressure pressure tray at the bottom of the chart, which showed a spike at about the same time. I then asked for temperatures, uneven temperatures, and he found those, and they also showed anomalous behavior upwards at about the same time.

Q. Other than the temperature data and the one strip chart showing two traces for the containment pressure, did Mr. Bensel show you any other data?

A. No, he didn't. That was the only written evidence which I believe he showed me.

Q. Did Mr. Bensel tell you that he had been concerned approximately two hours earlier about the volume or amount of hydrogen in the reactor building; that is around 9:30 p.m.?

A. That he was concerned about what?

Q. The volume of hydrogen in the reactor building.

A. No.

Q. In your memory, he didn't speak to you about hydrogen specifically at all; is that correct?

A. That is correct.

MS. BERNABEI: I would like to mark as TMIA Exhibit 2 notes of Mr. Seelinger, who was the site personnel on the first and second days of the accident, Mailgram Exhibit 2.

JUDGE SMITH: Do you have a copy of that?

MS. BERNABEI: Yes, I do.

JUDGE SMITH: It just occurred to me that I directed that TMIA Exhibit 1 be bound into the transcript and it has not been offered into evidence, nor has it been objected to, nor received.

MR. BLAKE: I understood that your binding of it in was for the convenience of the parties to have it referenced and available in the transcript.

JUDGE SMITH: It was for convenience. I would prefer, however, not to do that unless it was with the recognizance of being received as a matter of evidence.

MS. BERNABEI: I would move that it be introduced at this time.

MR. BLAKE: Does anybody have any objections?

JUDGE SMITH: Any objections?

(No response.)

JUDGE SMITH: Then TMIA Mailgram Exhibit Number 1 is received.

(Whereupon, the document marked as TMIA Mailgram Exhibit No. 1 was received in evidence.)

JUDGE SMITH: Would you describe TMIA Mailgram Exhibit Number 2?

MS. BERNABEI: I will describe it as the March 29, 1979 notes or log of Mr. Seelinger, Met-Ed personnel at the site on March 29th.

(Whereupon, the document referred to was marked as TMIA Mailgram Exhibit No. 2 for identification.)

JUDGE SMITH: Are you going to offer this?

MS. BERNABEI: I will.

BY MS. BERNABEI:

Q Mr. Lowe, I would like to refer you to page 9 --

JUDGE SMITH: How are you going to handle this?

MS. BERNABEI: It is Mr. Seelinger's. It was produced to us during the course of discovery by GPU and identified as the notes of Mr. Seelinger.

JUDGE SMITH: My only concern is that there be something on the face of it to identify it. We have something on the document that says "2030, March 29, 1979, page 3," and it begins "Trying to chage letdown filter 1000R in room C."

MS. BERNABEI: That's correct.

JUDGE SMITH: It has how many pages?

MS. BERNABEI: It is a ten-page document.

JUDGE SMITH: Pages 3 through 13 of handwritten notes?

MS. BERNABEI: That's correct.

JUDGE SMITH: If this is going to be an important part of his testimony, I would like for the accessibility of this document that it be moved up front; so if this is an important part of his testimony, it should be in early so that others

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can understand what he is testifying about. So would you please offer it as soon as you are able to, if that is going to be its use?

MS. BERNABEI: Fine. I talked to Mr. Blake about the licensee's objections to documents which we considered were compiled in the normal course of business, and I understand Mr. Blake's representations were that the licensee would not object to them on the grounds of authenticity or hearsay. Therefore, I move that it be entered into evidence as TMIA Mailgram Exhibit 2. It has been represented and produced to us during the course of discovery as Mr. Seelinger's notes for the period of the accident.

JUDGE SMITH: For what purpose do you offer it?

MS. BERNABEI: The notes indicate that Mr. Bensel was concerned with hydrogen in the reactor building two hours before he showed the pressure chart to Mr. Lowe, and there was a concern noted in the 9:30 timeframe on March 29th about the volume of hydrogen in the reactor building.

I think it attacks the credibility of that in that there was not knowledge or information about production of significant amounts of hydrogen until Mr. Lowe's discovery at 11:00 p.m. that night.

JUDGE SMITH: Mr. Blake?

MR. BLAKE: Ms. Bernabei has properly represented that we produced these in response to her request for Mr. Seelinger's

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notes. I stated to her -- and it would be my practice throughout these proceedings not to object on authenticity grounds to documents which the company has in its files and has produced in the course of discovery.

My problem is going to be with documents of this type the reliability of the document, or the use which will be made hereafter of the document where it goes in and the author is not available to explain what the document means -- or the language in the document.

Other than that, I'm not sure how to handle this one, Judge Smith. I recognize the Board's desire to include it in the transcript. I don't believe she is able to test Mr. Lowe simply by identifying the document at this juncture.

JUDGE SMITH: I only want it to be in the transcript when it becomes a very material part of the testimony, and that is just for convenience, in evidence for convenience.

In some instances it can actually be adopted as testimony. In this instance, apparently it is going to be used simply as -- it is authored by somebody else. What are you going to use it for in this cross-examination?

MS. BERNABEI: To indicate that there was a concern, a licensee concern -- specifically Mr. Bensel is named in this document -- about hydrogen two hours before, and the volume of hydrogen in the reactor over two hourse before Mr. Lowe supposedly discovered it.

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JUDGE SMITH: And you intend to cross-examine Mr. Lowe on it?

MS. BERNABEI: That's correct.

JUDGE SMITH: It is a toss-up on whether this should be in the transcript or not. We will see what happens.

MS. BERNABEI: Let me just state my understanding with Mr. Blake; it was that we would not have to bring witnesses here to sponsor each one of these documents. This is in the nature of a log, at least the way I read this document and the others that were produced with it. That is it is Mr. Seelinger's notations in a chronological fashion during the day.

He did have responsibilities to take notations of this sort; therefore, I think it is a business record exception to the hearsay rule, and it should be admitted.

JUDGE SMITH: Normally I would agree that if this was a log that he was keeping in the normal course of his duties and came from the corporation's records, and they don't deny its authenticity, then you might have something that could be admitted under the normal business record exception.

But you have another problem, and that is normally we admit a business record the meaning of it is apparent on its face. In other words, it is a business record which carries its own explanation.

Here I don't know if it does or not because we haven't

studied it, and you haven't helped us to be guided in that. But even though you might have something that meets all the business records exceptions, it still has to be probative; and if it is not apparent what it means on the face of it, then we have the obstacle of it being reliable and appropriate.

MR. GOLDBERG: I have another concern about the document, which may disappear if I get an explanation. That is that on the face of it is not a complete document, and it is notes the first page of which on this copy begins on page 3.

I would certainly be interested in what page 1 and 2 of these notes reveal, and whether they might not reveal the purpose and significance of the notes.

So without an explanation as to why we don't have the complete document, I see a problem with it.

MS. BERNABEI: I asked the same question --

JUDGE SMITH: If you offer a document to the various parties at a proceeding, any party -- and certainly Mr. Goldberg -- has a right to ask to see the complete document before it goes into evidence.

MS. BERNABEI: I think that was the question I asked Mr. Blake when I first received it. I asked for the whole document because we would be interested in the earlier portion of March 29th as well.

I have not found it, and I don't know about Mr. Blake's efforts. I think on its face -- and we can produce,

if you wish, the other portions of the document as it was produced on March 28th, March 30th and March 31st. The document is in the nature of a log, and I think that, together with the explanation of Mr. Seelinger' duties on these dates, would so indicate that it is a business record.

JUDGE SMITH: I am not quarreling about whether it is a business record. Is it a reliable and probative business record?

MS. BERNABEI: I think given Mr. Seelinger's position at that time, it is.

JUDGE SMITH: I don't know what his position is, but I'm assuming it is a very, very responsible, involved and relevant position.

What does the document say? I don't understand the document. What findings can we make from the document?

MS. BERNABEI: I am just referring the witness -- and the only portion which I think is relevant at this point is at page 9, the entry for 9:30 p.m. on March 29th. It indicates a concern and discussion of hydrogen in the reactor building and an indication that Mr. Bensel -- that is the person supposedly that helped Mr. Lowe discover the hydrogen -- is looking at equipment which would cause a spark related to the hydrogen in the reactor building; and, secondly, the line below that indicates that there is some kind of analysis being done, presumably about hydrogen in the reactor building.

I think that indicates that there was discussion and concern about it at least two hours before Mr. Lowe supposedly discovered the problem.

JUDGE SMITH: All right.

BY MS. BERNABEI:

Q. Mr. Lowe, are you aware of any inquiry or investigation by Mr. Bensel at about 9:30 p.m. to determine if certain -- if activation of certain equipment will cause a spark in the reactor building due to the presence of hydrogen?

A. I was not aware of his doing it, although I am certainly aware of activity which I initiated along with Mr. Seelinger and Mr. Kunder, which would have resulted in just this kind of an action.

Q. When was that?

A. As I said in my testimony, in the preface and it is included in the qualifications, I'm not sure that I can be accurate as to the precise hour. I could be accurate within a several hour timeframe. However, the hour that I used in my testimony I believe was about 2200.

The activity in question was that first problem we started to work on, and that was to try to vent the tubes there, which would normally pull hydrogen, and which we presumed would pull hydrogen back to the containment; that is to the containment because they were nearing the relief pressure of 95 psi-a -- or t -- and they were full of

radioactive gas.

The objective was then to vent them back, and that was the first problem of work. It was done well before the indications of the significance of the hydrogen spikes. And one of the specific requests that we made in making our plan for doing that was that someone look for and secure any spark sources within 12 feet of the entry point that we had chosen for the hydrogen to come back from the tank into containment.

Q. So it is your testimony that the instruction which is referenced here -- or the inquiry which is referenced in the note refers to your concern about the decay waste tanks?

A. Do I say that it does?

Q. Yes.

A. I can't say for sure because I didn't write the notes and I didn't know who was working on the problem. But it certainly would fit the sequence of events.

Q. Was there any analysis of the amount of hydrogen in the reactor building at that time?

A. Had we had one?

Q. Were you doing one? Yes, were you familiar, or were you, yourself, doing one?

A. No, I don't believe so. That analysis was not requested until about 0400 on the third day.

Q. Therefore, as far as you know, there was no analysis

of the volume of the reactor building or the volume of hydrogen in the reactor building?

A. No analysis for hydrogen?

Q. That's right.

A. As far as I know, that's true.

Bensel would have been the logical man to do this, by the way.

Q. In your testimony you said you did not review the pressure recorder prior to 11:00 p.m. on March 28th -- 29th?

A. Review it or view it?

Q. View it.

A. View it; I did not view it.

Q. Now, part of your instantaneous or immediate understanding of the pressure spike was based on your visual observation of the chart; is that correct?

A. Correct.

Q. And that's because it looked very much like the chart calculated for hypothetical hydrogen emissions; is that correct?

A. Yes.

Q. Now, there is testimony -- let me say this: there has been at least one individual who has identified, or stated that he believes that the pressure spike was observed and evaluated in the afternoon meeting on March 29th; do you have memory of that?

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A. I have absolutely no recollection of that.

Q. When you say --

A. I'm sorry; did you say we looked at it visually?

Q. Yes, you looked at it --

A. I have no memory of looking at it visually.

Q. Do you have any memory of it being analyzed at the afternoon meeting on March 29th?

A. No. As I said in the testimony, at some time during the afternoon, among many other things, the decay containment pressure spike was mentioned and noted as a voltage anomaly in the instrumentation.

Q. But you are certain that it was not actually observed; the pressure chart recorder was not observed and analyzed at that afternoon meeting?

A. What I am saying is I did not see it, and I was in the meeting all the time.

Q. And do you remember any discussion of hydrogen production in that afternoon meeting?

A. No, I don't recall any.

Q. I'm going to read to you from the response, the GPU response from interrogatories, Mr. Crimmins' memory of that meeting in the afternoon of March 29th, and ask you if this refreshes your recollection as to what may have occurred.

Again, you had a 3:30 meeting on March 29th.

MR. BLAKE: Ms. Bernabei, could you show the witness the document rather than just reading it to him?

MS. BERNABEI: Certainly.

BY MS. BERNABEI:

Q. Specifically, Mr. Lowe, I am referring you now to the second sentence in the last paragraph on that page.

A. Excuse me; I prefer to read the whole thing to get it in context, if you will give me a moment please.

Q. Certainly.

A. (Witness perusing document.)

Yes.

Q. Mr. Crimmins states, does he not, that he -- and I'll read it word for word, "I distinctly remember seeing and discussing the containment pressure trace and the spike in the trace. The assessment at that time was that it must have been a spurious instrumentation problem."

Does that refresh your recollection as to whether or not you saw the pressure strip chart and reviewed it and assessed it at that meeting?

A. I certainly do not remember seeing the pressure strip chart at that time.

Q. Do you remember any assessment or review of the pressure spike at that meeting?

A. No.

Q. Other than the visual impression or image of the

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pressure trace, you say that a portion of the base is for your --

A. Excuse me, Ms. Bernabei, you used the word "assessment," and to me normally that means a professional technical analysis to see if it is valid; and that is the sense in which I said no.

Mr. Crimmins here is saying "the assessment at that time," which to me has a slightly different meaning, that it was a judgment at the time rather than a technical assessment.

Q. But I assume it would have been an assessment using his -- what you consider highly qualified, technical ability; is that correct?

You do consider Mr. Crimmins to be --

A. I do.

Q. -- well-qualified, do you not?

MR. BLAKE: Ms. Bernabei, objection. Will you ask one question at a time and then wait for the answer? I object to the second of those two questions in that the witness has not answered the first one, unless you are withdrawing it.

BY MS. BERNABEI:

Q. Let me back up, and I'll give you one at a time, Mr. Lowe. You consider Mr. Crimmins highly qualified, do you not?

A. In his field he is, yes.

Q. And he would be qualified to interpret and evaluate the pressure spike, would he not, as you yourself would be?

A. You have to ask as to what. I don't think he would have been qualified for making electrical interpretations.

Q. I'm asking whether he would be qualified to understand the significance of the pressure spike upon reviewing and assessing it on March 29th.

A. I guess in general, yes; he is a very good man.

Q. And I assume what Mr. Crimmins was talking about in terms of an assessment is an assessment applying his technical capabilities and skills at that point?

A. I'm sorry; you are asking me what again?

Q. He uses the word "assessment at that time," and I assume he was talking about the assessment using his expert -- or technical capabilities and expertise; is that correct?

A. I don't read it that way; I read it as more a passing judgment.

As a matter of fact, I said in my testimony that I was skeptical of the explanation.

Q. Mr. Lowe, I am talking now about Mr. Crimmins and what Mr. Crimmins said. Mr. Crimmins said he believed that the assessment at that time was that it must have been a spurious instrumentation problem; and I'm asking you: doesn't that indicate an evaluation of the pressure spike using whatever capabilities he and the other members of the group had?

MR. BLAKE: Objective, Ms. Bernabei, the document has to stand on its own, and it doesn't even indicate that this assessment was Mr. Crimmins' or whose it was; you have to be careful about characterizing the document.

MS. BERNABEI: I think it is clear from the context but Mr. Lowe offered his opinion as to what the word "assessment" meant, and I am trying to probe his understanding. I think I am entitled to do that. Mr. Lowe is offering his opinion.

JUDGE SMITH: The only reason that we have allowed you to use that document se far with respect to his testimony was to refresh his memory as to the meeting. Now you are using it for a purpose which you sort of slipped into that hasn't been discussed, so to speak, by us.

You have asked the question several different ways. I think you have intended to ask it the same way, but you have only asked it once in the context of whether it was an assessment or in the sense of a consensus of whether he was capable of making an assessment.

You asked earlier as to what Mr. Crimmins meant by it. How does he know; he is no better judge than we are. At least you haven't established that, that he has any special expertise on it. Your whole line has not been very productive. I think that you ought to organize your line of inquiry towards some end. I don't know what you are going

to do.

MS. BERNABEI: If there is another individual for whom Mr. Lowe has respect and worked with that remembers a review and evaluation of the pressure spike eight hours prior to Mr. Lowe's.

JUDGE SMITH: All right. What are you asking Mr. Lowe to explain to the Board is what Mr. Crimmins meant as to the language here, which we can read for ourselves, and you haven't established that he has any particular vantage point to do it other than his presence there. You drew a blank in asking him to explain this to the Board, which we are capable of reading for ourselves; and I would read it in none of the ways that you have described it.

BY MS. BERNABEI:

Q. Mr. Lowe, would you give us some background? The meeting at 3:30 p.m. was the first meeting of the task force; is that correct?

A. Yes, that was the first meeting of the task force.

Q. And that was essentially to orient the members of the task force and indicate the purpose for which you had been assembled?

A. Yes.

Q. Was it also to define the tasks of the individual members of the task force?

A. No.

Q. It was not? You weren't to get your tasks defined so that you understood what you would be doing in the days that followed?

A. No.

Q. Was the scope of the task force examined?

A. Yes, in general.

Q. And the scope of the various -- or the two teams was established; is that correct?

A. Yes.

Q. And a decision was made to interview certain operators; is that correct?

A. To interview operators, that's right.

Q. Now, referring now to the basis for your instant recognition of the pressure spike in an explosion, one basis was what you called a mushiness in the primary system; is that correct?

A. Not quite. It was called that by the operators.

Q. But that was one basis of your -- one part of the puzzle which led to your instant recognition of the significance of the pressure spike?

A. Yes.

Q. Okay, I think a second -- a third basis, that is other than the visual image of the pressure spike and the mushiness in the system -- was that the decay tanks were full of radioactive gases; is that correct?

A. Yes.

Q. And there was no explanation at that time?

A. That's correct.

Q. And I think the fourth basis, at least according to your testimony, is that there was radiation above explainable levels in the containment building?

A. There was a lot of radiation in the containment building, yes.

Q. Now, isn't it true that in the afternoon meeting at 3:30 p.m. you knew about the mushiness in the primary system; that is, that that was a factor on which you were briefed and which was discussed at the time?

A. I'm sorry; knew about what?

Q. The mushiness, as you called it, in the primary system?

A. Yes.

Q. Wasn't it a fact that at that afternoon meeting at 3:30 p.m. you knew about the gas tank being full of radioactive gases which couldn't then be explained?

A. I believe so.

Q. And isn't it also true that you knew about the high levels of radiation in the containment building?

A. Yes.

Q. Assuming for the moment, although you don't remember it, that in fact the pressure chart was viewed and observed

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at that afternoon meeting, you knew all the other conditions which would lead you to understand and to indicate hydrogen and core damage, did you not?

A. Well, I'm not sure all those conditions you named were sufficient. They are some of the conditions that no doubt were implemented.

Q. Those were the four conditions you set out in your testimony, were they not?

A. They are.

Q. And assuming, although you don't remember, that in fact the pressure chart recorder, the strip chart, was available at the 3:30 meeting, those would all be present at the meeting; is that correct?

A. What would all be present?

Q. All the conditions which underlay your instant recognition of the pressure charts?

A. I'm not sure you can jump to such a simple-minded conclusion.

Q. I'm working now from your testimony. I'm saying that assuming for a moment that the strip recorder was present at the 3:30 meeting, and the other three conditions were met, that is you had information or knowledge of those three conditions -- is that correct?

A. I don't think that's correct.

Q. I thought that was your -- just your testimony right

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now.

A. No, my testimony is based on the conditions -- the one condition you haven't mentioned is lapse of time.

Q. On page 4 of your testimony -- I'm going to go down the factors one by one. On page 4 you indicate your information about the gas decay tanks; is that correct, your knowledge that they had high levels of gases which were then unexplained?

A. Are you referring to a specific --

Q. Page 4, the first paragraph.

A. Yes.

Q. Doesn't that indicate that you had information about the waste gas tanks?

A. Yes.

Q. So you had that information at the 3:30 meeting; that is one basis for your instant recognition of the significance of the pressure spike?

A. I believe we were told about those gas tanks at that meeting, yes.

Q. Didn't you also know about the mushiness in the primary system; that is the sense that there was steam outside -- steam in the system outside the pressurizer? Didn't you also know about that during that time period from 3:30 until 6:00 p.m.?

A. I'm not sure that I remembered it at that point.

I know that shortly after that when we went in the control room we knew about it.

Q. You didn't know about it at that meeting?

A. I'm not saying that I didn't. I don't recall that I knew about it then.

Q. That had been the situation for some time during that afternoon, had it not?

A. I'm sorry, Miss Bernabei; I'm having trouble hearing you.

Q. I'm sorry; the mushiness in the primary system in the sense that there was steam outside the pressurizer, that had existed for some time that afternoon, had it not?

A. That had existed that afternoon?

Q. That's right.

A. I'm not sure it had existed that afternoon. There was a question on the operators' part as to whether it existed, as to its actual existence. I do not know.

Q. There was a concern about this, is that right?

JUDGE SMITH: Please move the mike right up next to you. I am struggling to hear you as well.

BY MS. BERNABEI:

Q. There was a concern about it, wasn't there, in that meeting as well as earlier?

A. On what?

Q. Whether there was definitive proof or not, Mr.

Lowe?

A. Well, certainly I was told there was a concern about steam volumes earlier, yes.

Q. And didn't you also know about the high levels of radiation in the reactor building at that time, at the 3:30 to 6:00 p.m. meeting?

A. Yes.

Q. If we assume then for the moment that the three conditions, you had that knowledge, and that the pressure chart was in fact observed and reviewed at that meeting, the conditions would be met, would they not, for your interpretation of the pressure spikes?

A. I've said it before and I'll say it again: not necessarily. I think they are influential factors, but they may not have been sufficient.

Q. Did you notice any other factors --

A. There may -- go ahead.

Q. Are there any other factors which you note in your testimony which led you to this instant interpretation of the pressure spikes?

A. Not which I noted, no.

Q. Do you remember in the Thursday afternoon meeting any discussion of hydrogen?

MR. BLAKE: Objection; asked and answered.

MS. BERNABEI: I don't believe I asked it here today.

MR. BLAKE: My objection stands.

JUDGE SMITH: I'm sorry; the question was answered.

I'm just noticing that Judge Linenberger is having trouble hearing you. We might as well resolve this problem now. The witness has his microphone a few inches from his mouth; Mr. Blake has his a few inches, and I do. You don't, you persistently keep it a foot or more away and we can't hear you.

It's going to be a long hearing, and I'm going to ask you for your cooperation in resolving it.

MS. BERNABEI: I apologize.

JUDGE SMITH: Even now you are doing it. Bring it very, very close to your mouth and keep it there. It's a big strain for everybody. Not only that, but you are going to create problems for your own record.

JUDGE LINENBERGER: Yes, I want to make that observation. You are hurting your own case when you make it difficult for those in the courtroom to hear you. You are hurting your own case when you do that. Please keep that in mind.

JUDGE SMITH: I'm sorry, but I don't have the question.

MR. BLAKE: My recollection of the question is: do you have any recollection of hydrogen being discussed at the meeting on the afternoon of March 29; and my objection was that it was asked and answered.

JUDGE SMITH: I thought it had been asked and answered.

I'm not sure I recall it. I think it has been asked and answered, but let's put it to the witness.

Do you recall answering that question?

THE WITNESS: I think I answered it.

BY MS. BERNABEI:

Q. And your answer was no; is that correct?

A. (No response.)

MS. BERNABEI: It is a predicate for another series of questions.

JUDGE SMITH: Was hydrogen discussed at that meeting?

THE WITNESS: I believe there was some mention of the waste gas decay tanks, which, as we all knew, were full of hydrogen, or we presumed they were.

I don't recall other mention of hydrogen at that meeting.

BY MS. BERNABEI:

Q. Specifically, do you remember a discussion of hydrogen up to 4 percent containment design; that is that the hydrogen level at TMI-2 had reached the 4 percent containment design level?

A. Do I remember such a discussion at that meeting?

Q. That's right.

A No.

Q. I'm going to ask you a hypothetical question which is not based on information that you provided, Mr.

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Lowe, but that other witnesses will provide.

It is fair to say, is it not, that the only way that hydrogen can be produced up to 4 percent of the total volume of the containment at TMI-2 within a two-day period would be through zirconium steam reaction; is that correct?

MR. BLAKE: I have an objection.

JUDGE SMITH: Let's hear your objection.

MR. BLAKE: My objection is that she is now asking for an expert opinion from Mr. Lowe about a specific percentage of hydrogen and how it might be generated in a length of time after the accident. I cannot connect it to the scope of this testimony, and I certainly represent that Mr. Lowe has not been asked to appear here as Ms. Bernabei's witness.

MS. BERNABEI: It appears to me that it is appropriate to ask the witnesses such as Mr. Lowe questions beyond the scope. I understand that I do adopt his answers as my own, and I do so only knowing through his deposition what his answer will be.

It is also relevant to the rebuttal testimony we intend to produce, and I think the Board has indicated it will allow us to produce through Mr. Abr vici.

JUDGE SMITH: Do you agree with Mr. Blake's point that it is beyond the scope of the direct testimony?

MS. BERNABEI: Yes, but I believe it is appropriate.

JUDGE SMITH: For what purpose?

MS. BERNABEI: To form an expert opinion as to what event or what reaction could produce within two days 4 percent hydrogen, to which Mr. Abromovici will testify.

JUDGE SMITH: I understand that, but how about the rule that cross-examination be limited to the direct examination, and you are going beyond it?

MS. BERNABEI: That is permitted as long as a party is willing to take the testimony as its direct testimony and be bound by it; and we are willing to do that.

That is my understanding. It is also my understanding that the Board --

JUDGE SMITH: I would expect that if he gives you the answer, that might be the consequence of getting it; but that's not where we are. We are at the point where you are trying to put on your case in chief with somebody else's witness without notice, without complying with the prehearing procedures and with the rules of the Board. That's one of the reasons why we have the rule about going beyond the direct. There's a rule against going beyond the direct.

You say it is okay as long as you are bound with the answer, but that's not the sole reason for it. That's not even a related reason for it. That's not a reason; that's a consequence.

MS. BERNABEI: This is rebuttal testimony. What I am about to elicit will support our rebuttal testimony --

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JUDGE SMITH: Do you want to call this man as your witness for rebuttal on a matter beyond his direct; is that your purpose?

MS. BERNABEI: That is correct.

JUDGE SMITH: What do you say to that, Mr. Blake?

MR. BLAKE: I guess I'm disappointed, at a minimum, that in the hours spent yesterday talking about this witness that this would at least have arisen by way of an observation by the parties.

JUDGE WOLFE: Is your question based upon a hypothesis? Ms. Bernabei, would you answer my question now?

MS. BERNABEI: Yes.

JUDGE WOLFE: If your question is based upon a hypothetical situation, is it based upon any facts now before this Board and in evidenc?

MS. BERNABEI: It is based upon events which will be before the Board through the testimony of Mr. Abromovici, yes, which is permissible. A hypothetical upon facts which will be before this Board.

I should also state that this is not a surprise to the licensee. We asked Mr. Lowe the precise questions which he answered during his deposition.

JUDGE SMITH: We had a very long session yesterday. In the first place, you know the rule against cross-examination beyond the scope of direct examination. We had a very long

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discussion yesterday about the various witnesses that you would be calling. Some of them were under the control of the licensee. Mr. Lowe is their witness under their control. His name was not mentioned at all.

We told you that it is your responsibility to inform us. Unless you can come up with some justification, the objection is sustained. You may make your arguments now once and for all and completely.

MS. BERNABEI: Yes. It is, first of all, permissible for a party to question a witness beyond the scope of the direct testimony if the party is willing to accept or be bound by the testimony.

Second, it is rebuttal testimony --

JUDGE SMITH: What party; you?

MS. BERNABEI: That's right.

JUDGE SMITH: I disagree.

MS. BERNABEI: Secondly, the licensee had notice, and in keeping with the Board's rulings yesterday, that witnesses who were called either by the Board or by any party would be allowed to be questioned beyond the specific purpose for which they were called if necessary. In fact, I think, Judge Smith, that was your ruling with regard to Mr. Kunder.

JUDGE SMITH: Wait a minute; that was in a little bit different context. Some of the people who are appearing are going to be appearing as witnesses that the Board would

have called anyway, and they are going to be -- in the case of Mr. Kunder it will be at the instance of the staff, and that was the context of the ruling, that you do not then and there set out every item that you would ask witnesses called in that nature in advance. But here it is an entirely different matter. This is a witness called solely by the licensee with his direct testimony in writing. You have had it all this time. He is not your witness. I disagree with your observation that you are allowed to do it so long as you are willing to be bound by it. That is just simply incorrect if for no other reason than it is totally incompleted. So you have confused the two comments.

MS. BERNABEI: Third, it has been permitted in proceedings I have been involved with insofar as it obviates the need for a party at a later date to call their own expert on a very narrow point. It appears now that we will either have to hire or call another expert witness for a single expert opinion, which Mr. Lowe is fully capable of rendering, and it would save all the parties a lot of time. That is what would be required.

JUDGE SMITH: We don't want you to. We cannot in any sense force the licensee to provide witnesses for your case.

MS. BERNABEI: I think it is appropriate.

JUDGE SMITH: In fact, we have no authority to do it.

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MS. BERNABEI: Then let me get it in through cross-examination.

JUDGE SMITH: I don't know why you so easily walked away from it being beyond the scope of the direct. I thought I would hear an argument from you on that. I was surprised by this.

MS. BERNABEI: I will go at it a different way.

BY MS. BERNABEI:

Q. Mr. Lowe, you note on pages 8 and 9 of your testimony certain methods by which hydrogen can be produced; is that correct?

A. Are you referring to page 9?

Q. Yes, the paragraph which begins on page 8 and continues to page 9.

A. Yes.

Q. Now, one of those methods is hydrogen production by zirconium steam reaction; is that correct? Zirconium water reaction?

A. That is correct.

Q. Another method of hydrogen production is by radiolysis; is that correct?

A. I'm sorry; by what?

Q. Radiolysis.

A. Yes.

Q. Another is by the reaction of spray water with

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aluminum or zinc; is that correct?

A. Yes.

Q. Of those three methods of hydrogen production which you have listed on page 9 -- to which you refer, can hydrogen in excess of up to 4 percent of the containment volume be produced within a two-day period by any of the three of these other than the reaction of zirconium with steam?

JUDGE SMITH: Before you answer, I'm troubled with the way you have phrased the question. You used the expression "hydrogen to 4 percent," which to me means hydrogen from zero to 4 percent. I think you meant to ask "hydrogen as much as 4 percent."

MS. BERNABEI: I'll rephrase the question.

BY MS. BERNABEI:

Q. Mr. Lowe, could hydrogen in amounts to or exceeding 4 percent of the containment volume be produced other than by zirconium and steam reaction; that is, other than by -- in any of the other two ways that you have mentioned on page 9 of your testimony?

A. Yes.

Q. In two days?

A. That's right, in two days.

Q. In two days.

A. In this containment?

Q. In the TMI-2 containment; that is correct.

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A. And assuming that all hydrogen produced got into the containment?

Q. That is correct.

JUDGE SMITH: Mr. Lowe, I'm sorry to interrupt you. Before you give your answer, I'm still troubled by the language of the question and your acceptance of it.

What do you take "to and exceeding 4 percent" to mean? What kind of a numerical figure can you give me on that?

THE WITNESS: I suppose she means by volume.

JUDGE SMITH: All right, by volume; but can you give me a number? Can you give me boundary numbers for what "to and exceeding 4 percent" means?

THE WITNESS: No.

JUDGE SMITH: Then how can you answer the question? I don't understand how you can answer the question. Could it mean .005 percent?

THE WITNESS: It could.

JUDGE SMITH: All right, just so I understand what you mean by the question.

MS. BERNABEI: I will rephrase the question.

BY MS. BERNABEI:

Q. Other than by zirconium steam reaction and the two other ways you have referred to on page 9, could hydrogen be produced in an amount of 4 percent in the containment volume at TMI-2 in two days?

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A. Of the total containment volume?

Q. That's correct.

A. And the specific TMI-2 plant; no other plant?

Q. That is correct.

A. Of the three reactions mentioned, I do think that the mineral/water reaction is the only one which would do that.

Q. And that was the zirconium/steam reaction; is that correct?

A. I wouldn't limit it, but that certainly would be a major factor.

Q. When you say mineral/water, you are talking about the zirconium at the plant, is that correct, and its reaction with either steam or water?

A. I'm not limiting it to that, but I will include that.

Q. What other, other than the zirconium/steam or zirconium/water reaction could produce hydrogen in an amount of 4 percent within a two-day period at TMI-2?

A. I don't think as a practical matter, given the temperatures and pressures involved here, that there would be other sources.

Q. So your answer is there is no other practical source?

A. Yes.

JUDGE SMITH: I think this would be a good time to take a recess.

(Recess.)

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T-2

JUDGE SMITH: You may proceed, Ms. Bernabei.

MR. BLAKE: Judge Smith, before Ms. Bernabei proceeds, I think it would be remiss for me not to observe that it was not my recollection yesterday that the Board said that they would hear from Mr. Abromovici down the road. However, the Board did ask that I undertake to propose a stipulation which would put in a portion of Mr. Abromovici's testimony related to this 4 percent business and what he heard at that meeting that afternoon. I am undertaking to do that.

I anticipated that that stipulation would come in and I wouldn't be able to make good on that. But I really have no objection.

MS. BERNABEI: Yes, that's my memory as well.

BY MS. BERNABEI:

Q. Mr. Lowe, referring you now to page 13 of your testimony, specifically the next to the last sentence in the first full paragraph, you talk about very serious core damage; is that correct?

A. Correct.

Q. In your opinion, what percentage of the zirconium claddy would have to react or oxidize in order to produce serious core damage?

A. One percent.

Q. And that is, in fact, the figure which is contained in the NRC regulations, 10 CFR 50.46; is that correct?

A. I'm not sure that I know that.

JUDGE LINENBERGER: Excuse me, Ms. Bernabei. But in order for this Board member to understand the question as well as the answer, I should like to know what you refer to when you say serious core damage. Serious in what context, if you would, please?

MS. BERNABEI: I'm speaking about it in the context in which Mr. Lowe talks about it on page 13 of his testimony. That is how he interpreted the pressure spike and through his subsequent hydrogen calculations came to an opinion that it was clear that the core was very seriously damaged.

JUDGE LINENBERGER: Fine. Thank you. Then I would like to ask Mr. Lowe at this point in what context the word "seriously" is used in the next to the last sentence of the first full paragraph on page 13.

THE WITNESS: I suppose serious is a difficult word because it is so qualified, but I will try to make that somewhat more clear. I used very seriously damaged. That was the assessment at that time.

I think the testimony does refer to the possibility that a very large fraction of the zirconium had reacted.

JUDGE LINENBERGER: Thank you.

BY MS. BERNABEI:

Q. Mr. Lowe, are you familiar with the acceptance criteria for emergency core cooling systems?

A. I am generally familiar with it, yes. It is a complex regulation.

Q. The NRC requirements as to the acceptance criteria for emergency core cooling systems are provided that no more than one percent of the zirconium cladding may oxidize; is that correct?

A. I'm stretching my memory, but I don't think it is one percent. I think it is less. That certainly can be checked as a matter of fact.

Q. If I were to refer you to the provision of the NRC regulations, could you answer the question? I understand that you don't have any of your reference materials here.

MR. GOLDBERG: Objection. The regulations speak for themselves.

JUDGE SMITH: The regulations do speak for themselves; however, if she is trying to establish his knowledge of the regulations --

MS. BERNABEI: I'm trying to establish the basis for his opinion that serious core damage would be one percent.

Why don't I ask the question that way.

BY MS. BERNABEI:

Q. Mr. Lowe, what is the basis for your assessment or your opinion that serious core damage would involve one percent or greater oxidation of the zirconium cladding?

A. I think at that point and before it, as a matter of

fact, there would be very large economic losses.

Q. On March 28, 1979, was your understanding of serious core damage, that is 1 percent cladding failure, was that generally understood within the nuclear industry?

A. Well, there used to be a design target that you could get that you would design for normal operations with up to I think it was .1 percent of the zirconium fuel pin cylinders having pin holes in them. Above that was considered to be abnormal. That specific number varied with time and it got tighter with time. I don't recall at which time that number generally applied.

Q. I'm referring you now to your prior opinion that serious core damage -- the core was considered to be seriously damaged at the time 1 percent of the fuel cladding failed or oxidized.

Was that a generally understood definition of serious core damage at the time of the accident in your opinion?

A. Yes, but that is only one kind of serious core damage.

Q. I understand. But that is at least one kind of serious core damage?

A. Yes.

MS. BERNABEI: I have no other questions. I would move to introduce the TMIA Mailgram Exhibit 2.

JUDGE SMITH: Does your objection still stand?

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MR. BLAKE: Yes, sir.

JUDGE SMITH: The document, assuming that there is no dispute about the author's capability to understand what he is writing, and assuming that further there is no dispute that it comes from the business files of the corporation, it seems to me to be, as counsel states, a log and it seems to be understandable: hydrogen in RB, reactor building, Bensel looking at equipment which would cause spark.

Let's discuss it.

MR. BLAKE: Judge Smith, I would be willing to stipulate that for what that portion of the note says at the bottom of page 9, what that language is appears in notes taken by Mr. Seelinger, which apparently were taken on March 29th, but I don't regard this as a normal business record within the term that is normally used because it has marginal notes. It is not the type of document to place in that category.

I think the only use for it is that one section. I am willing to stipulate that that notation was apparently made by Mr. Seelinger in notes that he took on March 29.

JUDGE SMITH: Is that satisfactory?

MS. BERNABEI: Well, we may want to use the log or the notes at a later time. I would propose that it be introduced in its entirety. There are other portions we will refer to later.

JUDGE SMITH: That's where we run afoul where the Board is concerned. We don't want to receive a large document without knowing the use to which it will be put.

MS. BERNABEI: I have no objection to introduction of this page at this time, specifically the four lines which appear at the bottom of page 9.

JUDGE SMITH: What is the man's name?

MR. BLAKE: Seelinger, James Seelinger.

JUDGE SMITH: Why can't we stipulate that on March 29, 1979 at 2130 James Seelinger noted in his personal log the following: "H_2 in RB," standing for reactor building, with the following indication: "Bensel looking at equipment which would cause spark." Is that sufficient, or do you want the rest of that: Volume of reactor building versus analysis, and then there is a word there that is not clear to me?

Is that what you want?

MS. BERNABEI: That is sufficient.

JUDGE SMITH: Is that satisfactory to everyone?

MR. BLAKE: Yes.

JUDGE SMITH: Is that satisfactory?

MR. GOLDBERG: Yes.

JUDGE SMITH: Then it is a stipulation. Then if you later on wish to offer the exhibit, that is fine. But on the basis of the stipulation, the offer of the exhibit is at this time rejected.

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MS. BERNABEI: Yes, I understand that, Your Honor.

For the record, I would refer the Board to an exhibit which I believe is in evidence, but specifically having in mind your guidance, Judge Smith, I would refer the Board to our use of Joint Mailgram Exhibit 1-C, Item 104. That is the Battist to Frampton memorandum of December 4, 1979.

JUDGE SMITH: In that respect, you are alluding to your prior examination of Mr. Lowe in response to the second question in the paragraph which begins with regard to the second question?

MS. BERNABEI: Yes.

JUDGE SMITH: Mr. Au.

CROSS-EXAMINATION

BY MR. AU:

Q. Mr. Lowe, did you talk directly to TMI-2 control room operators on March 28?

A. No.

Q. Did you talk directly to Gary Miller on March 28?

A. No.

Q. Did you talk directly to the TMI-2 control room operators on March 29?

A. Yes.

Q. What was the substance of your converstation?

A. I visited the control room in the late afternoon of March 29. I do not recall the specific subjects of the

conversations. I did observe what they were doing.

Now, when you say operators, I presume you mean the people on the panel, and I do not recollect talking to them. I do recollect talking with some of their supervisors, and perhaps there were some of them who were engineers also.

Q. By operators, I meant the people at the panel and their supervisors. You did not talk to them about any pressure spike on the 29th?

A. No.

Q. Did you talk to Gary Miller on the 29th?

A. Let me be careful. The timing around midnight is somewhat vague. At what I judged to be 2300 of the night of the 29th I certainly did talk to them, including the unit superintendent and probably some of the plant engineers at the time that the significance of the spike was identified. Prior to that, the answer is no to the 29th.

MR. AU: Thank you. That's all I have.

CROSS-EXAMINATION

BY MR. GOLDBERG:

Q. Mr. Lowe, I have some questions for you. You testified earlier in response to some questions by Ms. Bernabei in connection with page 9 of your testimony on the sources of hydrogen in containment.

In response to a question by Ms. Bernabei, you indicated that the zircalloy-water reaction was the only practical source of

hydrogen in an amount of 4 percent containment given the temperatures and pressures that existed at TMI-2 on March 28. Is that correct?

A. Not quite, because there was another condition which was within a two-day period.

Q. Thank you. With that understanding, that was a fair characterization of your earlier answer to Ms. Bernabei's? question?

A. It is my judgment, yes.

Q. Did you know that on March 28, 1979?

A. I probably had it tucked away somewhere, yes. I don't mean to be facetious.

JUDGE SMITH: The question is: did he know that on March 28. Is that what the question is?

MR. GOLDBERG: Yes.

BY MR. GOLDBERG:

Q. So I take it you believe your level of understanding of the sources of hydrogen in the amount of 4 percent of containment at TMI-2 in the time frame of March 28, 1979 was such that you could have stated on March 28th that the zircalloy-water reaction was the only one of those sources identified on page 9 of your testimony that could have produced hydrogen in the amount of 4 percent of containment?

A. Given the segmental process used on the 29th, I

could have stated it on the 28th, yes.

Q. ~~Do you believe that the level of knowledge required to reach that conclusion was one that the operators at TMI-2 had on March 28, 1979~~?

A. ~~It would be speculation on my part to say that I knew or did not know. Normally, operators in that time period probably would not have known.~~

MR. BERNABEI: I would move to strike that question and answer since Mr. Lowe has indicated that it is merely speculation and he did not have a basis to answer that question.

JUDGE SMITH: I think that you agree that it was a speculative answer.

THE WITNESS: Yes. I have no factual evidence for it.

JUDGE SMITH: On that basis, we will sustain the objection.

Give us just a moment.

(Pause.)

JUDGE SMITH: Proceed.

BY MR. GOLDBERG:

Q. Mr. Lowe, thinking back to the level of knowledge of hydrogen generation that existed on March 28, 1979, do you have an estimate as to how long it would take for hydrogen to accumulate at 4 percent of containment, TMI-2 containment by volume, by zircalloy-water reaction?

A. Assuming that the hydrogen generated got into the

containment without delay -- I don't really have an estimate for that. It could be very rapid if temperatures were high. It could be quite slow.

Q. I would like to direct your attention to page 3 of your testimony at the top where you discuss the many phone calls which took place between your office, your Washington office, and GPU on the day of March 28, 1979.

What type of information was exchanged between GPU and your office during those phone calls?

A. It was primarily meteorological and atmospheric diffusion analyses results, I believe. I haven't checked them recently.

Q. Were plant conditions discussed during those phone calls?

A. To my knowledge, not specifically, except the ones that I noted -- I take that back just a little bit. I believe that some of the people at Three Mile Island who were working in the meteorological area probably mentioned dose information to our people and perhaps containment monitor readings.

Q. Were core conditions discussed during those phone calls?

A. Not to my knowledge, except for as noted in my testimony.

Q. A little further down on page 3 of your testimony, you indicate that you called Mr. Keaten and recommended that

the primary coolant be sampled and measured for isotope silver-110. Was your recommendation acted upon?

A. I don't believe so.

Q. Do you know why?

A. I don't know. I expect it was hard to do.

Q. With respect to the briefing about plant status which occurred at 1530 on March 29, was there any mention at that briefing of a pressure spike?

A. This is March 29 in the meeting which commenced approximately 1532?

Q. Yes, that is correct.

A. As I think I've said in the testimony, either during that meeting or immediately after it, I do recall a mention of pressure spike.

Q. What do you recall was said about the pressure spike?

A. I think there was said that there was one and that it was attributed to spurious indications. I might have said a voltage spike or something like that.

Q. On page 4 you discuss the waste gas decay tanks being near their relief pressure. Can you explain briefly what would happen if the relief pressure were met or exceeded?

A. Yes. The concern was that we knew they were full of a lot of radioactive gas. One objective was to keep that from being released to the atmosphere. If the relief valve

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had lifted, they would have released radioactive gas via the normal pathway, I presume -- we presumed that -- to the atmosphere.

Q. Would you expect those waste gas decay tanks to contain hydrogen?

A. Yes.

Q. Under normal routine plant operations?

A. Under normal conditions, they would. They would contain other gases also.

Q. Also on page 4 you mentioned Mr. Kunder taking you aside for a short but intensive explanation of what he perceived to be the urgent needs of the plant.

Briefly, what were the urgent needs of the plant at that time?

A. I do not recall I'm sure all that he said. I do recall -- I believe that is the time when he mentioned the waste gas decay tanks. He was concerned that the plant needed support, and he had made some sort of a list of problem areas in which they needed support. I don't remember what that was.

Q. You mentioned on page 4 you were talking to some of the operators and engineers in the control room. Was the pressure spike discussed at that time?

A. Where are we in time now?

Q. We are on page 4 of your testimony after the

discussion with Mr. Kunder between 1700 and 1800 hours on the 29th. You mentioned you talked to operators and engineers in the control room.

A. No, it was not discussed until what I timed in here as 2300.

Q. In your discussions in the control room with those operators, was hydrogen production discussed?

A. Not until 2300. Again, I'm talking as to the precise timing. I use precise times here, but I've also said they may be off by an hour or so.

Q. On page 7 of your testimony when you discuss your instant recognition of the spiking caused by hydrogen ignition in containment, could you describe for us what you mean by ignition?

A. Generic, it means burning.

Q. Does it necessarily mean explosion?

A. No.

Q. What would your definition of explosion be?

A. The development of a sonic shock wave in the process of ignition.

Q. And it was your conclusion that the spike was caused by a hydrogen ignition but not a hydrogen explosion?

A. At that time, I don't think that I made a distinction, and I used the word ignition to be inclusive of explosion.

Q. What is your judgment now as to whether or not the spike was caused by an explosion?

A. There is very good evidence that it was not an explosion in the sense that it had a sonic shock wave.

Q. After your recognition of the cause of the spike and the hydrogen ignition, you go on to state that you concluded it was from a zircalloy-water reaction.

Exactly what was the basis for your conclusion at the time your recognized the significance of the spike?

A. I tried to state that in the testimony, but I will try it again. The fundamental, physical basis for that conclusion was that it was a hypothesis which put together the known pieces of information that we had at the time which had been worrisome to us.

Specifically, the fact that the pressurized level would change without apparent action on the part of the operators. We now understand why that happened. Much later we understood why. It explained why the gas tanks were so full. It clearly was consistent with a pressure spike of the type that was shown on the trace. In fact, there were two of them. As to the actuation of containment sprays, it was consistent with the temperature anomaly recorded at that time.

I think that's -- well, also the picture of the spike itself looked like the very short rise time one used to get in calculating these things here.

Q. You stated before and you state in your testimony that you were skeptical of the explanation that the spike was being caused by a voltage anomaly in the instrumentation.

Why were you skeptical at that time?

A. On the general premise that if you are in the middle of an accident situation, you are skeptical of everything that doesn't have a solid, physical explanation.

MR. GOLDBERG: Can I have just one moment, Judge Smith?

JUDGE SMITH: Yes.

(Pause.)

MR. GOLDBERG: I don't have any further questions. Thank you, Mr. Lowe.

JUDGE SMITH: Mr. Blake.

REDIRECT EXAMINATION

BY MR. BLAKE:

Q. Mr. Lowe, Ms. Bernabei asked you questions about a memorandum in December of 1979 authored by Lewis Battist. That memorandum states, and I'm quoting a portion, "He does not know if he was the first to recognize the short pressure rise in containment was an explosion, but he remembers," et cetera, and he goes on.

In December of 1979, did you believe that you were the first to have recognized the significance of the pressure spike?

A. At what time?

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Q. As of the time frame of this memorandum, did you believe that you were?

A. Yes.

Q. And today, do you know for certain that you were the first?

A. All evidence I've got so indicates.

MR. BLAKE: Thank you. I have no more questions, Judge Smith.

JUDGE LINENBERGER: The most recent questions that have been put to you, some of the recent questions put to you regarded a distinction between ignition and explosion, and I believe that you indicated -- correct me if I am wrong -- that when you used the term "ignition," you were not ruling out the possibility of an explosion; is that correct?

THE WITNESS: That's correct, at that time.

JUDGE LINENBERGER: In addition to the distinction you drew between burning and explosion, what difference in the containment building conditions might have to exist for there to be, instead of ignition, an explosion? Can you shed some light on that?

THE WITNESS: Yes, and no. In order to be an explosion, there has to be a high enough concentration in air with other conditions being conducive also such as temperature, humidity and pressure that when burning starts it will move rapidly enough to form a sonic shock front, for there to be an explosion.

As I recall, that is not likely to happen until percentages of hydrogen are -- here I don't quite remember the handbook numbers, but they're up around 10 percent by volume of hydrogen in air with normal humidity at approximately atmospheric pressure.

JUDGE LINENBERGER: Taking you back to the time on March 29 when certain things that were observed caused you to

reach certain conclusions -- I am intentionally vague here -- in arriving at those conclusions, did you give any consideration to conditions that might yield a 4 percent by volume of concentration supportive of burning versus conditions that might yield a 10 or higher percent by volume concentration that might have supported an explosion?

THE WITNESS: Yes, but a few hours later, but I never completed the calculation, one thing, lacking some information to and, secondly, being much more concerned about the hydrogen measure. So, in essence, we did not pursue the question of whether it had been an explosion or a non-explosive ignition.

As a practical matter, the containment was sub-atmospheric, which indicated that the containment barrier had not been breached, which was an important thing.

We knew that many of the vital electrical systems were still operable, although there had been trouble and there continued to be trouble with some of them such as pressurization. We didn't have time to analyze what kind of ignition it was that occurred. We didn't have that time.

JUDGE LINENBERGER: In answer to a question someone put to you about the physical appearance of the containment pressure strip chart trace, you indicated to that, one of the things that struck you as significant was the very short rise time of that so-called pressure spike. Now, would you explain to the Board your thinking with respect to that short rise

time, at least in the context of drawing the inference you did?

THE WITNESS: I am going to try to reconstruct the thinking at the time. For one thing, the current paper being used in that case I believe was moving at about one inch per hour, so that when I say "short," it looked like the pen came straight up and came straight down with a little wiggle at above atmospheric pressure.

It stayed above atmospheric pressure by a few pounds for a while after it dropped down very rapidly. I don't think it can be deduced, nor did I think then, as to how rapid that rise time was, but it clearly was a minute or two, and I really, I think, presumed it was faster than that.

JUDGE LINENBERGER: Would you characterize the rise time as being comparable to the decay time?

THE WITNESS: They were essentially indistinguishable, except for this tail-off in decay time, and I have forgotten what pressure that tail-off started, and then it went sub-atmospheric after a while.

JUDGE LINENBERGER: Now, explicitly in your thinking as you now reconstruct it, or your thinking at that time as you now reconstruct it, what kind of mechanisms occurred to you that would be responsible for a rise time of comparable shortness to a subsequent decay time?

THE WITNESS: There was only one explanation for that that occurred to me at that time. And remember, at that time,

this was an hypothesis. It was not yet a proof. That mechanism by which it would come down precisely as fast as it went up had to be a core spray, actually.

I did think about it being simply absorbed in the massive concrete and steel, but without any calculation, that didn't seem like it would happen that fast if that were the mechanism.

Also, my organization had just recently done a lot of containment spray calculations, and it indicated that containment sprays were a lot more effective than we had earlier believed in removal of heat.

JUDGE LINENBERGER: Are you saying then that the freshness of this recollection that containment sprays might be more effective than you had previously realized contributed to your evaluation process at this point?

THE WITNESS: I can't honestly say that that was a conscious factor at the time. The fact that it came down fast was a surprise, because when we did do the calculation, it didn't come down that fast.

JUDGE LINENBERGER: What in the calculation for which it did not come down that fast, what kind of heat removal mechanisms were you invoking here in that calculation? Do they involve spray removal of heat or the heat sink of objects in the containment, or can't you answer that?

THE WITNESS: I can't really recall, but I do think the

plant in Rochester, the Ginna plant -- we didn't take credit for the spray. It was in the days when you made the calculation and you didn't take credit for that.

JUDGE LINENBERGER: All right, sir. Let me change directions here just a little bit. The pressure spike that we have been talking about that is displayed on the strip chart recording paper occurred at something on the order of 10 minutes to 2:00 in the afternoon of the day that the event was initiated; is that correct?

THE WITNESS: That's correct.

JUDGE LINENBERGER: Let's round it off. Instead of 10 minutes to 2:00, we'll call it 2:00 p.m., the afternoon of the day that the event was initiated. And initiation of the event, so far as I know -- I do not recall whether it's in your testimony, but I think the initiation of the event was said to have occurred at 4:00 a.m.

So, we have from 4:00 a.m. to 1400 in the afternoon, slightly less, as the time span over which enough hydrogen would have to be generated somewhere, and from that somewhere get into the containment -- maybe it was generated in the containment.

But in that ten hour period, there had to be the opportunity for the buildup of at least something on the order of 4 percent concentration by volume in the containment in order for, in your view, burning of the hydrogen in the

containment to have taken place.

Now, what interests me here is -- and again, please answer in the context of what you can recall of your thought processes then -- did it seem reasonable to you, almost a day and a half later when, as indicated on page whatever it is of your testimony that some young fellow walked up and said. "Have you seen this?" late at night?

As you reconstruct your thought process, was it logical to you at that time when you saw this recorded strip chart spike that 10 hours would have been enough, long enough for the generation of enough hydrogen somewhere which eventually ended up burning in the containment?

Did that kind of parsing of the question take place in your mind, do you recall?

THE WITNESS: Frankly, I don't believe that I considered at all how it got there, except the pathway, for example. It was very clear, but still an intuitive hypothesis at that time that it was hydrogen from zirc water reaction.

I don't believe I knew what the cycle entry had been or the very pathway it might have gotten into the containment. Of course, we know now.

JUDGE LINENBERGER: Yes, but there have been a lot of post-mortems to draw on. Staying in the context of your testimony, not so much what we know now but how you reconstructed things at that time, at the top of page 7, you seem to have

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hypothesized that the impact of an ignition or a burning event in the containment caused you to infer that the primary system must have a considerable amount of hydrogen in it.

Now, I guess my problem is, with 10 hours available to reach 4 percent concentration in the containment such that it could burn, a pressure spike in the containment at the end of those 10 hours, I guess I'm probing as to how those combination of observations would cause you to conclude that the primary system had a hydrogen problem -- or to hypothesize, let's say, recognizing --

THE WITNESS: Yes. The primary system was behaving in a very peculiar fashion. We didn't understand it and the operators didn't understand it, the characteristics of it.

It behaved as though it had a non-condensable -- I'm sorry, it behaved as though it had gas in it. They thought it was steam, but that didn't make sense, because all the temperature readings we had -- and there were a lot of thermocouples, and there were a number of T-hot and T-cold measurements -- were too low for there to be steam at that pressure, which was then about 1,000 psi.

They were just too low. The high was around 500 F, and most of them were less than that. It just didn't seem physically possible for there to be something in there to make that level yo-yo the way it did, and to have it be steam. It was an enigma.

k8

But once we postulated there was a non-condensable bubble in there, and we had seen the spike which one could attribute to hydrogen, the immediately subsidiary conclusion was -- or rather, hypothesis was you had to have a non-condensable bubble and it had to be hydrogen.

JUDGE LINENBERGER: Excuse me. I think I understand the sense in which you're saying non-condensable, but would it be equally logical to describe it as a compressable?

THE WITNESS: Yes, that's better.

JUDGE LINENBERGER: Now, here is my next problem. You had 10 hours for hydrogen somehow to have been produced, for it somehow to manifest itself in containment by virtue of the pressure spike which you interpreted as burning, after which interpretation you hypothesized that the primary system had a hydrogen problem.

If sufficient hydrogen to cause the burning in the containment after 10 hours had originally been generated within the primary system, it must not have had much problem getting to the containment.

Now, then, here we are a day or thereabouts, a day and a half, later. You personally see the pressure spike, and you say, "Aha, the primary system may, I hypothesize, have a hydrogen bubble."

During that first 10 hours, apparently the hydrogen had no problem progressing from the primary system to the

containment.

Now, it looks as though maybe it isn't going into the containment. I am curious, again, about your thought processes then.

THE WITNESS: I'm going to try to be careful about those thought processes, because frankly they were based on high school physics, and now we have much more elaborate and precise knowledge of what happened.

But at the time, we did know, one of the first things we were told when we got there was that the pressure operated relief valve from the pressurizer to the primary containment, or rather down to the drain tank in the primary containment had been open for two hours and 39 minutes.

I don't believe we knew at that time that subsequently they had made a run for low pressure just before that hydrogen ignition.

They had tried to get down below whatever the injection pressure is for decay heat, and they didn't make it. But they opened up everything to try to get it.

I haven't gone back to review the record on that, but I think that process was occurring several hours before the ignition took place.

JUDGE LINENBERGER: Is the significance of what you just said that initially this valve in the open position provided communication for hydrogen between the primary system

k10

and the containment building, but subsequently that path was no longer available?

THE WITNESS: That's right. But then when they ran for low pressure, they opened up again. That's the point.

JUDGE LINENBERGER: I want to belabor the point just a bit more on the subject of very seriously damaged core or fuel. During part of the question-and-answer session by Ms. Bernabei going to that subject, you talked about at some point in history something on the order of a tenth of 1 percent of what I'll call leakers-- that's my word, not yours -- was acceptable in the core.

I do recall a number something like that; don't challenge it. You indicated, I think I heard you indicate that the order of 1 percent leakers would not be acceptable.

Now, to my way of thinking, neither one of those numbers represents per se a damaged core, if indeed the leak characteristic was built in at the time of fuel pen manufacture and assembly; is that correct?

THE WITNESS: That's correct. As a matter of fact, I think I recall in the early designs, 1 percent had been acceptable. And it got tightened down. It got to this, that the technical specifications began to require primary coolant activity limits which could not be maintained with most cleanup systems and so forth if you had in the range of 1 percent, and therefore you had to run off and pull out the fuel which was

leaking, and that can be a very serious economic penalty.

JUDGE LINENBERGER: In the context of your statement on page 13, next to last sentence, the first full paragraph, it was clear now, and I quote, "that the core was very seriously damaged," in the context of that statement and what I thought I heard you say to Ms. Bernabei that very seriously damaged, to your way of thinking, might be of the order of 1 percent core problem, I have a problem understanding whether you meant 1 percent leakers that might not have sustained any damage in the core, or 1 percent degradation of zirconium cladding.

To me, your testimony did not make a distinction there. I would like to hear what your opinion is, please.

THE WITNESS: Let me try to make the distinction. Going into the accident, before the accident had enlightened us, I would have considered a 1 percent fuel failure as having been serious damage to the core. Obviously, 5 percent would be more serious.

JUDGE LINENBERGER: Excuse me. You said "fuel failure," and again I have to try to get you to be more explicit. Do you mean fuel failure in the sense of leakers received from the manufacturer, or do you mean fuel failure in the sense of zirconium cladding degradation?

THE WITNESS: Either, the sum total of both. Beginning an operation, that would be very serious. I could have used the word "destroyed" in the next to last sentence, because the

first calculation indicated that 20 percent of the zirconium had burned, the first one I did. I knew it was wrong, because I didn't have a handbook for molecular weight and all that and I was guessing. But I knew it was plenty.

And it was much different from what I would have previously called serious damage. It was essentially the destruction of the core. What was the actual, physical state we didn't know, whether the zirconium oxide would hold the fuel pellets in place or not. It turns out they didn't.

One of the major concerns was coolable geometry, and that was one of the implications of this testing.

JUDGE LINENBERGER: It seems to me that another implication of this statement is that damage to this very serious degree, which you considered it to be, considered it then to have been must have occurred in that first 10 hours when you hypothesized that the reactor vessel was feeding hydrogen into the containment building; is that correct?

THE WITNESS: That's correct.

JUDGE LINENBERGER: And I then further ask you how you reconcile that important, rather massive, as you now characterize it, in that first 10 hours with the presence, second day, third day, perhaps longer, of a serious hydrogen bubble in the primary system if the bulk if not all of the core damage had taken place in that first 10 hours when the core was still communicating with the containment? I have a problem there

putting those two things in perspective.

THE WITNESS: I am not sure I ever really, to be honest, sorted that out at the time. I did presume that if a lot of hydrogen had gotten out, there might be more in there, and without trying to figure out how that happened.

What we did know was that the core was open in the beginning. At that time, I don't think I did know that they had run for low pressure.

JUDGE LINENBERGER: Excuse me. Chairman Smith reminds me of another question that arises from a statement contained about halfway through the conclusion of the paragraph at the top of page 7 in which you describe the subatmospheric status of the containment pressure as possibly being due to having used up oxygen by burning hydrogen.

Now, I can understand, I think, that mechanism, but even under normal operation, isn't containment maintained slightly subatmospheric, and did the degree of subatmospherisity -- if I can coin that word -- change to cause you to make this statement?

THE WITNESS: I don't think I derived it that way. Let me try to answer the first part of your question first. I don't know whether TMI operates at subatmospheric. It's not specifically designed to do that.

I think there would be times when it did and there would be times when it didn't.

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JUDGE LINENBERGER: I was making a conclusion that was unfounded, I guess.

THE WITNESS: There are some plants that supposedly do. What I was looking at was -- I'm pretty sure, and this is qualitative in drawing this conclusion, but I do remember that a factor was the shape of the curve.

The spike came down rapidly, and there was a short tail off the spike of maybe not more than ten minutes, and then it ran for an hour or so at above atmospheric, and gradually drifted down to subatmospheric and stayed there for an impressive length of time.

I do remember a slight question, but I didn't bother to stop then, as to whether the chart was properly calibrated, whether the 14.7 pounds per square inch really was that.

But it was the shape that was the primary indicator that led to that judgment that it was subatmospheric. Later on, we confirmed it.

JUDGE LINENBERGER: What was it that you confirmed?

THE WITNESS: That it was subatmospheric; in other words, checked the calibration and so forth.

JUDGE LINENBERGER: Did you consider at the time, as you now recall, the possibility of its being subatmospheric because there had been time for things in the containment to start soaking up heat?

THE WITNESS: Yes.

JUDGE LINENBERGER: Did you reject that?

THE WITNESS: No. I presumed that the tail on the curve, the immediate tail, may have been residual sprays or water or something. I've got to be honest: I don't know whether I'm thinking about this now or thought about it then.

JUDGE LINENBERGER: I can understand.

THE WITNESS: We all know there were massive heat sinks in there which more slowly would pick heat up.

JUDGE LINENBERGER: Thank you, sir.

JUDGE WOLFE: Mr. Lowe, in the preparation of your written testimony, when you drew on your recollection of what had been told you say on March 28, 1979, did you find in writing your testimony that you had a very good recollection of precisely what was told you for purposes of writing your testimony, or did you find that overall you just could recall the substance of what had been told to you? Which of the two, or anything else you can add on that?

THE WITNESS: There were two kinds of sources. One is, as soon as things looked as though they were serious, I had my office set up a telephone log, and each person who communicated with anybody about the accident had to write out a little chit of paper. That I suppose is in the record somewhere.

Most of that had to do with weather data.

JUDGE WOLFE: Most of that had to do with what?

THE WITNESS: With weather data. The conversations I

had, one with Jack Thorpe I wrote a memo about which I think has now been introduced into evidence.

The one with Keaten, I remember making, and I made notes of it, but later. That was the one where I called Keaten and recommended that they take a measurement of silver-110 in the primary water.

That is based on a written recollection, but that, contrary to the Thorpe memo, was not written down on the very same day.

So, by and large, what I have stated is based on fairly well recall from documented information.

JUDGE WOLFE: I am looking at what you had spoken to, namely your own memorandum to the file, March 28, stating what Jack Thorpe had told you at 4:20 p.m. on March 28, 1979.

I think, in writing your prepared written testimony, you had reviewed this memorandum to the files?

THE WITNESS: Yes.

JUDGE WOLFE: I am looking at the last sentence of that memorandum. And Mr. Jack Thorpe apparently specifically told you, and you inscribed it in your memorandum, "Plant thinks core is recovered."

In writing your prepared testimony, since that is precisely, I take it, what he told you, why did you then proceed at the top of page 3 of your prepared written testimony, "He reported" -- namely, Jack Thorpe reported, "The plant thinks

core cooling is recovered."

Did Mr. Thorpe make that clear to you, what he was saying at the time, or is this what you understood him to say?

THE WITNESS: It is what I understood him to say. My impression of that whole exchange, of which both the memo and the testimony are some kind of summary, is that the basic point was they had gotten steam out of the loops and gotten water going normally through the core. They started the pump, or I guess more than one.

And I guess what really is influential in my thinking about the interpretation of the memo of the 28th is that I do recall very distinctly -- and I believe it was the night of the 31st -- seeing the first estimates that the core itself had been uncovered, that it was in steam.

JUDGE WOLFE: Is it a matter of importance at all that Mr. Thorpe's memorandum or your memorandum rather of March 28, which is TMIA Mailgram Exhibit No. 1, states that Mr. Thorpe spoke of, "steam bubbles existed in A and B loops."?

In your testimony, at the bottom of page 2, you speak of a single steam bubble. Why do you speak in your testimony of a single steam bubble when apparently Mr. Thorpe had reported to you with regard to steam bubbles?

THE WITNESS: Actually, the bubble reads plural in the testimony also -- I'm even going to back off of that. It says, "Bubble in A and B." If you have a bubble in A, it's going to

be a different bubble than the bubble in B. But the actual -- I'm not sure the physical picture was that precise.

Frankly, I don't recall what the plural of "bubble" meant, except that they had steam in both A and B loops.

JUDGE SMITH: Ms. Bernabei, do you have follow-on questions?

MS. BERNABEI: Yes, just a few.

MR. BLAKE: Just a moment, please. I wonder if I might inquire, could we take an occasion throughout the day to sort of refresh our memories about how witnesses are brought forward and how it's going to be conducted throughout this proceeding?

Is there a limitation at this juncture on recross by the parties limited to redirect?

JUDGE SMITH: If you'll notice, I invited follow-on questions. Those would be questions that developed as a consequence of your questioning, questions that followed. We are not back to cross again.

If the Board asks a question -- that's why I hesitate to use the word "recross" -- this is only an opportunity to follow up on questions that were asked after you stopped your cross-examination.

RECROSS-EXAMINATION

BY MS. BERNABEI:

Q In response to a question from Mr. Goldberg, I believe you stated that in an accident situation, you would be

skeptical of anything without a solid physical explanation; is that correct?

A. Yes.

Q. And is it fair to say that operators in an accident situation would have a similar predilection, a similar orientation in that they would be skeptical of any explanation without a solid physical basis?

A. I don't know. I have a hope, but I don't know.

Q. Do you know anything about operator training, that is operator training including their training to react and respond to an accident?

A. Well, I know something about it. I have not participated in either doing it or receiving it.

Q. From what you know about it, would it be fair to say that they would be oriented in their responsibilities in the same manner as you approach your responsibility, that is to be skeptical of anything without a solid physical basis?

MR. BLAKE: Objection. I could be wrong, but the basis for my objection is my lack of recollection of questions about licensed operator training or Mr. Lowe's having responded to questions about that area, certainly not on his direct, and I don't recall that having been asked in questions that followed Ms. Bernabei's cross.

MS. BERNABEI: That wasn't the thrust of the question. It was to get whatever basis he has about operator training

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and operator knowledge, his expectation of operators' orientation, whether they would be similar to his own in accident situations.

MR. BLAKE: My objection stands.

JUDGE SMITH: Would you object if the question were addressed to operator practices, which I understand is where she is going, what her point is?

MR. BLAKE: I think my objection would be the same. I just recall no prior questions about operator practices, which would now allow a follow-on.

JUDGE SMITH: Overruled. You may answer, Mr. Lowe.

THE WITNESS: Would you repeat the question, please?

BY MS. BERNABEI:

Q. Yes. Based on your knowledge of operator practices, do you believe they would have the same orientation in responding to an accident as you described you had; that is, you would be skeptical of anything without a solid physical basis?

A. Well, first of all, I don't believe that operators in general have professional degrees in science or engineering, so to that extent, I suppose, they wouldn't approach it from the same point of view.

On the other hand, my impression of operators is that they are a very highly disciplined and competent group, and they know a great deal about how the plant works.

They probably weren't, in this case -- and I guess this is speculation -- experts in accident analysis.

Q. That wasn't quite my question, Mr. Lowe. What is your opinion of how they would react in an accident situation? Do they have the same orientation of interpreting hard data such as a pressure spike, with an orientation of being skeptical without a physical explanation or basis?

A. My impression is that operators react to accident situations superbly, provided it is within the envelope of their procedures and training. And I doubt that this accident was.

Q. You spoke about the shape of the pressure spike, and you spoke, I believe, about the tail-off time; is that correct?

A. Yes.

Q. If I interpreted you correctly, you were talking about the portion of the spike after it had returned, after it had spiked down; is that correct?

A. Yes.

Q. The tail had returned to atmospheric levels?

A. Yes, I think I understand what you're saying.

Q. I'm just trying to characterize the tail-off time. If we could define it, it would be the time after the spike had come down but before it returned to the atmospheric level?

A. Yes.

Q. And that tail-off time was practically an hour; is

that correct?

A. There are two steps in it. One, I am remembering the picture now, and I suppose I could get it out and look at it. But the first step is about a 10 minute tail-off that's fairly steep.

After that, there's a tailoff which is on the order of an hour or so, perhaps longer.

Q. Didn't the second tail-off--that was the one of about an hour after the spike had come down, that gradual tail-off -- didn't that indicate that the spike indicated a real pressure incursion and not an electrical malfunction? Wouldn't that be one indicator of that?

A. It depends on what else was going on at the time. I am not sure that I know, because there were elevations in pressures when they opened up the pressure operated relief valve.

Q. I am confining my question now to the shape of the tail-off that extended for about an hour and it was gradual from the point of the decline of the spike.

Wouldn't that alone indicate, independent of other conditions, a real pressure increase and not electrical malfunction?

A. No.

Q. Do you have any information as to whether that would indicate a real pressure incursion instead of an electrical

malfunction to an operator?

A. Didn't I just answer that?

Q. I believe you were answering it from your perspective, and I am asking you now, with your knowledge of operator practices, would that indicate a real pressure increase to an operator?

A. Would it have indicated -- it is a recording of a real pressure increase, yes.

Q. I'm asking you about the shape, now, and just the tail-off. In your opinion, with your knowledge of operator practices, wouldn't the gradual tail-off over an hour period indicate that the spike had been a real pressure incursion and not an electrical malfunction?

A. Not necessarily.

Q. If I could return for a moment to one of Judge Linenberger's questions, I believe it was your answer in response to one of my questions that 1 percent oxidation of zirconium cladding would cause serious core damage; is that correct?

A. Not quite. I think what I was saying was that if you have 1 percent of what we call fuel pins fail, by one mechanism or another, in the pre-accident days, at the time that design targets were a tenth of a percent, the 1 percent would be considered serious damage, yes.

Q. That's not the question asked. The question asked

is, isn't it true that 1 percent oxidation of the cladding would produce serious core damage?

A. Well, yes. I think it would be enveloped by the previous statement.

Q. If you can estimate --

A. I'm sorry. I have to say there that if you mean oxidation because of a breach in the fuel pin, then yes, it would be enveloped by the previous statement.

Q. In your opinion, what percentage of cladding oxidation would have to occur to cause a breach in the fuel pins?

A. I am not sure that I can answer that question. It would have to be some amount, but it would depend upon whether it was pinhole corrosion oxidation, or whether it was general oxidation. There are factors of many, many thousands difference in the percentage of oxidation in those two types of failure mechanisms.

Q. Assuming general oxidation, can you give us a ball-park figure as to what percentage of zirconium must oxidize in order to get core damage, that is in order to get a breach in the fuel pins so as to cause core damage?

MR. BLAKE: Objection. My objection is, I just do not understand the question to be sufficiently specific for the witness to answer.

JUDGE SMITH: I think Judge Linenberger is having the

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same problem. Sustained.

BY MS. BERNABEI:

Q. Mr. Lowe, I believe you either stated or agreed to a prior question from Judge Linenberger about, in order for hydrogen to ignite or for there to be combustion, hydrogen must reach a level or reach an amount of 4 percent of the total containment volume; is that correct?

A. To ignite?

Q That's correct.

A. I happen to believe it is higher, but there is said to be evidence that 4 percent is the lower flammable limit under ideal conditions.

Q. In your opinion, how much of the cladding, zirconium cladding would need to oxidize to produce hydrogen in this amount, that is hydrogen in an amount of 4 percent of containment volume?

A. I would really have to calculate it. I have calculated it in the past. I simply don't remember the number. It is a substantial fraction of the core.

Q. At those oxidation levels, would those oxidation levels in your opinion cause serious core damage?

A. I'm sorry, the oxidation levels required to produce 4 percent in the total containment?

A. That's correct.

Q. Would that be serious core damage? Yes, it would be.

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JUDGE LINENBERGER: Ms. Bernabei, there's a good possibility here that the way you have worded your questions and the way the witness has attempted to answer them -- and I think he is attempting to be cooperative as he can be -- could lead to some confusion.

Let me talk about oxidation for just a moment, and observe that -- and I don't want to testify here, but to observe that it is possible to have oxidation without having any metal water reactions.

And so when you ask the question the way you do or the way you have asked it, it is not at all clear whether you are asking for an answer from the witness that involves metal water reaction or not. You only characterized it as oxidation.

MS. BERNABEI: I should make myself clear, then.

JUDGE LINENBERGER: Yes, you should.

MS. BERNABEI: The premise to the question was that it would involve a metal water reaction.

BY MS. BERNABEI:

Q Is your answer with that premise or assumption, Mr. Lowe?

MR. BLAKE: What is the question?

MS. BERNABEI: I asked Mr. Lowe a series of questions as to whether or not the amount of oxidation needed to produce hydrogen in the amount of 4 percent of the containment volume would necessarily indicate core damage.

And the assumption in the question was that that was oxidation with a metal water reaction.

BY MS. BERNABEI:

Q. In answering that question, did you employ that assumption as a premise, Mr. Lowe?

A. That was my assumption.

MS. BERNABEI: Thank you.

JUDGE SMITH: Any further questions of Mr. Lowe?

(No response.)

JUDGE SMITH: You may step down. Thank you very much --

MR. AU: Excuse me. Could we ask a couple questions?

JUDGE SMITH: All right.

MR. AU: May I ask the Court's permission to have Mr. Dornsife ask questions?

JUDGE SMITH: Yes.

RECROSS-EXAMINATION

BY MR. DORNSIFE:

Q. These are very short questions. They are based on the Board questions concerning the percent of hydrogen, ignitability of hydrogen.

I understood you to say that, or is it not correct that the source of hydrogen getting into containment would have been through the rupture disc on the reactor coolant drain tank?

A. Well, I assumed that because it would have come out through the pressure operated relief valve, which is what my

image of it is, that it would have gone that way. Therefore, it goes down the pipe into the reactor drain tank, and they had already blown the rupture disc. I am not sure we knew that at the time. My image was of it coming out of the core.

Q. Since that is located in the basement, is it possible that a pocket of hydrogen could have built up and just a small pocket have ignited to cause the pressure transient that resulted?

A. That's a possibility.

Q. Based on that premise, is it possible that someone could have recognized a burn of a small amount of hydrogen, but not have associated it with gross core damage?

A. If there had been enough to light off -- here I am being qualitative and judgmental without calculating it -- yes. I think that would have been characterized as serious core damage. It might not have been anywhere near as serious, however, as what I used as a basis for a working hypothesis to take the next steps.

Q. Another short line: if I understand your testimony correctly, you are saying you believe you were the first one to recognize the significance of the pressure spike and transmit your analysis of that impression to offsite management.

You're not saying in your testimony there could have been some -- for instance, an operator may have recognized the significance and may or may not have transmitted that

information to his supervisor?

A. I am saying that if any professional operator or engineer had known that and not transmitted it to me, that is an inconceivable situation.

Q. But he could have transmitted to his superior? Your testimony is not saying that's not possible?

A. It would be speculation on my part of what he might have done, except that not to have dealt with the issue, knowing about it, just doesn't jive with the kind of men these are.

MR. DORNSIFE: Thank you. I have no further questions.

JUDGE SMITH: Anything further?

MS. BERNABEI: May I just raise one point? Based on Mr. Dornsife's questioning of Mr. Lowe, I think he stated it would be speculative as to what operators might or might not have done, given their recognition, if they had recognized the significance of the pressure spike.

Therefore, I renew my motion to strike those portions of his testimony which talk about how it is inconceivable that if anyone had known or interpreted the pressure spike, they would not have communicated it to their peers and managers.

JUDGE SMITH: Overruled.

You may step down. Thank you.

(Witness excused.)

JUDGE SMITH: Anything further this evening?

MR. BLAKE: No, nothing further, but I would like to discuss this evening tomorrow.

JUDGE SMITH: All right. Is there any need to be on the record?

(No response.)

JUDGE SMITH: Then we will adjourn for this evening.

MR. GOLDBERG: Before we go off the record, there is one matter, a brief matter which I would like to put on the record.

Previously, TMIA requested Staff to search for certain documents they believed existed in Staff's files. We did that. We couldn't find the documents.

TMIA then asked that we ask the Office of Inspection and the Auditor to do so. That was done. It didn't identify certain specific documents.

Subsequently, TMIA asked that we ask the Office of Congressional Affairs to do a search. They did locate some of the specific documents that TMIA requested.

Late yesterday, I received authorization from the Office of Congressional Affairs to release certain documents that TMIA requeste which they did locate in the files.

I didn't have time to prepare a letter transmitting that, but I would like at this time to provide Ms. Bernabei with the documents that the Office of Congressional Affairs did identify as responsive to oral request to me some time ago.

JUDGE SMITH: We will adjourn until 9:00 a.m. tomorrow.

(Whereupon, at 6:00 p.m., the hearing was adjourned, to reconvene at 9:00 a.m., Thursday, November, 11, 1984, in Harrisburg, Pennsylvania.)

CERTIFICATE OF OFFICIAL REPORTER

This is to certify that the attached proceedings before the UNITED STATES NUCLEAR REGULATORY COMMISSION in the matter of:

NAME OF PROCEEDING:

Metropolitan Edison Company
(Three Mile Island Nuclear Station, Unit No. 1)

DOCKET NO.: 50-289SP
(Restart Remand on Management)
PLACE: Room 156
Main Capitol Building
DATE: Harrisburg, Pennsylvania
Wednesday, November 14, 1984

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission.

(Sigt) Judith A. Toberman
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